UNIVERSITY INSTITUTE OF ENGINEERING AND TECHNOLOGY
KURUKSHETRA UNIVERSITY, KURUKSHETRA
("A" Grade NAAC Accredited University)

(2015-16 onwards in phased manner)

MASTER OF TECHNOLOGY IN MECHANICAL ENGINEERING (INDUSTRIAL & PRODUCTION ENGINEERING) (CREDIT BASED)

SEMESTER-I	Subject	L	T	P/D	Total	Minor Test	Major Test	Duration	Credits
MTIP-601C	Non-Conventional Machining	4	-	-	4	40	60	3	4
MTIP-603C	Product Design & Development	4	-	-	4	40	60	3	4
MTIP-605C	Computer Aided Design and Manufacturing	4	-	-	4	40	60	3	4
MTIP-607C	Advanced Engineering Materials	4	-	-	4	40	60	3	4
MTME-809	Research Methodology and Optimization Techniques	4	-	-	4	40	60	3	4
MTIP-611C	CAD/CAM Lab	-	-	2	2	40	60	2	1
					Total	**240**	**360**		**21**
						600			

SEMESTER-II	Subject	L	T	P/D	Total	Minor Test	Major Test	Duration	Credits
MTIP-602C	Mechatronics	4	-	-	4	40	60	3	4
MTIP-604C	Tool Engineering	4	-	-	4	40	60	3	4
MTIP-606C	Advanced Metal Casting	4	-	-	4	40	60	3	4
MTIP-608C	Advanced Welding Processes	4	-	-	4	40	60	3	**4**
MTIP-610C	Mechatronics Lab	-	-	2	2	40	60	2	1
-	**Elective-I (I&P)**	4	-	-	4	40	60	3	4
Total						**240**	**360**		**21**
						600			

LIST OF ELECTIVES – I (Industrial and Production Engineering) for 2nd Semester		
1.	MTIP-612C	Advanced Metal Cutting
2.	MTIP-614C	Computational Methods in Engineering
3.	MTIP-616C	Design of Experiments
4.	MTIP-618C	Operations Management
5.	MTIP-620C	Strategic Entrepreneurship

SEMESTER-III	Subject	L	T	P	Total	Minor Test	Major Test	Duration	Credits
-	**Elective-II**	4	-	-	4	40	60	3	4
-	**Elective-III**	4	-	-	4	40	60	3	4
MTIP-613C	**Synopsis of Dissertation**	-	-	-	-	100	-	-	10
					Total	**180**	**120**		**18**
						300			

LIST OF ELECTIVES –II (Industrial and Production Engineering) for 3rd Semester		
1.	MTIP-615C	Supply Chain Management
2.	MTIP-617C	Finite Element Methods
3.	MTIP-619C	Sequencing and Scheduling
4.	MTIP-621C	Productivity Management
5.	MTIP-623C	Simulation of Industrial Systems

LIST OF ELECTIVES – III (Industrial and Production Engineering) for 3rd Semester		
1.	MTIP-625C	Smart Materials
2.	MTIP-627C	Manufacturing Optimization through Intelligent Techniques
3.	MTIP-629C	Quality Engineering and Management
4.	MTIP-631C	Enterprise Resource Planning
5.	MTIP-633C	Intellectual Property Rights and Patent Laws

SEMESTER-IV		L	T	P	Total	Minor Test	Major Test	Credits
MTIP-622C	Dissertation	-	-	-	-	100	200	18
					Total		**300**	**18**

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INSTRUCTIONS FOR PAPER SETTER

1. The question paper is to be attempted in **THREE Hours**.
2. Maximum Marks for the paper are **60.**
3. The syllabus for the course is divided into **FOUR units.**
4. The paper will have a total of **NINE questions.**
5. **Question No. 1,** which is compulsory, shall be OBJECTIVE Type **and have content from the entire syllabus (all Four Units).**

Q. No. 2 & 3	**from Unit I**
Q. No. 4 & 5	**from Unit II**
Q. No. 6 & 7	**from Unit III**
Q. No. 8 & 9	**from Unit IV**

6. All questions will have equal **weightage of 12 marks.**
7. The candidate will attempt a total of **FIVE questions**, each of 12 marks. Q. No. 1 is compulsory. The candidate shall attempt remaining **four** questions by selecting **only one question from each unit.**
8. A question may have any number of sections labeled as 1(a), 1(b), 1(c), 1(d), ---- 2(a), 2(b), --.A section may further have any number of subsections labeled as (i), (ii), (iii),.
9. **SPECIAL INSRUCTIONS FOR Q. No. 1 ONLY**

   Question No. 1, which is compulsory, shall be OBJECTIVE/ short answer type **and have content from the entire syllabus (all Four Units).**

   Emphasis is to be given on the basic concepts, analytical reasoning and understanding of the various topics in the subject. This question may have a number of parts and/or subparts. The short questions could be combination of following types:

   i. Multiple Choice
   ii. Yes/ No choice
   iii. Fill in Blanks type
   iv. Short numerical computations
   v. Short Definitions
   vi. Matching of Tables

The above mentioned question types is **only a Guideline**. Examiner could set the question as per the nature of the subject.

10 (3095)

First Semester

10 (3096)

MASTER OF TECHNOLOGY IN MECHANICAL ENGINEERING (1st Sem.)
(INDUSTRIAL & PRODUCTION ENGINEERING)

MTIP–601C	NON-CONVENTIONAL MACHINING						
Lecture	Tutorial	Practical	Credit	Major Test	Minor Test	Total	Time
4	0	-	4	60	40	100	3 hrs
Purpose	To acquaint the students with the advanced technologies and processes in various streams of Non-conventional machining.						
Course Outcomes							
CO1	To impart knowledge of Various Non-conventional Mechanical Working Processes, technology, process parameters and analysis for metal removal for these processes.						
CO2	To acquaint students with deep knowhow about chemical and electrochemical machining processes,						
CO3	To impart knowledge to students about various kinds of Electric discharge machining processes, process parameters associated with these processes and various process characteristics.						
CO4	To let student understand the working and technology associated with Laser Beam machining and Electron beam machining processes.						

UNIT I

Introduction, Need of Non-conventional machining processes, Characteristics of conventional and Non-conventional Machining processes. **Mechanical Working Processes**: **Abrasive Jet Machining:** Machining setup, Abrasives, Process Parameters, Machining Characteristics, Material removal models in AJM, Process capability, Advantages, limitations, Applications

Water Jet Machining: Basic mechanism of Water jet machining setup, Process parameters, Catcher, Process capabilities, Advantages, limitations, Applications **Abrasive Water Jet Machining process:** Working Principle, AWJM Machine, Process Variables, Mechanism of Metal Removal, Cutting Parameters, Process capabilities, Applications, Environmental issues.

Ultrasonic Machining: Fundamental principles, Equipment, Magnetostriction, Elements of process, Mechanics of cutting, Analysis of Process Parameters, Process capabilities, Economic considerations. Applications, Limitations

UNIT II

Chemical Machining: Introduction, Fundamental Principles, Process Parameters; Maskants and Etchants, Advantages, Limitations, Applications.

Electrochemical Machining Processes: Introduction, Classification of ECM Processes, Fundamentals Principles of ECM, Elements of ECM, ECM Machine Tool Process, Determination of Metal Removal Rate, Evaluation of Metal Removal of an alloy, Electrochemistry of ECM, Cathode and Anode reaction, Dynamics of ECM, Self-Regulating feature of ECM, Process Parameters, Process capabilities, Electroc
hemical Deburring. **Electrochemical Grinding:** Schematics, Electrochemistry, Process Parameters, Process capabilities, Applications, Advantages, Limitations.

UNIT III

EDM: Introduction, Basic Principles & Schematics, Process Parameters, Characteristics of EDM, Dielectric, Electrode Material, Modelling of Material Removal, Spark Erosion

Generators, Analysis and Metal Removal Rate in RC circuit, Selection of Tool Material and Tool Design, Di-Electric system, Process Variables, Dielectric Pollution and its effects, Process Characteristics, Applications, Electric Discharge Grinding and Electric Discharge Diamond Grinding; **Wire EDM**: Working Principle, Wire EDM Machine, Advances in Wire-cut EDM Process Variables, Process Characteristics, Applications.

UNIT IV

Laser Beam Machining Back Ground, Production of Laser, Working Principle of LBM, Types of LASERS, Process Characteristics, Metallurgical effects, Advantages and Limitations, Applications.

Electron Beam Machining:

Electron Beam Action, Generation and control of Electron beam, Theory of Electron Beam Machining, Process Parameters, Process capabilities, Applications.

High Energy Rate Forming, Elctro-Hydraulic Forming, Explosive Forming, Hot Machining Analysis of the Process.

RECOMMENDED BOOKS:

1. Advanced Machining Processes by V.K. Jain. Allied Publishers Pvt Ltd
2. Modern Machining Processes by P.C. Pandey and H.S. Shan. Tata McGraw- Hill
3. Unconventional Manufacturing Process by M K Singh, New Age Publishers
4. Advanced Methods of Machining by J. A. Mcgeough, Springer
5. Non-Traditional Manufacturing Process by Benedict, CRC pub.
6. Nonconventional manufacturing by P. K. Mishra, Narosa Publishers

Note: The paper will have a total of ***NINE questions.*** **Question No. 1,** which is compulsory, shall be OBJECTIVE Type and have contents from the entire syllabus (all Four Units). All questions will have equal ***weight of 12 marks.*** The student will attempt a total of ***FIVE questions***, each of 12 marks. Q. No. 1 is compulsory. *The student shall attempt remaining* ***four*** *questions by selecting* ***only one question from each unit.***

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MASTER OF TECHNOLOGY IN MECHANICAL ENGINEERING (1st Sem.)
(INDUSTRIAL & PRODUCTION ENGINEERING)

MTIP-603C	PRODUCT DESIGN & DEVELOPMENT						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
4	**0**	**-**	**4**	**60**	**40**	**100**	**3 hrs**
Purpose	The objective of the course is to understand about the product design with inputs from aesthetics, ergonomics, design for manufacturing ease and cost effectiveness apart from reliability and durability and other considerations.						
Course Outcomes							
CO1	To understand the concept of product design, design considerations, design practiced by the industry, production and marketing, and aesthetics.						
CO2	To provide a detailed fundamental approach to several primary processes and design guidelines for manufacturing, assembly and environment.						
CO3	To discuss the human factor engineering and the concept of value engineering.						
CO4	To study the modern approaches to product design, concept of product development and its manufacturing and economic aspects.						

UNIT-I

INTRODUCTION: Introduction to product design, Design by evolution and innovation, Essential factors of product design, Production consumption cycle, Flow and value addition in production consumption cycle, Morphology of design.

PRODUCT DESIGN PRACTICE AND INDUSTRY: Product strategies, Time to market, Analysis of the product, Basic design considerations, Role of aesthetics in product design.

UNIT-II

DESIGN FOR MANUFACTURE AND ASSEMBLY: Overview and motivation, Basic method: Design guidelines: Design for assembly, Design for piece part production, Advanced method: Manufacturing cost analysis, cost driver modeling, manufacturing cost analysis, Critique for design for assembly method.

DESIGN FOR THE ENVIRONMENT: Environmental objectives, Basic DFE methods, design guidelines, Life cycle assessment, Techniques to reduce environmental impact

UNIT-III

HUMAN ENGINEERING CONSIDERATIONS IN PRODUCT DESIGN: Human being as applicator of forces, Anthropometry, the design of controls, the design of displays, Man/Machine information exchange, Workplace layout from ergonomic considerations.

VALUE ENGINEERING: Value, Nature and measurement of value, Maximum value, Normal degree of value, Importance of value, value analysis job plan, creativity, steps to problem solving and value analysis, value analysis tests, value engineering idea generation check list, Cost reduction through value engineering-case study, materials and process selection in value engineering.

