MANAV RACHNA UNIVERSITY

FACULTY OF ENGINEERING

DEPARTMENT OF MECHANICAL ENGINEERING

PROGRAM STRUCTURE

&

DETAILED SYLLABUS

M.Tech. Mechanical Engineering

BATCH: 2020-2022

PROGRAM STRUCTURE

SEMESTER - 1							
SUBJECT CODES	**SUBJECT NAME**	**L**	**T**	**P**	**O**	**NO. OF CONTACT HOURS PER WEEK**	**NO. OF CREDITS**
MEH501B-T/P	MODERN MANUFACTURING PROCESSES	3	0	2	0	5	4
MEH502B-T/P	PRODUCTION SYSTEM & MANAGEMENT	3	0	2	0	5	4
MEH503B-T/P	METAL FORMING ANALYSIS	3	0	2	0	5	4
MEH504/ MEH505B-T/P	ADVANCED METROLOGY/WORK MEASUREMENT TECHNIQUES	3	0	2	0	5	4
MES506B	RESEARCH METHODOLOGY	1	0	2	0	3	2
	TOTAL (L-T-P/CONTACT HOURS/CREDITS)	**13**	**0**	**10**	**0**	**23**	**18**
SEMESTER-2							
SUBJECT CODES	**SUBJECT NAME**	**L**	**T**	**P**	**O**	**NO. OF CONTACT HOURS PER WEEK**	**NO. OF CREDITS**
MEH507B-T/P	PRODUCTION ERGONOMICS & WORK PLACE DESIGN	3	0	2	0	5	4
MEH508B-T/P	ADVANCED WELDING TECHNIQUES	3	0	2	0	5	4
MEH509B/ MEH510B-T/P	CIM/INDUSTRIAL AUTOMATION	3	0	2	0	5	4
MEH511B/ MEH512B-T/P	RAPID PROTOTYPING/ADVANCED FOUNDRY TECHNOLOGY	3	0	2	0	5	4
MES513B	TECHNICAL RESEARCH PAPER WRITING	1	0	2	0	3	2
MES515B	PEDAGOGICAL SKILLS	2	0	0	0	0	0

	TOTAL (L-T-P/CONTACT HOURS/CREDITS)	**15**	**0**	**10**	**0**	**23**	**18**
MEN516B	SUMMER TRAINING POST 2nd SEMESTER						3
SEMESTER-3							
SUBJECT CODES	**SUBJECT NAME**	**L**	**T**	**P**	**O**	**NO. OF CONTACT HOURS PER WEEK**	**NO. OF CREDITS**
MEH601B-T/P	THEORY OF METAL CUTTING	3	0	2	0	5	4
MES602B	ADVANCED OPTIMISATION TECHNIQUES	1	0	2	0	3	2
MEH603B/ MEH604B-T/P	GLOBAL LOGISTICS SYSTEMS/ ADVANCED MATERIAL SCIENCE	3	0	2	0	5	4
MEH605B-T/P/MEH606B-T/P	CAD/CAM IN ENGG. PROCESS/MACHINE TOOL DESIGN	3	0	2	0	5	4
MES607B	SEMINAR	0	0	0	2	2	2
MEN608B	DISSERTATION PREPARATION / PROJECT REPORT	0	0	0	3	3	3
	TOTAL (L-T-P/CONTACT HOURS/CREDITS)	**10**	**0**	**8**	**5**	**23**	**19**
SEMESTER-4							
SUBJECT CODES	**SUBJECT NAME**	**L**	**T**	**P**	**O**	**NO. OF CONTACT HOURS PER WEEK**	**NO. OF CREDITS**
MEH609B/ MEH610B	LEAN MANUFACTURING/ STATISTICAL QUALITY CONTROL	3	0	0	0	3	3
MEN611B	DISSERTATION WORK	0	0	0	12	12	12
	TOTAL (L-T-P/CONTACT HOURS/CREDITS)	**3**	**0**	**0**	**12**	**15**	**15**

PROGRAMME BOOKLET

M.Tech. Mechanical Engineering (MEP01B)

(Batch: 2020-2022)
(Syllabus: Scheme B)

Department of Mechanical Engineering
Faculty of Engineering
Manav Rachna University

MANAV RACHNA UNIVERSITY

Vision

To educate students in frontier areas of knowledge enabling them to take up challenges as ethical and responsible global citizens

Mission

- **To impart outcome based holistic education**
- **To disseminate education in frontier areas**
- **To produce globally competitive, ethical and socially responsible human resources**
- **To produce human resources sensitive to issues of Environment and Sustainable Development**
- **To develop Environment and Sustainable development as a thrust area of research and development.**

Quality Policy

To continuously learn from the best practices, study role models and develop transparent procedures for empowerment of stakeholders.