UNIT-IV

MODERN APPROACHES TO PRODUCT DESIGN: Concurrent design, Quality function deployment (QFD), Rapid prototyping

PRODUCT DEVELOPMENT: A modern product development process, reverse engineering and redesign product development process, product life cycle, product development teams, Product development planning, Manufacturing & economic aspects of product development.

RECOMMENDED BOOKS:

1. Kail T Ulrich and Steven D Eppinger, "Product Design and Development."
2. AK Chitale and Gupta, "Product Design and Engineering"
3. Niebel & Draper, "Product Design and Process Engineering"
4. Kevin Otto & Kristin Wood, "Product Design-Techniques in reverse engineering and new product development"
5. Middendorf Marcel Dekker, "Design of Systems and Devices"

Note: The paper will have a total of ***NINE questions.*** **Question No. 1,** which is compulsory, shall be OBJECTIVE Type and have contents from the entire syllabus (all Four Units). All questions will have equal ***weight of 12 marks.*** The student will attempt a total of ***FIVE questions***, each of 12 marks.
Q. No. 1 is compulsory. *The student shall attempt remaining* ***four*** *questions by selecting* ***only one question from each unit.***

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MASTER OF TECHNOLOGY IN MECHANICAL ENGINEERING (1st Sem.)
(INDUSTRIAL & PRODUCTION ENGINEERING)

MTIP–605C	COMPUTER AIDED DESIGN AND MANUFACTURING						
Lecture	Tutorial	Practical	Credit	Major Test	Minor Test	Total	Time
4	0	-	4	60	40	100	3 hrs
Purpose	The objective of the course is to understand about the technology of computers for the design, process planning and manufacturing the products.						
Course Outcomes							
CO1	To understand the fundamentals and applications of computers in the field of designing and manufacturing and the transformation of geometric models.						
CO2	To understand the concepts of G.T. and cellular manufacturing.						
CO3	To know the use of computers in process planning and flexible manufacturing systems.						
CO4	To learn the basics and coding systems for CNC.						

UNIT I

Fundamentals of CAD: Introduction, Design Process, Application of computers in design, Creating manufacturing database, Benefits of CAD. Computer Hardware, Graphic input devices, display devices, Graphics output devices, Central processing unit (CPU).

Geometric transformations: 2D and 3D; transformations of geometric models like translation, scaling, rotation, reflection, shear; homogeneous representations, concatenated representation; Orthographic projections, Numerical Problems

UNIT II

Introduction to Manufacturing

Basic definitions, design activities for manufacturing systems, Planning and control activates for manufacturing system, Manufacturing control, Types of production – low, Medium and high quantity production.

Group Technology and Cellular Manufacturing

Part families, parts classifications and coding, Production flow Analysis, cellular Manufacturing- composite part concept, machine cell design, applications of group technology, Grouping parts and machines by Rank order clustering technique, Arranging machines in a G.T. cell.

UNIT III

Process Planning

Introduction, Manual process planning, Computer aided process planning – variant, generative, Decision logic- decision tables, decision trees, Introduction to Artificial intelligence.

Flexible Manufacturing

Introduction, FMS components, Flexibility in Manufacturing – machine, Product, Routing, Operation, types of FMS, FMS layouts, FMS planning and control issues, deadlock in FMS, FMS benefits and applications.

UNIT IV

CNC Basics and Part Programming

Introduction,-Principle of CNC, Classification of CNC/NC – point to point and continuous path, positioning system- fixed zero and floating zero, Dimensioning- absolute and incremental, Coordinate system, Basic requirements of CNC machine control, CNC/NC words, Manual part programming, (G&M codes only) canned cycles, tool length and radius compensation.

RECOMMENDED BOOKS:

1. **Chris McMahon and Jimmie Browne**, CAD/CAM – Principle Practice and Manufacturing Management, Addison Wesley England, Second Edition, 2000.
2. **Ibrahim Zeid**, CAD/CAM theory and Practice, Tata McGraw Hill Publishing Co. Ltd., New Delhi, 1992.
3. **Ibrahim Zeid**, Mastering CAD/CAM, Tata McGraw Hill Publishing Co. Ltd., New Delhi.
4. **Rogers, D.F. and Adams, A.**, Mathematical Elements for Computer Graphics, McGraw Hill Inc, NY, 1989
5. **P. Radhakrishnan, S. Subramanayan and V.Raju**, CAD/CAM/CIM, New Age International (P) Ltd., New Delhi.
6. **Groover M.P. and Zimmers E. W.**, CAD/CAM: Computer Aided Design and Manufacturing, Prentice Hall International, New Delhi, 1992.
7. **Dr. Sadhu Singh**, Computer Aided Design and Manufacturing, Khanna Publishers, New Delhi, Second Edition, 2000.
8. **M.P. Groover**, Automation, Productions systems and Computer-Integrated Manufacturing by Prentice – Hall
9. **Chang, Wang & Wysk** Computer Aided Manufacturing. Prentice Hall
10. **Kundra &Rao**, Numerical Control and Computer Aided Manufacturing by, Rao and Tiwari, Tata Mc-Graw Hill.
11. **Mattson**, CNC programming Principles and applications, Cengage Learning India Pvt. Ltd. Delhi

Note: The paper will have a total of ***NINE questions.*** **Question No. 1,** which is compulsory, shall be OBJECTIVE Type and have contents from the entire syllabus (all Four Units).

All questions will have equal ***weight of 12 marks.*** The student will attempt a total of ***FIVE questions***, each of 12 marks. Q. No. 1 is compulsory. *The student shall attempt remaining* ***four*** *questions by selecting* ***only one question from each unit.***

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MASTER OF TECHNOLOGY IN MECHANICAL ENGINEERING (1st Sem.)
(INDUSTRIAL & PRODUCTION ENGINEERING)

MTIP–607 C	ADVANCED ENGINEERING MATERIAL						
Lecture	Tutorial	Practical	Credit	Major Test	Minor Test	Total	Time
4	0	-	4	60	40	100	3 hrs
Purpose	The objective of the course is to impart the students with the knowledge of various advanced and smart materials.						
Course Outcomes							
CO1	To impart knowledge of Piezoelectric and shape memory alloys.						
CO2	To acquaint students with deep know how about Electro-rheological and composite materials						
CO3	To impart knowledge to students about MEMS systems and High temperature application materials.						
CO4	To let student understand the processing and characteristics of powder metallurgy processes and structural materials.						

UNIT-I

Piezoelectric materials (PZT): piezoelectric effect, Di-electric hysteresis, piezoelectric constants, hydrogen storage alloys, functionally gradient material (FGM).

Shape memory alloys (SMA): Shape memory effect and the metallurgical phenomenon of SMA, Temperature assisted shape memory effect,

UNIT-II

Electro rheological (ER) and magneto-rheological (MR) materials: Characteristics of ER and EM fluids. ER and EM materials.

Composite materials: Design and manufacturing of polymer matrix, metal matrix and ceramic matrix composites. Various forms and type of reinforcements, fillers and additives. Design of composites for structural, wear resistance and high temperature applications.

UNIT-III

Micro-electro-mechanical (MEMS) systems: Introduction, characteristics of silicon wafers and other materials for MEMS applications. Various manufacturing techniques of MEMS components,

Materials for high temperature applications: Ni-Cr alloys, ODS materials, Ni base and Co based super alloys, carbon-carbon composites. Diffusion bond coating of high temperature materials, Different types of Thermal spray coating for aero engines and gas turbines

UNIT-IV

Powder metallurgy: Introduction and feature of powder metallurgy processes. Advanced solidification techniques: directional solidification, single crystal growth and levitation melting.

Structural Materials: Porous matrix ceramics- composites, Metallic foam, Cellular Materials, Nano tubes, Functional Materials: Low dielectric constant materials, optoelectronic materials. Glassy and Nano crystalline materials for soft and hard magnetic properties and their applications.

Recommended Books:

[1] Gandhi, M.V. and Thompson, B.S., Smart materials and Structures, Chapman & Hall, 1992.
[2] Otsuka, K. and Wayman, C. M., Shape memory materials, C.U.P, 1998
[3] Taylor, W., Pizoelectricity, George Gorden and Breach Sc. Pub., 1985
[4] Mallick, P.K., Fiber Reinforced Composites Materials, Manufacturing and Design. Marcel Dekker Inc, New York, 1993.
[5] Rama Rao, P. (ed.), Advances in Materials and their applications, Wiley Eastern Ltd.

Note: The paper will have a total of ***NINE questions.*** **Question No. 1,** which is compulsory, shall be OBJECTIVE Type and have contents from the entire syllabus (all Four Units).

All questions will have equal ***weight of 12 marks.*** The student will attempt a total of ***FIVE questions***, each of 12 marks. Q. No. 1 is compulsory. *The student shall attempt remaining* ***four*** *questions by selecting* ***only one question from each unit.***

MASTER OF TECHNOLOGY IN MECHANICAL ENGINEERING (1st Sem.)
(INDUSTRIAL & PRODUCTION ENGINEERING)

MTME-809	RESEARCH METHODOLOGY AND OPTIMIZATION TECHNIQUES						
Lecture	Tutorial	Practical	Credit	Major Test	Minor Test	Total	Time
4	0	-	4	60	40	100	3 hrs
Purpose	The objective of the course is to know about the concept of research methodology and various optimization techniques related to the field of industrial and production engineering.						
Course Outcomes							
CO1	To understand the concept of formulation of a research problem and taguchi methodology.						
CO2	To familiarize with the use of software and report writing.						
CO3	To know about the linear programming methods and applications.						
CO4	To understand the concepts of different optimization techniques and its use in optimization of problems.						

UNIT I

Introduction to research methodology, various types of techniques, alternative approaches to the study of the research problem and problem formulation, formulation of hypotheses, feasibility, preparation and presentation of research proposal.

Introduction to experimental design, Taguchi method, concept of orthogonal array, primary and secondary data collection, S/N ratio, validation, regression and correlation analysis, tests of significance based on normal, T and chi square distributions, analysis of variance.

UNIT II

Edition, tabulation & testing of hypotheses, interpolation of results, presentation, styles for figures, tables, text, quoting of reference and bibliography. Use of software for statistical analysis like SPSS, Minitab or MATLAB, Report writing, preparation of thesis, use of software like MS Office.

The course will include extensive use of software, reporting writing and seminars in tutorial class.

UNIT III

Integer linear programming methods and applications, Introduction to integer non-linear programming, Basics of geometric programming.

Multi-objective optimization methods and applications, Formulation of problems – Separable programming and stochastic programming.

UNIT IV

Introduction to Genetic algorithms, neural network based optimization and optimization of fuzzy systems, Evolutionary Algorithm and Ant Colony Optimization techniques.

Note: - Some of the algorithms are to be exercised using MAT LAB.

RECOMMENDED BOOKS:

1. C.R Kothari, Research Methodology, Wishwa Prakashan
2. P.G Triphati, Research Methodology, Sultan Chand & Sons, N.Delhi
3. Fisher, Design of Experiments, Hafner
4. Sadhu Singh, Research Methodology in Social Sciences, Himalya Publishers

5. Kalyanmoy Deb, Optimization for engineering design – algorithms and examples. PHI,New Delhi,1995.
6. SingiresuS.Rao, "Engineering optimization –Theory and practices", John Wiley & Sons
7. Garfinkel, R.S. and Nemhauser, G.L., Integer programming, John Wiley & Sons, 1972.

Note: The paper will have a total of ***NINE questions.*** **Question No. 1,** which is compulsory, shall be OBJECTIVE Type and have contents from the entire syllabus (all Four Units).

All questions will have equal ***weight of 12 marks.*** The student will attempt a total of ***FIVE questions***, each of 12 marks. Q. No. 1 is compulsory. *The student shall attempt remaining* ***four*** *questions by selecting* ***only one question from each unit.***

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MASTER OF TECHNOLOGY IN MECHANICAL ENGINEERING (1st Sem.)
(INDUSTRIAL & PRODUCTION ENGINEERING)

MTIP–611C	CAD/CAM LAB						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
0	**0**	**2**	**1**	**60**	**40**	**100**	**2 hrs.**
Purpose	To acquaint the students with 2-D and 3-D modeling using design softwares.						
Course Outcomes							
CO1	To understand the basic solid modeling and applied features of the softwares.						
CO2	To learn and practice of surface techniques and surface creations using software.						
CO3	To learn and practice of assembly and detailed drafting.						

List of Experiments:

The students will be required to carry out the following exercises or their equivalent tasks using a 3-D modeling software package (e.g. Solid-works/ Creo/ Ideas/ Solid Edge/UG/CATIA/ etc.). Practical must be performed on licensed version (Preferably the latest version) of any one of above mentioned software.

1 BASIC SOLID MODELING

Introduction & sketcher tools

a) CAD Tools and Applications: CAD - CAM - CAE
b) Parametric Feature Based Modelling and Parent-Child Relation
c) Design Intent and Associativity between 3 Modes
d) Modelling Software - Getting Started & Graphical User Interface
e) Sketch Entities and Tools
f) Dimensioning and Adding Relations to define the Sketch

Sketched Features (Boss / Base and Cut)

a) Base Features
b) Extrude & Revolve
c) Reference Geometry, Curves & 3D Sketch
d) Sweep & Loft

Editing & Refining Model

a) Editing Sketch, Sketch Plane and Editing Feature
b) Suppress / Un-Suppress Feature and Reordering Feature

2 ADVANCE FEATURES APPLIED FEATURES

a) Patterns & Mirror
b) Fillet/Round & Chamfer
c) Hole & Hole Wizard
d) Draft, Shell, Rib and Scale
e) Dome, Flex and Wrap

Multi Body

a) Indent Tool

b) Combine Bodies – Boolean Operations
c) Split, Move/Copy and Delete Bodies

Other Tools & Options

a) Design Table and Configurations
b) Adding Equations and Link Values
c) Tools - Measure and Mass Properties
d) Appearance - Edit Material, Colour and Texture
e) Options - System and Document Properties

3 SURFACING TECHNIQUES BASIC SURFACE CREATIONS

a) Extrude & Revolve
b) Sweep & Loft
c) Boundary Surface
d) Planar Surface

Other Derived Techniques

a) Offset Surface
b) Radiate Surface
c) Ruled Surface
d) Fill Surface
e) Mid Surface

Modify / Edit Surfaces

a) Fillet/Round
b) Extend
c) Trim & Untrim
d) Knit Surfaces
e) Delete and Patch

Surfaces for Hybrid Modelling

a) Thicken – Boss / Base and Cut
b) Replace face
c) End condition for Sketched feature - Up to Surface or Offset from Surface.
d) Solid body from closed surfaces

4 ASSEMBLY & MECHANISMS BOTTOM UP ASSEMBLY APPROACH

a) Inserting Components/Sub-Assemblies
b) Adding Mates - Standard & Advance
c) Editing Mates, Part and Replacing Components

Top down Approach & Mechanisms

a) Inserting New Part to Existing Assembly
b) Use of Layout Sketching
c) External References - In-context and Out-of-context, Locked and Broken

Assembly Features

a) Component Patterns & Mirrors
b) Cuts & Holes
c) Belt/Chain and Weld Bead

Representations of Assembly Components

a) Light Weight, Suppressed and Resolved
b) Hide, Transparency and Isolate

10 (3108)

c) Exploded View

Assembly Check

a) Interference Detection,

b) Collision Detection and Physical Dynamics

Motion Study

c) Assembly Motion & Physical Simulation

d) Animation Wizard & Save as AVI file

e) Mechanism Analysis – Plot Displacement, Velocity and Acceleration Diagram

5 DETAILED DRAFTING

Introduction to Engineering Drawings

a) General Procedure for Drafting & Detailing

b) Inserting Drawing Views, Dimensioning and Adding Annotations

c) Drawing Templates & Sheet Format

d) Setting Options

Drawing Views

a) Model View & Standard 3 View

b) Projected View & Auxiliary View

c) Section & Aligned Section View

d) Detail View, Broken-out Section and Crop View.

Dimensioning

a) Standards, Rules and Guidelines

b) Dimension Insertion/Creation - Insert Model Items & Dimension tool

Annotations

a) Notes & Holes Callout

b) Datum & Geometric Tolerances

c) Surface Finish & Weld Symbols

d) Centre Mark & Centre line

e) BOM Balloon & Bill of Material

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Second Semester

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MASTER OF TECHNOLOGY IN MECHANICAL ENGINEERING (2nd Sem.)
(INDUSTRIAL & PRODUCTION ENGINEERING)

MTIP-602C	MECHATRONICS						
Lecture	Tutorial	Practical	Credit	Major Test	Minor Test	Total	Time
4	0	-	4	60	40	100	3 hrs
Purpose	To acquaint the knowledge of electronic devices and electromechanical systems for embedded, distributed structure of the sensors, processing signals, actuators and communications.						
Course Outcomes							
CO1	Define and explain the concepts of Mechatronics, fundamental of electronics and digital circuits and semiconductor devices.						
CO2	Understanding of various types of control valves in hydraulic system with its hydraulic symbols.						
CO3	Understanding of different types of pneumatic system with their circuit diagrams.						
CO4	Explanation of microcontrollers and programmable logic controllers (PLC's)						

UNIT-1

Introduction: The Mechatronics approach: A methodology for integrated design of Mechanical, Electronics and Electrical, Control, computer and Instrumentation

Fundamentals of Electronics and digital circuits: Number systems: Binary, Octal, Hexadecimal, Conversion from Binary to Decimal, Octal and Hexadecimal and vice–versa, Binary arithmetic: Addition, subtraction, Multiplication and division, Boolean Algebra: Laws, De-Morgan's laws, Logic Gates, Truth tables, Karnaugh maps and logic circuits. Generation of Boolean function from truth tables and simplification, Review of semiconductor devices, operational amplifier, Configurations: Inverting, summing, integrating and differentiating, Concepts of digital and analog systems, Digital to analog conversion (DAC): R-2R and summing Op-amp circuit, Analog to digital conversion (ADC): successive approximation method, Programs for DI, DO, DA and AD for PCL 208 card.

UNIT-II

HYDRAULIC SYSTEMS:

Direction Control Valves: Poppet Valve, Spool Valve, Sliding Spool type DCV, Check Valve, Pilot operated check valve, Restriction check valve, 2 Way vale, 3 way valve, 4 way valve, Manually actuated valve, Mechanically actuated valve, Pilot operated DCV, Solenoid Actuated valve, Rotary Valve, Centre flow path configurations for three position four way valve, Shuttle valve

Pressure Control Valve: Simple and compound pressure Relief Valve, Pressure Reducing Valve, Unloading valve, sequence valve, counterbalance valve, Brake Valve

Flow Control Valves: Fixed and non-adjustable valve, adjustable, throttling, non-pressure compensated pressure control valve, Pressure/temperature compensated flow control valve, Shuttle and Fast exhaust valve, Time delay valve, Flow Control Valves, Fluid Conditioners **Hydraulic Symbols (ANSI).**

Hydraulic Circuit design: Control of Single and double acting cylinders, double pump Hydraulic System

UNIT-III

PNEUMATIC SYSTEM:

Air Generation and distribution: Air compressors, Air Receiver, Filters, intercoolers, After-coolers, Relief Valve, Air dryers, Primary and secondary lines, Piping layouts, Air Filters, Air Regulators, Air Lubricator, Actuators and output devices, Direction control valves, Flow control valves, junction elements, Pneumatic circuits, Control of Single and double acting cylinders.

UNIT-IV

INTRODUCTION TO MICROCONTROLLER

8051 Architecture: Memory map - Addressing modes, I/O Ports -Counters and Timers – Serial data - I/O - Interrupts -Instruction set, Data transfer instructions, Arithmetic and Logical Instructions, Jump and Call Instructions, Assembly Language Programming tools. Interfacing applications

PROGRAMMABLE LOGIC CONTROLLERS

Introduction - Principles of operation - PLC Architecture and specifications - PLC hardware Components, Analog & digital I/O modules, CPU & memory module - Programming devices - PLC ladder diagram, Converting simple relay ladder diagram in to PLC relay ladder diagram. PLC programming Simple instructions - Manually operated switches - Mechanically operated Proximity switches - Latching relays, Applications of PLC.

Recommended Books:

1. Mechatronics by W. Bolton, Pearson Education.
2. Pneumatic system, Majumdar, TMH
3. Hydraulic and Pneumatic systems by Andrew Parr, TMH.
4. Automation, Production systems and computer integrated manufacturing by M.P. Groover, TMH.
5. Mechatronics system design by Shetty and Kolk, Thomson learning.
6. Mechatronics by Mahalik, TMH

Note: The paper will have a total of ***NINE*** *questions.* Question No. 1, which is compulsory, shall be **OBJECTIVE** Type and have contents from the entire syllabus (all Four Units).

All questions will have equal *weight of 12 marks.* The student will attempt a total of ***FIVE*** *questions,* each of 12 marks. Q. No. 1 is compulsory. *The student shall attempt remaining/our questions by selecting only one question from each unit.*

to (3112)

MASTER OF TECHNOLOGY IN MECHANICAL ENGINEERING (2nd Sem.)
(INDUSTRIAL & PRODUCTION ENGINEERING)

MTIP–604C	TOOL ENGINEERING						
Lecture	Tutorial	Practical	Credit	Major Test	Minor Test	Total	Time
4	0	-	4	60	40	100	3 hrs
Purpose	The objective of the course is to impart the students with the knowledge of various aspects of design of different types of Tools and fixtures used in Industries.						
Course Outcomes							
CO1	To impart knowledge of materials for cutting tool and Design of cutting tools.						
CO2	To acquaint students with various kinds of Gages and Work holding devices.						
CO3	To impart knowledge to students about Drill jigs and Fixtures.						
CO4	To let student understand the tool design process for NC Machine tools						

UNIT-I

Cutting Tool Materials: Introduction and desirable properties , Carbon and Medium-Alloy Steels , High-Speed Steels , Cast-Cobalt Alloys , Carbides , Coated Tools , Alumina-Based Ceramics , Cubic Boron Nitride , Silicon-Nitride Based Ceramics , Diamond , Reinforced Tool Materials , Cutting-Tool Reconditioning

Design of Cutting Tools Basic Requirements, Mechanics and Geometry of Chip Formation, General Considerations for Metal Cutting, Design of single point Cutting Tools, Design of Milling Cutters, Design of Drills and Drilling, Design of Reamers, Design of Taps, Design of Inserts, Determining Shank Size for Single-point Carbide Tools, Determining the Insert Thickness for Carbide Tools, Chip Breakers, Design of form tools

UNIT-II

Gauges and Gauge Design: Limits fits and tolerances, Geometrical tolerances-specification and measurement, Types of gauges, Gauge design, gauge tolerances, Material for Gauges.

Work Holding Devices: Basic requirements of work holding devices, Location: Principles, methods and devices, Clamping: Principles, methods and devices.

UNIT-III

Drill Jigs: Definition and types of Drill Jigs, Chip Formation in Drilling, General Considerations in the Design of Drill Jigs, Drill Bushings, Drill Jigs, and Modern Manufacturing

Design of Fixtures: Fixtures and Economics , Types of Fixtures , Milling Fixtures , Boring Fixtures, Broaching Fixtures, Lathe Fixtures, Grinding

UNIT-IV

Tool Design for Numerically Controlled Machine Tools: Fixture Design for Numerically Controlled Machine Tools, Cutting Tools for Numerical Control, Tool-holding Methods for Numerical Control

Recommended Books:

1. ASTME, "Fundamentals of Tool Design", Prentice Hall of India, 1983.
2. Donaldson, "Tool Design", Tata-McGraw Hill, 3rd Edition, 2000.
3. Joshi P.H., "Jigs and Fixtures", Tata-McGraw Hill, 2010.

Note: The paper will have a total of ***NINE questions.*** **Question No. 1,** which is compulsory, shall be OBJECTIVE Type and have contents from the entire syllabus (all Four Units).

10(3193)

All questions will have equal ***weight of 12 marks.*** The student will attempt a total of ***FIVE questions***, each of 12 marks. Q. No. 1 is compulsory. *The student shall attempt remaining* ***four*** *questions by selecting* ***only one question from each unit.***

10(3114)

MASTER OF TECHNOLOGY IN MECHANICAL ENGINEERING (2nd Sem.)
(INDUSTRIAL & PRODUCTION ENGINEERING)

MTIP–606C	ADVANCED METAL CASTING						
Lecture	Tutorial	Practical	Credit	Major Test	Minor Test	Total	Time
4	0	-	4	60	40	100	3 hrs
Purpose	The main objective of the course is to impart the students with the knowledge of Moulding and casting.						
Course Outcomes							
CO1	To impart knowledge about various functional requirements of moulding materials and specifications and testing of Moulding sand properties.						
CO2	To acquaint students with the phenomenon of solidification and analytics involved in solidification of Molten metal in various types of Mould metal combintions.						
CO3	To impart knowledge to students about Gating system design and Riser design for getting an accurately designed defect free casting.						
CO4	To let student understand some special casting processes and testing of casting.						

UNIT-I

Functional Requirement of Moulding Materials: Principal ingredients of moulding Sands; Different Types of Sands; Clays, Different types of Clay structures, ; Moisture; Bonding mechanism of silica –clay-water System, Hardened Mould or dry sand practice, The Requirement of core sands, Indian Foundry Industry and challenges.

Specification and testing of Moulding Sands

Grain Size, Grain Shape, Clay content, Moisture Content, Bulk Density and Specific Surface Area, ADV, Fines Content, Sintering Temperature, Mould hardness, Permeability, Strength, Deformation & toughness, Compactability, Mouldability, High Temperature Characteristics.

UNIT-II

Solidifications of Metals, Nucleation, free energy concept, critical radius of nucleus, Distribution coefficient and Constitutional Undercooling, Solidification in Pure Metals and Alloys, Directional Solidification, Casting Characteristics related to Solidification; Fluidity, Dendritic Growth, Dendritic coherency, Segregation, Inverse Segregation, Hot tearing, Hipping, Solidification under pressure.

Heat Transfer during casting process: Resistance to Heat Transfer, Centerline Feeding Resistance, Rate of solidification, Solidification of Large casting in an insulating mould, Solidification with predominant interface resistance, Solidification with constant casting surface temperature, Solidification with predominant resistance in mould and solidified Metal, Solidification Time and Chvorinov rule, Numerical Exercises.

UNIT-III

Gating System Design: Gating system defined, Types of Gating Systems, Types of Gates, Elements of Gating System, Gating System design, Factors involved in Gating design, Pouring time, Choke Area, Sprue design, Gating Ratio, Sprue runner gate ratio, Elimination of Slag and Dross, Filtration, Numerical exercises.

10 (3115)

Riser Design: Need for riser, Basic requirements of an effective feeding system for a casting, Feeding Efficiency, Types of Risers, Effective feeding distances for simple and complex shapes. Use of chills, Directional solidification, Stresses in castings, Metal Mould reactions, Claine's Method, Modulus Method, Naval Research Laboratory (NRL) Method, Pouring rate and Temperature, Padding, Use of exothermic materials, Chills, Feeding Aids, Numerical exercises.

UNIT-IV

Special casting Processes: Shell Moulding, Investment Casting, Permanent Mould Casting, Diecasting, Centrifugal casting.

Inspection and testing of casting: Visual, Optical, Dimensional inspection, Laser Scanning, White light scanning, Radiographic Inspection, ultrasonic testing, Magnetic Particle Testing, dye penetration, Casting Defects; Classification, Causes and remedies.

RECOMMENDED BOOKS:

1. H.F. Taylor, "Foundry Engineering", John Wiley and Sons.
2. P.L. Jain, "Principles of Foundry Technology", Mc-Graw Hill.
3. Mahi Sahoo and Sudhari Sahu, "Principles of Metal Casting.
4. Amitabha Ghosh, " Manufacuring Science", Affliated East West Press.
5. P.N Rao, "Manufacturing Technology: Foundry, Forming and Welding" TMH.
6. K.P. Sinha,"Foundry Technology", Standard Publishers, Delhi.
7. Flinn, "Fundamentals of Metals Casting", Addison Wesley.
8. Heine Loper and Resenthal, "Principles of Metal Casting", Mc-Graw Hill.
9. Hielel and Draper, "Product Design & Process Engineering", Mc-Graw Hill.
10. Salman & Simans, "Foundry Practice", Issac Pitman.
11. ASME, "Metals Handbook- Metal Casting."
12. P.C. Mukharjee, Fundamentals of Metal casting Technology, Oxford, IBH.
13. P.R.Beeley, Foundry Technology , Butterworth Heinmann

Note: The paper will have a total of ***NINE questions.*** **Question No. 1,** which is compulsory, shall be OBJECTIVE Type and have contents from the entire syllabus (all Four Units).

All questions will have equal ***weight of 12 marks.*** The student will attempt a total of ***FIVE questions***, each of 12 marks. Q. No. 1 is compulsory. *The student shall attempt remaining* ***four*** *questions by selecting* ***only one question from each unit.***

10 (3176)

MASTER OF TECHNOLOGY IN MECHANICAL ENGINEERING (2nd Sem.)
(INDUSTRIAL & PRODUCTION ENGINEERING)

MTIP–608C	ADVANCED WELDING PROCESSES						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
4	0	-	4	60	40	100	3 hrs
Purpose	The main objective of the course is to impart the students with the knowledge of Welding metallurgy and welding processes.						
Course Outcomes							
CO1	To impart knowledge about various Weld metallurgy and Weld arc characteristics.						
CO2	To acquaint students with the various welding power sources and their applications.						
CO3	To impart knowledge to students about Electrode coatings and Metal transfer phenomenon in weld metal transfer.						
CO4	To let student understand the basics of Solid state welding processes and some of the latest welding techniques.						

UNIT-I

WELDING METALLURGY: Introduction, Weld Metal Zone, Theory of solidification of metals and alloys, Homogeneous Nucleation, Heterogeneous Nucleation, Freezing of alloys, Epitaxial Solidification; Effect of Welding speed on Grain structure, Fusion boundary zone, Heat affected zone, Under bead zone, Grain Refined Zone, Partial transformed zone, Properties of HAZ

WELDING ARC: Definition of Arc, Structure and characteristics, Arc efficiency, arc blow, Electrical Characteristics of arc, Types of Welding Arcs, mechanism of arc initiation and maintenance, role of electrode polarity on arc behaviour and arc stability, analysis of the arc. Arc length regulation in mechanized welding processes.

UNIT-II

WELDING POWER SOURCES: Requirement of an Arc welding power sources, basic characteristics of power sources for various arc welding processes, duty cycle, Selection of a static Volt-Ampere characteristic for a welding process, AC/DC welding power source, DC rectifiers, thyristor controlled rectifiers, transistorized units, inverter systems, Mathematical Problems on Static volt ampere characteristics

UNIT-III

COATED ELECTRODES: Electrode coatings, classification of coatings of electrodes for SMAW, SAW fluxes, role of flux ingredients and shielding gases, classification of solid and flux code wires.

METAL TRANSFER & MELTING RATE: Mechanism and types of metal transfer, forces affecting metal transfer, modes of metal transfer, metal transfer in various welding processes, effective of polarity on metal transfer and melting rate.

UNIT-IV

SOLID STATE WELDING: Theory and mechanism of solid state welding. Techniques and scope of friction welding, diffusion welding, cold pressure welding and ultrasonic welding. High energy rate welding. Analysis of the Process.

WELDING TECHNIQUES: Technique, scope and application of the electron beam and laser welding processes. Under water welding - process & problem.

RECOMMENDED BOOKS:

1. Raymond Sacks, —Welding: Principles & Practices‖ McGraw-Hill
2. R.S.Parmar, —Welding processes & Technology‖, Khanna Publishers
3. R.S.Parmar, —Welding Engineering & Technology‖, Khanna Publishers
4. S.V. Nandkarni, —Modern Arc Welding Technology, Oxford & IBH publishing Co.
5. L.M.Gourd, —Principles of Welding Technology‖, ELBS/ Edward Arnold.
6. Richard L. Little, —Welding & Welding Technology‖, Mc-Graw Hill.
7. Cary, Howard, —Modern Welding Technology', prentice Hall, 1998.
8. Rossi, —Welding Technology‖, Mc-Graw Hill.

Note: The paper will have a total of ***NINE questions.*** **Question No. 1,** which is compulsory, shall be OBJECTIVE Type and have contents from the entire syllabus (all Four Units). All questions will have equal ***weight of 12 marks.*** The student will attempt a total of ***FIVE questions***, each of 12 marks. Q. No. 1 is compulsory. *The student shall attempt remaining* ***four questions by selecting only one question from each unit.***

10 (3118)

MASTER OF TECHNOLOGY IN MECHANICAL ENGINEERING (2nd Sem.)
(INDUSTRIAL & PRODUCTION ENGINEERING)

MTIP–610C	MECHATRONICS LAB						
Lecture	Tutorial	Practical	Credit	Major Test	Minor Test	Total	Time
0	0	2	1	60	40	100	2hrs
Purpose	To practice on electrical circuits, hydraulic and pneumatic systems for their practical implications.						
Course Outcomes							
CO1	To understand the PLC using PLC simulators.						
CO2	To demonstrate and actuate the positioning using sensors, actuators and programming.						
CO3	To study the pneumatic and electro-pneumatic training system with simulation software.						
CO4	To design and test on hydraulic and pneumatic circuits.						

List of Experiments

1. To study and conduct exercises on PLC Simulator.
2. Control of conveyor manually and through programming, also programming using sensors and conveyor.
3. Control of X-Y position table manually and through programming.
4. To study and conduct exercises on Robotic simulation software.
5. To study and conduct exercises on Pneumatic & Electro-Pneumatic Training System.
6. **Design and testing of hydraulic circuits such as**
   i) Pressure control
   ii) Flow control
   iii) Direction control
   iv) Design of circuit with programmed logic sequence, using an optional PLC in hydraulic
   Electro hydraulic Trainer.
7. **Design and testing of pneumatic circuits such as**
   i. Pressure control
   ii. Flow control
   iii. Direction control
   iv. Circuits with logic controls
   v. Circuits with timers
   vi. Circuits with multiple cylinder sequences in Pneumatic Electro pneumatic Trainer.
8. To perform exercises on Process control trainer

Note: At least eight experiments should be performed from the above list.

10 (3119)

Electives-I

(Second Semester)

10/3/20

MASTER OF TECHNOLOGY IN MECHANICAL ENGINEERING (2nd Sem.)
(INDUSTRIAL & PRODUCTION ENGINEERING)

MTIP–612C	ADVANCED METAL CUTTING						
Lecture	Tutorial	Practical	Credit	Major Test	Minor Test	Total	Time
4	0	-	4	60	40	100	3 hrs
Purpose	The main objective of the course is to impart the students with the knowledge of advanced cutting tools, tools geometry, mechanisms and analysis.						
Course Outcomes							
CO1	To impart knowledge about various functional related to tools geometry.						
CO2	To acquaint with the analysis of fundamental factors affecting tool forces						
CO3	To impart knowledge about cutting tool life and mathematical modelling for wear.						
CO4	Tó let student understand abrasive machining and its process simulation.						

UNIT-I

Introduction, system of Tool nomenclature, Tool Geometry, Mechanism of Chip formation and forces in orthogonal cutting, Merchant's force diagram.

Oblique Cutting: Normal chip reduction coefficient under oblique cutting, true shear angle, effective rake, influx region consideration for deformation, direction of maximum elongation, effect of cutting variables on chip reduction co-efficient, forces system in oblique cutting, effect of wear land on force system, force system in milling, effect of helix angle.

UNIT-II

Fundamentals of Dynamometry, Theoretical determination of forces, angle relations, heat and temperature during metal cutting; distribution, measurement, analysis, theoretical estimation of work piece temperature, hot machining

Fundamental factors, which effect tool forces: Correlation of standard mechanized test. (Abuladze –relation), nature of contact and stagnant phenomenon, rates of strains, shear strain and normal strain distributions, cutting variables on cutting forces.

UNIT-III

Cutting Tools: Tools materials analysis of plastic failure (from stability criterion), Analysis failure by brittle fracture, wear of cutting tools, criterion, flank and crater wear analysis, optimum tool life, tool life equations, (Taylor's woxen etc) Tool life test, machining optimization, predominant types of wear; abrasive, adhesive, diffusion wear models, wear measurements and techniques, Major Test of tool wear oxidative mathematical modelling for wear, test of machinability and influence of metallurgy on machinability. Economics of metal machining

UNIT-IV

Abrasive Machining: Mechanics of grinding, cutting action of grit, maximum grit chip thickness, energy and grit force temperature during grinding, wheel wear, grinding, process simulation, testing of grinding wheels, mechanics of lapping and honing, free body abrasion.

RECOMMENDED BOOKS:

1. Principles of Machine tools by Sen & Bhattacharya by New Central Book Agency.
2. Machining of Metals, by Brown; Prentice hall.
3. Principles of Metal cutting by Shaw; Oxford I.B.H.
4. Metal cutting theory & Cutting tool design by Arshimov & Alekree, MIR Publications.
5. Machining Science & Application by Knowenberg Longman Press.

Note: The paper will have a total of ***NINE questions.*** **Question No. 1,** which is compulsory, shall be OBJECTIVE Type and have contents from the entire syllabus (all Four Units). All questions will have equal ***weight of 12 marks.*** The student will attempt a total of ***FIVE questions***, each of 12 marks. Q. No. 1 is compulsory. *The student shall attempt remaining* ***four*** *questions by selecting* ***only one question from each unit.***

MASTER OF TECHNOLOGY IN MECHANICAL ENGINEERING (2nd Sem.)
(INDUSTRIAL & PRODUCTION ENGINEERING)

MTIP–614C	COMPUTATIONAL METHODS IN ENGINEERING						
Lecture	Tutorial	Practical	Credit	Major Test	Minor Test	Total	Time
4	0	-	4	60	40	100	3 hrs
Purpose	To understand the computational methods and their applications.						
Course Outcomes							
CO1	To solve interpolation, curve fitting problems and system of linear equations using computer programme.						
CO2	To solve eigen value problems and first order differential equations.						
CO3	To solve higher order differential equations and Neumann & mixed problems.						
CO4	To understand the concept of distribution, sampling and correlation analysis and solve problems using different techniques.						

UNIT – I

Error & approximation, Solution of transcendental equations, Interpolation, Splines.
Integration & differentiation, Solution to system of linear equations (Gauss elimination, LU decomposition, solution by iteration), Method of least squares.

UNIT – II

Matrix eigen value problems, Inclusion of matrix eigen values, Power method, tridiagonalization & QR-Factorization, methods for first order differential equations.

UNIT – III

Methods for systems & higher order differential equations, Methods for elliptic, parabolic & hyperbolic partial differential equations, Neumann & mixed problems.

UNIT-IV

Random variables, mean & variance of a distribution, normal distribution, Random sampling, Estimation of parameters.
Confidence intervals, Testing of Hypothesis, Decisions, Quality Control, Acceptance Sampling, Goodness of Fit. X2-test, Correlation analysis.

Recommended Books:

1. Erwin Kreyszig, "Advanced Engineering Mathematics", John Wiley & Sons, Inc., 8th edition 2010.
2. H. K. Dass, Higher Engineering Mathematics by S Chand & Co. Ltd., 15th edition 2006.
3. Dr B. S. Grewal, Higher Engineering Mathematics by Khanna Publication, 40th edition 2007.
4. S.S. Sastry, Introductory methods in Numerical Analysis by PHI,Latest Edition.

Note: The paper will have a total of ***NINE questions.*** **Question No. 1,** which is compulsory, shall be OBJECTIVE Type and have contents from the entire syllabus (all Four Units).

All questions will have equal ***weight of 12 marks.*** The student will attempt a total of ***FIVE questions***, each of 12 marks. Q. No. 1 is compulsory. *The student shall attempt remaining* ***four*** *questions by selecting* ***only one question from each unit.***

10 (3124)

MASTER OF TECHNOLOGY IN MECHANICAL ENGINEERING (2nd Sem.)
(INDUSTRIAL & PRODUCTION ENGINEERING)

MTIP–616C	DESIGN OF EXPERIMENTS						
Lecture	Tutorial	Practical	Credit	Major Test	Minor Test	Total	Time
4	0	-	4	60	40	100	3 hrs
Purpose	To understand the concept of design of experiments for optimization of problems.						
Course Outcomes							
CO1	To understand the concepts of statistics, sampling and sampling distribution.						
CO2	To understand the factorial design and fitting response curves and surfaces.						
CO3	To study the fitting regression models and testing of hypothesis						
CO4	To study and implement the Taguchi philosophy, terms used and experimentation for parametric optimization.						

UNIT-I

Introduction: Strategy of experimentation, Some typical applications of experimental design, Basic principles, Guidelines for designing experiments, A brief history of statistical design, Using statistical design in experimentation Simple Comparative Experiments: Introduction, Basic statistical concepts, Sampling and sampling Distribution, Inferences about the Differences in means, randomized designs, Paired comparison Designs, Inferences about the Variances of Normal Distributions.

UNIT-II

Introduction To Factorial Design: Basic definition and principles, Advantages of factorials, The two factor factorial design, General factorial design, Fitting response curves and Surfaces, Blocking in a factorial design.

UNIT-III

Fitting Regression Models: Introduction, Linear regression models, Estimate of parameters in linear regression models, Hypothesis testing in multiple regression, Confidence intervals in multiple regression, Prediction of new response observations, Regression model diagnostics, Testing for lack of fit.

UNIT-IV

Taguchi Method Of Design Of Experiments: Concept design, Parameter design, Tolerance design, Quality loss function, Signal-to- Noise ratio, Orthogonal array experiments, Analysis of Mean (ANOM), Quality characteristics, Selection and testing of noise factors, Selection of control factors, Parameter optimization experiment, Parameter design case study Analysis of Variance (ANOVA): Introduction, Example of ANOVA process, Degrees of freedom, Error variance and pooling, Error variance and application, Error variance and utilizing empty columns, the F-test

Recommended Books:

1. Design and Analysis of Experiments by Douglas C Montgomery, John Wiley
2. Statistical Design and Analysis of Experiments by John P.W.M., John Wiley
3. Introduction to Linear Regression Analysis by Montgomery D.C., Runger G. C., John Wiley

4. Response Surface Methodology Process and Product Optimization Using Designed Experiments by Myres R.H. and Montgomery D. C. Wiley
5. Introduction to Quality Engineering Taguchi , G UNIPUB, White Plains, New York.

Note: The paper will have a total of ***NINE questions.*** **Question No. 1,** which is compulsory, shall be OBJECTIVE Type and have contents from the entire syllabus (all Four Units). All questions will have equal ***weight of 12 marks.*** The student will attempt a total of ***FIVE questions***, each of 12 marks. Q. No. 1 is compulsory. *The student shall attempt remaining* ***four*** *questions by selecting* ***only one question from each unit.***

MASTER OF TECHNOLOGY IN MECHANICAL ENGINEERING (2nd Sem.)
(INDUSTRIAL & PRODUCTION ENGINEERING)

MTIP–618C	OPERATIONS MANAGEMENT						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
4	**0**	**-**	**4**	**60**	**40**	**100**	**3 hrs**
Purpose	The main objective of the course is to impart the students with the knowledge of business and managerial skills.						
Course Outcomes							
CO1	To understand the basics of operation management and implementation of JIT in industries.						
CO2	To understand the concepts of supply chain management and its implications.						
CO3	To know about the business processing.						
CO4	To know about different approaches to waste reductions.						

UNIT I

Basics of Production Management:
Types of production, life cycle approach to production system, Productivity and Productivity measures, types of productivity index, productivity improvement, production scheduling, MRP v/s JIT, requirements and problems in implementing JIT, Benefits of JIT, Introduction to JIT purchasing and JIT quality management

UNIT II

Supply chain management, its importance, objectives and applications. Tenabled supply chain supply chain drives concepts of stockless, VRM and CRM.

UNIT III

Business Process:
Re-engineering-characteristics, organizational support, responsibility of re-engineering, re-engineering opportunities, choosing the process to re-engineer, success factors and advantages.

UNIT IV

ERP:
Evolution of ERP, Characteristics, approaches, methodology for implementation, Success factors.
Waste Management:
Introduction, classification of waste, systematic approach to waste reduction, waste disposal.

RECOMMENDED BOOKS:

1. Operation Research by D. S. Hira & P. K. Gupta,
2. Introduction to Operation Research by Hiller & Liebeman
3. Production and Operations Management by S.A.Chunawalla and D.R.Patel

Note: The paper will have a total of ***NINE questions.*** **Question No. 1,** which is compulsory, shall be OBJECTIVE Type and have contents from the entire syllabus (all Four Units).

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All questions will have equal ***weight of 12 marks.*** The student will attempt a total of ***FIVE questions***, each of 12 marks. Q. No. 1 is compulsory. *The student shall attempt remaining* ***four*** *questions by selecting* ***only one question from each unit.***

MASTER OF TECHNOLOGY IN MECHANICAL ENGINEERING (2nd Sem.)
(INDUSTRIAL & PRODUCTION ENGINEERING)

MTIP–620C	STRATEGIC ENTREPRENEURSHIP						
Lecture	Tutorial	Practical	Credit	Major Test	Minor Test	Total	Time
4	0	-	4	60	40	100	3 hrs
Purpose	To provide knowledge to the students about entrepreneurship concepts and various development programmes and policies.						
Course Outcomes							
CO1	To know about the small scale industries, scopes and the causes of their sickness.						
CO2	To know about the EDP and different government policies.						
CO3	To learn about business incubations and its future perspectives.						
CO4	To learn E-business marketing and developments.						

UNIT I

Small Scale Industries

Definition and types of SSI's; Role, scope and performance in national economy; Problems of small scale industries.

Industrial Sickness

Definition; Causes of sickness; Indian scenario, Government help; Management strategies; Need for trained entrepreneurs

UNIT II

Entrepreneurship Development Programmes

Introduction, Origin of EDP's , Organizations involved in EDP's, Objectives of EDPs, Implementation of EDP's, Short comings of EDP's, Role in entrepreneurship development.

Step: Introduction, Origin, Status in India, Success and failure factors, Govt. polices and incentives, future prospects in India.

UNIT III

Business Incubation

Introduction, Origin and development of business incubators in India and other countries, types of incubators, success parameters for a business incubator, Benefits to industries, institutes, government and society; future prospects. A few case studies (at least 2).

UNIT IV

Special Aspects of Entrepreneurship

Entrepreneurship, Social entrepreneurship, International entrepreneurship, Rural entrepreneurship, Community Development, Women entrepreneurship.

Network Marketing

Introduction, E-business, E-commerce, E-auction, A basic internet e-business architecture, A multi-tier e-business architecture.

RECOMMENDED BOOKS:

1. Strategic Entrepreneurship by P.K. Gupta, (Everest Publishing House)
2. Project Management –Strategic Design and Implementation by David Cleland McGraw Hill
3. Entrepreneurship-New Venture Creation by David H Holl (Prentice Hall of India)
4. Sustainable Strategic Management by Steed & Steed (Prentice Hall of India)
5. Marketing Management by Kotler (Prentice Hall of India)

6. Management of Technology by Tarek Khalil (McGraw Hill)
7. Engineering Economic Principles by Henry Steiner (McGraw Hill)

Note: The paper will have a total of ***NINE questions.*** **Question No. 1,** which is compulsory, shall be OBJECTIVE Type and have contents from the entire syllabus (all Four Units). All questions will have equal ***weight of 12 marks.*** The student will attempt a total of ***FIVE questions***, each of 12 marks. Q. No. 1 is compulsory. *The student shall attempt remaining* ***four*** *questions by selecting* ***only one question from each unit.***

(Third Semester)

10 (3131)

MASTER OF TECHNOLOGY IN MECHANICAL ENGINEERING (3rd Sem.)
(INDUSTRIAL AND PRODUCTION ENGINEERING)

MTIP–613C	SYNOPSIS OF DISSERTATION						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
-	-	-	**10**		**100**	**100**	--
Purpose	To main objective of this course is to plan a research work (includes the problem analysis/literature review, objectives, proposed methodologies and references) in the field of Industrial and Production Engineering or interrelated fields of applications.						
Course Outcomes							
CO1	To understand about the extent of past research in a particular area of interest chosen for research.						
CO2	To set the objectives for the proposed problem.						
CO3	To know different research methodologies related to their research area.						
CO4	To prepare their plan of research work in summarize and structured way for quick review.						

The students are required to initially work on Literature survey/ problem formulation / adopted methodology/ Industry selection/ etc. on some latest areas of Industrial and Production Engineering or related fields.

The students will be required to submit a progress report duly signed by their respective supervisors to the department, related to their dissertation work in the last week of September and November. The progress report will cover the following:

- The goal set for the month.
- Research papers studied.
- Methodology used in achieving the goal.
- The extent of fulfillment of the goal.

The progress report must be at least of 3-4 pages and the cover page should include the tentative topic, name of the candidate, name of the supervisor, period of progress report, signature of candidate and supervisor.

The students will be required to appear for comprehensive seminar & viva-voce and submit a synopsis report based on their progress related to the dissertation at the end of semester. The synopsis report will be submitted in the same format as that of the thesis and will contain the following:

1. Introduction
2. Literature Survey
3. Gaps in Literature
4. Objectives of the Proposed Work
5. Methodology
6. References

* Student will choose his/her guide in the end of second semester.

Elective-II

(Third Semester)

MASTER OF TECHNOLOGY IN MECHANICAL ENGINEERING (INDUSTRIAL & PRODUCTION ENGINEERING)

MTIP–615C	SUPPLY CHAIN MANAGEMENT						
Lecture	Tutorial	Practical	Credit	Major Test	Minor Test	Total	Time
4	0	-	4	60	40	100	3 hrs
Purpose	The main objective of the course is to impart the students with the knowledge of Supply chain and different aspects of supply chain management.						
Course Outcomes							
CO1	To impart knowledge about basics of Supply chain management and logistics management.						
CO2	To acquaint students with the different aspects involved in sourcing and procurement in supply chain management.						
CO3	To impart knowledge to students about different Inventory management techniques in properly managed supply chain.						
CO4	To let student understand the working of Probabilistic models in SCM and Decision making during Supply Chain Management.						

UNIT I

Introduction to Supply Chain Management (SCM): Concept of Logistics Management, Concept of supply management and SCM, Core competency, Value chain, Elements of supply chain efficiency, Flow in supply chains, Key issues in supply chain management

UNIT II

Sourcing and Procurement: Outsourcing benefit, Importance of suppliers, Evaluating a potential supplier, Supply contracts, Competitive bidding and Negotiation, E-procurement

UNIT III

Introduction to Inventory Management: Selective Control Techniques, MUSIC 3D [illegible]; Various costs. Deterministic Models, Quantity Discounts - all units, incremental price; Sensitivity, Make-or-buy decisions.

UNIT IV

Independent Demand Systems (Probabilistic Models): Q- system, P- system, Mathematical modelling under known stock out costs and service levels, Bullwhip effect, Information and supply chain trade-offs.

Decision making and application: Decision making in SC – Applications of SCM – ware house management system – product data management – E –Commerce – Reverse logistics Cases in Paper industry – Furniture industry.

RECOMMENDED BOOKS:

1. Chopra, S., and Meindl, P., Supply chain Management: Strategy, Planning and Operations. Second Edition, Pearson Education (Singapore) Pte. Ltd, 2004.

2. Simchi-Levi, D., Kaminsky, P., and Simchi-Levi, E., Designing & Managing the Supply Chain: Concepts, Strategies & Case studies. Second Edition, Tata McGraw-Hill Edition, 2003.
3. Doebler, D.W. and Burt, D.N., Purchsing and Supply Chain Management: Text and Cases, McGraw-Hill Publishing Company Limited, New Delhi, 1996.

Note: The paper will have a total of ***NINE questions.*** **Question No. 1,** which is compulsory, shall be OBJECTIVE Type and have contents from the entire syllabus (all Four Units).

All questions will have equal ***weight of 12 marks.*** The student will attempt a total of ***FIVE questions***, each of 12 marks. Q. No. 1 is compulsory. *The student shall attempt remaining* ***four*** *questions by selecting* ***only one question from each unit.***

MASTER OF TECHNOLOGY IN MECHANICAL ENGINEERING (3rd Sem.)
(INDUSTRIAL & PRODUCTION ENGINEERING)

MTIP–617C	FINITE ELEMENT METHODS						
Lecture	Tutorial	Practical	Credit	Major Test	Minor Test	Total	Time
4	0	-	4	60	40	100	3 hrs
Purpose	The main objective of the course is to impart the students with the knowledge of solving problems using FEM.						
Course Outcomes							
CO1	To formulate the boundary value problems using different methods.						
CO2	To model boundary value problems and solve different problems using FEM.						
CO3	To learn about 1-D stress-strain relations and solve 3-D stress strain problems with boundary conditions using computer programs.						
CO4	To solve one-dimensional and two-dimensional steady-state problems for conduction, convection and radiation and transient conditions and different problems related to fluid and thermal engineering.						

UNIT-I

GENERAL PROCEDURE OF FINITE ELEMENT METHOD

Basic concept of FEM, Engineering applications, Comparison of FEM with other methods of analysis, Discretization of the domain-Basic element shapes, discretization process, Interpolation polynomials, Selection of the order of the interpolation polynomial, Convergence requirements, Linear interpolation polynomials in terms of global and local coordinates, Formulation of element characteristic matrices and vectors-Direct approach, variational approach, weighted residual approach, Assembly of element matrices and vectors and derivation of system equations together with their solution.

UNIT-II

HIGH-- ORDER AND ISO-PARAMETRIC ELEMENT FORMULATIONS

Introduction, Higher order one-dimensional element, Higher order elements in terms of natural coordinates and in terms of classical interpolation polynomials, Continuity conditions, Iso-parametric elements, Numerical integration in one, two and three-dimensions.

UNIT-III

SOLID AND STRUCTURAL MECHANICS

Introduction, Basic equations of solid mechanics, Static analysis-Formulation of equilibrium equations, analysis of trusses and frames, analysis of plates, analysis of three-dimensional problems, analysis of solids of revolution, Dynamic analysis-Dynamic equations of motion, consistent and lumped mass matrices, consistent mass matrices in global coordinate system, Dynamic response calculation using FEM

UNIT-IV

APPLICATIONS AND GENERALISATON OF THE FINITE ELEMENT METHOD

Energy balance and rate equations of heat transfer, Governing differential equation for the heat conduction in three-dimensional bodies, Derivation of finite element equations for one-dimensional, two-dimensional, unsteady state and radiation heat transfer problems and their solutions, Solution of Helmholtz equation and Reynolds equation, Least squares finite element approach.

RECOMMENDED BOOKS:

1. The Finite Element Method in Engineering – S.S. Rao, Pub. - Pergamon Press.

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2. Numerical Methods in Finite Element Analysis-Klaus-Jurgen Bathe and Edwar L. Wilson, Pub.-PHI.
3. The Finite Element Method – O.C. Zienkiewicz – McGraw-Hill
4. The Finite Element Methods for Engineers – K.H. Huebner – Wiley, New York

Note: The paper will have a total of ***NINE questions.*** **Question No. 1,** which is compulsory, shall be OBJECTIVE Type and have contents from the entire syllabus (all Four Units).

All questions will have equal ***weight of 12 marks.*** The student will attempt a total of ***FIVE questions***, each of 12 marks. Q. No. 1 is compulsory. *The student shall attempt remaining* ***four*** *questions by selecting* ***only one question from each unit.***

MASTER OF TECHNOLOGY IN MECHANICAL ENGINEERING (3rd Sem.)
(INDUSTRIAL & PRODUCTION ENGINEERING)

MTIP–619C	SEQUENCING AND SCHEDULING						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
4	**0**	**-**	**4**	**60**	**40**	**100**	**3 hrs**
Purpose	The main objective of the course is to impart the students with the knowledge of different production and machine models of sequencing and scheduling.						
Course Outcomes							
CO1	To understand the concept of sequencing and scheduling.						
CO2	To simulate the job shop models.						
CO3	To understand the flow shop models.						
CO4	To study other models of scheduling of continuous production.						

UNIT I

Single machine models - Scheduling function and theory – scheduling problem: objectives, constraints – pure sequencing – performance measures, sequencing theorems - SPT, EDD sequence – minimization of mean flow time, mean tardiness etc – branch and bound algorithm –assignment model.

UNIT II

Parallel machine models - Independent jobs, Minimizing make span.
Job shop models – dynamic job shop simulation.

UNIT III

Flow shop models - Johnson's problem – Extension of Johnsons's rule for 3 machine problem – Jackson's method – algorithm – Palmer's method.

UNIT IV

Other models - Scheduling of intermittent production: Resource smoothing – Giffler Thomson algorithm – Branch and Bound method – Scheduling of continuous production - Line balancing.

RECOMMENDED BOOKS:

1. Michael Pinedoo, Scheduling: theory, algorithms and systems, Prentice Hall, New Delhi, 1995.

2. King, J.R. Production planning and control, Pergamon International Library, 1975.

3. Kenneth R. Baker, Introduction to sequencing and scheduling, John Wiley and Sons, 1974.

Note: The paper will have a total of ***NINE questions.*** **Question No. 1,** which is compulsory, shall be OBJECTIVE Type and have contents from the entire syllabus (all Four Units).

All questions will have equal ***weight of 12 marks.*** The student will attempt a total of ***FIVE questions***, each of 12 marks. Q. No. 1 is compulsory. *The student shall attempt remaining* ***four*** *questions by selecting* ***only one question from each unit.***

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MASTER OF TECHNOLOGY IN MECHANICAL ENGINEERING (3rd Sem.)
(INDUSTRIAL & PRODUCTION ENGINEERING)

MTIP-621C	PRODUCTIVITY MANAGEMENT						
Lecture	Tutorial	Practical	Credit	Major Test	Minor Test	Total	Time
4	0	-	4	60	40	100	3 hrs
Purpose	The main objective of the course is to impart the students with the knowledge of productivity management and strategies in manufacturing and service sectors.						
Course Outcomes							
CO1	To know the productivity basics.						
CO2	To study the productivity management and measurements in small, medium and large sized organization.						
CO3	To study different approaches to measure the impact of external environment.						
CO4	To study different implementation strategies related to productivity.						

UNIT I

Introduction: Productivity Basics

Concern and the Significance of Productivity Management, the Rationale of Productivity Measurement, Productivity: Some Perspectives, Productivity Measurement: A Case for Re-appraisal

UNIT II

Productivity Measurement: A Conceptual Framework

Objectives of Productivity Measurement, Management by Objectives (MBO) and Productivity Measurement, Systems Approach to Productivity Measurement, Performance Objectives – Productivity (PO-P): The Concept, PO-P: The Model, PO-P: The Methodology.

Productivity Measurements in Manufacturing Sector

Productivity Measurement in Manufacturing Sector, Productivity Measurement in a Medium Sized Organization, Productivity Measurement in a Large Sized Organization.

UNIT III

PO-P Application: Productivity Measurement in Service Sector

Need for measuring Productivity in Service Sector, Difficulties in measuring productivity, Productivity of an R&D System, Productivity of an Educational Institution.

Productivity Management: The Role of External Environment

External Environment and Organization, Impact of external Environment, External Environment: Its Sub-systems, Approaches to measure Impact of External Environment.

UNIT IV

Productivity Management and Implementation Strategies

Productivity Management System, Productivity Policy, Productivity: Organization& Planning, Productivity Measurement, Productivity Measurement Evaluation, Productivity Improvement Strategies, Productivity Audit and Control

RECOMMENDED BOOKS:

1. Productivity Management by Prem Vrat, G.D.Sardana and B.S.Sahai
2. Production and Operations Management by S.A.Chunawalla and D.R.Patel

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Note: The paper will have a total of ***NINE questions.*** **Question No. 1,** which is compulsory, shall be OBJECTIVE Type and have contents from the entire syllabus (all Four Units).

All questions will have equal ***weight of 12 marks.*** The student will attempt a total of ***FIVE questions***, each of 12 marks. Q. No. 1 is compulsory. *The student shall attempt remaining* ***four*** *questions by selecting* ***only one question from each unit.***

10 (3140)

MASTER OF TECHNOLOGY IN MECHANICAL ENGINEERING (3rd Sem.)
(INDUSTRIAL & PRODUCTION ENGINEERING)

MTIP–623C	SIMULATION OF INDUSTRIAL SYSTEMS						
Lecture	Tutorial	Practical	Credit	Major Test	Minor Test	Total	Time
4	0	-	4	60	40	100	3 hrs
Purpose	The main objective of the course is to impart the students with the knowledge of industrial systems and its simulation.						
Course Outcomes							
CO1	To explain the concept of industrial simulation systems and its models of simulation.						
CO2	To understand the simulation of discrete and queueing systems.						
CO3	To understand the simulation if inventory systems and design of simulation experiments.						
CO4	To simulate the industrial problems like reliability problems, computer time sharing problem and understand the simulation languages.						

UNIT-I

Introduction and overview, concept of system, system environment, elements of system, system modeling, types of models, Monte Carlo method, system simulation, simulation - a management laboratory, advantages & limitations of system simulation, continuous and discrete systems.

Simulation of continuous systems: characteristics of a continuous system, comparison of numerical integration with continuous simulation system. Simulation of an integration formula.

UNIT-II

Simulation of discrete system: Time flow mechanisms, Discrete and continuous probability density functions. Generation of random numbers, testing of random numbers for randomness and for auto correlation, generation of random variates for discrete distribution, generation of random variates for continuous probability distributions-binomial, normal, exponential and beta distributions; combination of discrete event and continuous models.

Simulation of queuing systems: Concept of queuing theory, characteristic of queues, stationary and time dependent queues, queue discipline, time series analysis, measure of system performance,

Kendall's notation, auto covariance and auto correlation function, auto correlation effects in queuing systems, simulation of single server queues, multi-server queues, queues involving complex arrivals and service times with blanking and reneging.

UNIT-III

Simulation of inventory systems: Rudiments of inventory theory, MRP, in-process inventory. Necessity of simulation in inventory problems, forecasting and regression analysis, forecasting through simulation, generation of Poisson and Erlang variates, simulation of complex inventory situations.

Design of Simulation experiments: Length of run, elimination of initial bias, Variance, Variance reduction techniques, stratified sampling, antipathetic sampling, common random numbers, time series analysis, spectral analysis, model validation, optimization procedures, search methods, single variable deterministic case search, single variable non-deterministic

case search, and regenerative technique.

UNIT-IV

Simulation of PERT: Simulation of - maintenance and replacement problems, capacity planning, production systems, reliability problems, computer time sharing problem, the elevator system.

Simulation Languages: Continuous and discrete simulation languages, block structured continuous languages, special purpose simulation languages, SIMSCRIPT, GPSS SIMULA importance and limitations of special purpose languages.

RECOMMENDED BOOKS:

1. Simulation and Modelling Loffick - Tata McGraw Hill
2. System Simulation with Digital Computer, Deo Narsingh- Prentice Hall
3. System Simulation, Hira, D.S. - S. Chand & Co.
4. Computer Simulation and Modelling Meelamkavil- John Willey
5. System Simulation by Gordon - Prentice hall
6. Jerry Banks and John, S. Carson II, 'Discrete – Event System Simulation', Prentice Hall Inc., NewJersey, 1984.
7. Geoffrey Gordon, 'System simulation', Prentice Hall, NJ, 1978.
8. Law, A.M. and W.D. Keltor, 'Simulation modelling analysis', McGraw Hill, 1982.9

Note: The paper will have a total of ***NINE questions.*** **Question No. 1,** which is compulsory, shall be OBJECTIVE Type and have contents from the entire syllabus (all Four Units).

All questions will have equal ***weight of 12 marks.*** The student will attempt a total of ***FIVE questions***, each of 12 marks. Q. No. 1 is compulsory. *The student shall attempt remaining* ***four*** *questions by selecting* ***only one question from each unit.***

Electives-III

(Third Semester)

MASTER OF TECHNOLOGY IN MECHANICAL ENGINEERING (3rd Sem.)
(INDUSTRIAL & PRODUCTION ENGINEERING)

MTIP–625C	SMART MATERIALS						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
4	**0**	**-**	**4**	**60**	**40**	**100**	**3 hrs**
Purpose	The main objective of the course is to impart the students with the knowledge of different smart materials and structures.						
Course Outcomes							
CO1	To know about smart materials and piezoelectric materials.						
CO2	To understand the concept of magneto-strictive materials and the actuators based on HBLS smart materials.						
CO3	To know about low bandwidth-high strain generating materials and the actuators based on LBHS smart materials.						
CO4	To understand the concept of integration of smart sensors and actuators to smart structures.						

UNIT-I

Introduction to Smart Materials

Intelligence, AI Vs. embedded Intelligence, the role of Smart Materials in developing Intelligent Systems and Adaptive Structures.

Introduction to High bandwidth - Low strain generating (HBLS) Smart Materials

Piezoelectric Materials – constitutive relationship, electromechanical coupling coefficients, piezoelectric constants, piezo-ceramic materials, variation of coupling coefficients in hard and soft piezoceramics, polycrystalline vs single crystal piezoelectric materials, polyvinyldene fluoride, piezoelectric composites

UNIT-II

Magnetostrictive Materials–constitutive relationship, magneto-mechanical coupling coefficients, Joule Effect, Villari Effect, Matteuci Effect, Wiedemann effect, Giant magnetostriction in Terfenol-D, Terfenol-D particulate composites, Galfenol and Metglas materials.

Actuators based on HBLS Smart Materials – Current Trends for Actuators and Micromechatronics

UNIT-III

Introduction to Low bandwidth - High strain generating (LBHS) materials

Shape Memory Alloys (SMA) – Phase Transformations, Electro-active Polymers (EAP)

Actuators based on LBHS Smart Materials: Shape Memory Alloy based actuators for Shape Control, Electro-active Polymers for Work-Volume Generation, Sensors based on HBLS Smart Materials, Sensors based on LBHS Smart Materials

UNIT-IV

Integration of Smart Sensors and Actuators to Smart Structures – Finite Element Modelling, Optimal Placement of Sensors and Actuators, Design of Controller for Smart Structure, Case Studies to Advanced Smart Materials: Active Fibre Composites (AFC), Energy Harvesting Actuators and Energy Scavenging Sensors

Self-healing and Autophagous Smart Materials

RECOMMENDED BOOKS:

1. Smart Materials by Mel Schwartz, CRC Press, Taylor & Francis.
2. Smart Material Systems and MEMS by Vijay K. Vardhan, K. J. Vinoy, Wiley India

Note: The paper will have a total of ***NINE questions.*** **Question No. 1,** which is compulsory, shall be OBJECTIVE Type and have contents from the entire syllabus (all Four Units).
All questions will have equal ***weight of 12 marks.*** The student will attempt a total of ***FIVE questions***, each of 12 marks. Q. No. 1 is compulsory. *The student shall attempt remaining* ***four*** *questions by selecting* ***only one question from each unit.***

MASTER OF TECHNOLOGY IN MECHANICAL ENGINEERING (3rd Sem.)
(INDUSTRIAL & PRODUCTION ENGINEERING)

MTIP–627C	MANUFACTURING OPTIMIZATION THROUGH INTELLIGENT TECHNIQUES						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
4	**0**	**-**	**4**	**60**	**40**	**100**	**3 hrs**
Purpose	The main objective of the course is to impart the students with the knowledge of different optimization techniques for solving manufacturing and machining problems.						
Course Outcomes							
CO1	To study different conventional optimization techniques for solving the optimization problems.						
CO2	To study different intelligent optimization techniques for manufacturing optimization problems.						
CO3	To solve the optimization problems related to machining and mechanical elements.						
CO4	To solve the optimization problems related to CNC machine tools.						

UNIT-I

Conventional Optimization Techniques for Manufacturing Applications:

Single Variable Techniques Suitable for Solving Various Manufacturing Optimization Problems (Direct Search Method)

Multivariable Techniques Suitable for Solving Various Manufacturing Optimization Problems (Direct Search Methods)

UNIT-II

Intelligent Optimization Techniques for Manufacturing Optimization Problems

Genetic Algorithm (GA), Simulated Annealing (SA), Ant Colony Optimization (ACO), Particle Swarm Optimization (PSO), Tabu Search (TS)

UNIT-III

Optimal Design of Mechanical Elements

Introduction, Gear Design Optimization, Design Optimization of Single-Point Cutting Tool

Optimization of Machining Tolerance Allocation

Dimensions and Tolerances, Tolerance Allocation of Welded Assembly, Tolerance Design of Over Running Clutch Assembly, Tolerance Design Optimization of Stepped Clone Pulley, Tolerance Design Optimization of Stepped-Block Assembly

UNIT-IV

Optimization of Operating Parameters for CNC Machine Tools

Optimization of Turning Process, Optimization of Multi-Pass Turning Process, Optimization of Face Milling Process, Surface Grinding Process Optimization.

Modern Manufacturing Applications

Implementation of Genetic Algorithm for Grouping of Part Families and Matching Cell, Application of Intelligent Techniques for Adaptive Control Optimization.

RECOMMENDED BOOKS:

1. Manufacturing Optimization through Intelligent Techniques by R. Saravanan, CRC press, Taylor & Francis Group.
2. Process Planning Optimization in Reconfigurable Manufacturing Systems by Farayi Musharavati.

Note: The paper will have a total of ***NINE questions.*** **Question No. 1,** which is compulsory, shall be OBJECTIVE Type and have contents from the entire syllabus (all Four Units).

All questions will have equal ***weight of 12 marks.*** The student will attempt a total of ***FIVE questions***, each of 12 marks. Q. No. 1 is compulsory. *The student shall attempt remaining* ***four questions by selecting only one question from each unit.***

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MASTER OF TECHNOLOGY IN MECHANICAL ENGINEERING (3rd Sem.)
(INDUSTRIAL & PRODUCTION ENGINEERING)

MTIP–629C	QUALITY ENGINEERING AND MANAGEMENT						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
4	**0**	**-**	**4**	**60**	**40**	**100**	**3 hrs**
Purpose	The main objective of the course is to impart the students with the knowledge of quality tools and engineering for the improvement of product quality.						
Course Outcomes							
CO1	To understand the statistical concepts of quality.						
CO2	To study the quality control charts.						
CO3	To understand the concepts of sampling plans for solving the problems.						
CO4	To study the quality systems.						

Unit-I

Introduction: Statistical concepts in quality control, Graphical representation of ground data, Continuous & discrete probability distributions, central limit theorem, Chi-square test, Introduction to quality control, process control and product control, chance and assignable causes of quality variation, advantages of Shewart control charts, process control charts for variables, Fixation of control limits, Type I and Type II errors, Theory of runs, interpretation of out of control points, Probability limits, initiation of control charts, trial control limits, determination of aimed-at value of process setting, rational Method of sub grouping, control chart parameters, control limits and specifications limits, natural tolerance limits, relationship of process in control to upper and lower specifications limits, process capability studies.

Unit-II

Control charts: Special control charts for variables, Group control charts, Arithmetic moving X ad R charts, Geometric Moving charts, X control charts with reject limits, Steady trend in process average with cost dispersion, trend chart with sloping limits, variable subgroup size CUSUM or cumulative sum control chart.

Unit-III

Sampling plans: Probability theory, hyper-geometric, Binomial and Poisson distributions, Acceptance inspection 100% inspection, no Inspection and sampling inspection, Operating characteristic curve, effect of sample size and acceptance number. Type a and Type B O.C curves, single, Double and multiple sampling plans, Sequential sampling plans Acceptance/rejection ad acceptance/rectification plans, procedure's risk ad consumer's risk, difference quality level, Average outgoing quality curve, average outgoing quality limit, quality protection offered by a sampling plan, Average sample number, Design of single, double and sequential plans.

Unit-IV

Quality systems: Economics of product inspection, selection of economic sampling plans, Product quality and reliability, failure data analysis and life testing, elements of total quality control quality assurance, ISO9000 quality system.

RECOMMENDED BOOKS:

1. Statistical Quality Control by Grant & Leaveworth, McGraw Hill
2. Quality Control & Industrial Statistics by Duncan, Irwin Press
3. Quality Control Handbook by Juran, McGraw Hill
4. Quality Control by Hansen, Prentice Hall
5. An Introduction to reliability & control by Thomason, Machinery Publishing

6. Total Quality Control by A.V. Taylor, McGraw-Hill

Note: The paper will have a total of ***NINE questions.*** **Question No. 1,** which is compulsory, shall be OBJECTIVE Type and have contents from the entire syllabus (all Four Units). All questions will have equal ***weight of 12 marks.***

The student will attempt a total of ***FIVE questions***, each of 12 marks. Q. No. 1 is compulsory. *The student shall attempt remaining* ***four*** *questions by selecting* ***only one question from each unit.***

10 (3149)

MASTER OF TECHNOLOGY IN MECHANICAL ENGINEERING (3rd Sem.)
(INDUSTRIAL & PRODUCTION ENGINEERING)

MTIP–631C	ENTERPRISE RESOURCE PLANNING						
Lecture	Tutorial	Practical	Credit	Major Test	Minor Test	Total	Time
4	0	-	4	60	40	100	3 hrs
Purpose	The main objective of the course is to impart the students with the knowledge of integrated applications to manage the business and automate many back office functions related to technology, services and human resources.						
Course Outcomes							
CO1	To study the basic principles and models of an enterprise.						
CO2	To understand the concepts of technology and architecture in ERP.						
CO3	To study ERP system packages.						
CO4	To study the ERP procurement issues.						

UNIT I

ENTERPRISE RESOURCE PLANNING: Principles, ERP framework, Business Blue Print, Business Engineering vs Business process Re-Engineering , Tools , Languages , Value chain, Supply and Demand chain , Extended supply chain management, Dynamic Models , Process Models

UNIT II

TECHNOLOGY AND ARCHITECTURE: Client/Server architecture, Technology choices, Internet direction, Evaluation framework, CRM, CRM pricing, chain safety, Evaluation framework.

UNIT III

ERP SYSTEM PACKAGES: SAP, People soft, Baan and Oracle , Comparison , Integration of different ERP applications, ERP as sales force automation , Integration of ERP and Internet ,ERP Implementation strategies ,Organizational and social issues.

UNIT IV

Overview, Architecture, AIM, applications, Oracle SCM. SAP: Overview, Architecture, applications, before and after Y2K, critical issues, Training on various modules of IBCS ERP Package, Oracle ERP and MAXIMO, including ERP on the NET

ERP PROCUREMENT ISSUES: Market Trends – Outsourcing ERP – Economics – Hidden Cost Issues – ROI – Analysis of cases from five Indian Companies. TOTAL: 45 PERIODS

Recommended Books:

1. Sadagopan.S , ERP-A Managerial Perspective, Tata Mcgraw Hill, 1999.
2. Jose Antonio Fernandez , The SAP R/3 Handbook, Tata Mcgraw Hill, 1998.
3. Vinod Kumar Crag and N.K.Venkitakrishnan ,Enterprise Resource Planning –Concepts and Practice, Prentice Hall of India, 1998.
4. ERPWARE , ERP Implementation Framework, Garg&Venkitakrishnan, Prentice Hall, 1999.
5. Thomas E Vollmann and BeryWhybark , Manufacturing and Control Systems, Galgothia Publications, 1998.

Note: The paper will have a total of ***NINE questions.*** **Question No. 1,** which is compulsory, shall be OBJECTIVE Type and have contents from the entire syllabus (all Four Units).

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All questions will have equal ***weight of 12 marks.*** The student will attempt a total of ***FIVE questions***, each of 12 marks. Q. No. 1 is compulsory. *The student shall attempt remaining* ***four*** *questions by selecting* ***only one question from each unit.***

10 (3151)

MASTER OF TECHNOLOGY IN MECHANICAL ENGINEERING (3rd Sem.)
(INDUSTRIAL & PRODUCTION ENGINEERING)

MTIP–633C	INTELLECTUAL PROPERTY RIGHTS AND PATENT LAWS						
Lecture	Tutorial	Practical	Credit	Major Test	Minor Test	Total	Time
4	0	-	4	60	40	100	3 hrs
Purpose	The main objective of the course is to impart the students with the knowledge of property rights and patent laws related to industry and others.						
Course Outcomes							
CO1	To understand the basic intellectual property fundamentals.						
CO2	To introduce about the purpose, rights, procedure, prosecution and transfer of patents rights.						
CO3	To know about the industrial design, intellectual property management and its requirements.						
CO4	To understand about the copyright and trademark policies, procedures for registration and its infrigments.						

UNIT I

INTELLECTUAL PROPERTY (IP) FUNDAMENTALS: Introduction, Legal concept of Property, Kinds of properties, Movable Property, Immovable Property.

IP and Classification of IP, Industrial Designs, Copy Right, Trade Mark, Importance of IP and Terms of protection.

UNIT II

PATENTS: Purpose of a Patent, Recognized conditions for Patentability, Originality of Inventions, Novelty, Non-obviousness, Utility.

Exclusive rights conferred by a Patent, National Protection, International Protection. , Patent Filing Procedure and Prosecution, Infringement of Patents, Acquisition and Transfer of Patent Rights.

UNIT III

INDUSTRIAL DESIGNS: Subject matter of Industrial Designs, Requirements for obtaining protection for industrial Design, Differences between Patent protection and Industrial design Protection, benefits of Industrial Design protection, National and International Procedure for filing, Rights granted to Design holders.

INTELLECTUAL PROPERTY MANAGEMENT: Introduction to Intellectual Property Management (IPM), Need for IP management, Interrelationships between legal advocacy and IPM, Role of Legal Practitioners, Role of Managers, IP Commercialization, IP Audit and its Importance.

UNIT IV

COPY RIGHT AND TRADEMARKS: Copyright subsists, Meaning of word 'Original', Fair dealing, Rights of Owners of Copy Rights, Procedures, Authorities and Institutions under the Copy Right Act, Infringement and remedies.

Trademarks (TM), Different types of Trademarks ,Service Mark , Classification Mark , Collective Mark, Importance of TM, Difference between registered TM and TM in use, Basic requirements for the registration of TM, Procedure for registration , Rights of registered TM owners , Infringement and remedies

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Recommended Books:

1. G.B.Reddy, "Intellectual Property Rights and the Law",Gogia Law Agency, 7th Edition - Reprint, 2009.
2. N.R.Subbaram, "Demystifying Intellectual Property Rights",Lexis Nexis Butterworths Wadhwa, First Edition, 2009
3. N.R. Subbaram, "Patent law – Practices and Procedures", Wadhwa, Second Edition, 2007
4. N.S. Gopalakrishnan & T.G. Agitha, „Principles of Intellectual Property", Eastern Book Company, First Edition, 2009

Note: The paper will have a total of ***NINE questions.*** **Question No. 1,** which is compulsory, shall be OBJECTIVE Type and have contents from the entire syllabus (all Four Units).

All questions will have equal ***weight of 12 marks.*** The student will attempt a total of ***FIVE questions***, each of 12 marks. Q. No. 1 is compulsory. *The student shall attempt remaining* ***four*** *questions by selecting* ***only one question from each unit.***

10 (3153)

Fourth Semester

10 (3154)

MASTER OF TECHNOLOGY IN MECHANICAL ENGINEERING (4th Sem.)
(INDUSTRIAL AND PRODUCTION ENGINEERING)

MTIP-622C	DISSERTATION						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
-	-	-	18	200	100	300	-
Purpose	The main objective of the course is to make student do some good research in the field of their interests related to industrial and production engg. or interrelated fields of applications.						
Course Outcomes							
CO1	To make student understand about the extent of past research in a particular area of interest chosen for research.						
CO2	To make student find research gap after past literature review and formulate a problem for research.						
CO3	To impart knowledge to students about different research methodologies, experimental techniques while performing the research in their particular research problem.						
CO4	To make student understand how to articulate their research work in the form of a chapter wise organized research dissertation.						

The students are required to undertake Analytical/Experimental/computational investigations in the field of Industrial and Production Engg. or related fields which have been finalized in the third semester. They would be working under the supervision of a faculty member.

The students will be required to submit a progress report duly signed by their respective supervisors to the department, related to their dissertation work in the last week of February and April. The progress report will cover the following:

- The goal set for the month.
- Research papers studied.
- Methodology used in achieving the goal.
- The extent of fulfillment of the goal.
- References

The progress report must be at least of 3-4 pages and the cover page should include the tentative topic, name of the candidate, name of the supervisor, period of progress report, signature of candidate and supervisor.

The final dissertation will be submitted in the end of semester which will be evaluated by internal as well as external examiners based upon his/her research work. At least two publications are expected before final submission of the dissertation from every student in peer reviewed referred journals from the work done by them in their dissertation.

Every dissertation will be evaluated by the joint PG evaluation Committee of the respective college, guide, an expert from the university campus and another external expert from outside the University.

Each year the College running the course will send the list of eligible students along with the topic name to the Chairman, Board of studies in Mechanical Engg. for nominating external examiner and examiner from university campus.

The list should be sent at least before 20th Dec. each year so that the evaluation of the thesis could be done in time. Any delay caused due to late submission of the student list along with the topics name will be the responsibility of the respective Director of the Institute.

In the absence of any examiner, the Director of the institute can nominate the alternative names on his own from the university campus and outside the university.