Strategic Objectives

- **To facilitate, enhance & promote innovation in curriculum design and delivery and have Outcome-oriented Learning Culture.**
- **To promote Research Environment and Management Practices.**
- **To enhance the quality of the student learning experience.**
- **To provide Resources and Infrastructure for Academic Excellence.**

DEPARTMENT OF MECHANICAL ENGINEERING

Vision: To become centre of excellence by providing state-of-art education in teaching, research, innovation, entrepreneurship, environmental sustainability and develop an ethical human beings for service of the society.

Mission:

- To develop globally competent engineers, who address future issues of the society innovatively.
- Operating and maintaining various smart manufacturing aides optimally by providing state-of-art facilities and conduct research in latest technologies.
- To nurture talents who strive to serve society through sustainable methods while maintaining the highest professional and ethical standards.
- Maintaining highest quality standards and ensure satisfaction of all stakeholders.
- To work for continuous improvement in collaboration with Industry.

M.Tech. Mechanical Engineering

Programme Outcomes (PO's)

PO1: An ability to independently carry out research /investigation and development work to solve practical problems related to Manufacturing and Production Engineering

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

PO3: Students should be able to demonstrate a degree of mastery over the area of Manufacturing and Production Engineering. The mastery should be at a level higher than the requirements in the appropriate bachelor program

PO4: The ability to apply knowledge, techniques, skills and modern tools of manufacturing technology listed below to the solution of manufacturing: and Automation

1. Materials 2. Manufacturing Processes 3. Quality 4. Automation

PO5: The ability to apply creativity in designing manufacturing systems, components and processes

PO6: Meaningful industrial exposure in the area of manufacturing technology

Program Educational Objectives (PEOs)

PEO1: Acquire in depth knowledge in optimisation techniques for various manufacturing process.

PEO2: Achieve expertise in industrial automation design and development.

PEO3: Attain expertise in cutting edge and conventional manufacturing technologies.

Program Specific Outcomes (PSOs)

PSO1: Acquire knowledge in optimisation techniques in manufacturing process.

PSO2: Achieve design and development skills in the area of production engineering.

PSO3: Attain knowledge in modern manufacturing technologies.

SEMESTER - 1										
SUBJECT CODES	**SUBJECT NAME**	**OFFERING DEPARTMENT**	**COURSE NATURE (HARD/SOFT/ WORKSHOP/NTCC**	**COURSE TYPE (CORE/ELECTIVE/ UNIVERSITY COMPULSORY**	**L**	**T**	**P**	**O**	**NO. OF CONTACT HOURS PER WEEK**	**NO. OF CREDITS**
MEH501B-T	MODERN MANUFACTURING PROCESSES	ME	HARD	CORE	3	0	0	0	3	3
MEH501B-P	MODERN MANUFACTURING PROCESSES LAB	ME	HARD	CORE	0	0	2	0	2	1
MEH502B-T	PRODUCTION SYSTEM & MANAGEMENT	ME	HARD	CORE	3	0	0	0	3	3
MEH502B-P	PRODUCTION SYSTEM & MANAGEMENT LAB	ME	HARD	CORE	0	0	2	0	2	1
MEH503B-T	METAL FORMING ANALYSIS	ME	HARD	CORE	3	0	0	0	3	3
MEH503B-P	METAL FORMING ANALYSIS LAB	ME	HARD	CORE	0	0	2	0	2	1
MEH504/ MEH505B-T	ADVANCED METROLOGY/WORK MEASUREMENT TECHNIQUES	ME	HARD	CORE	3	0	0	0	3	3
MEH504/ MEH505B-P	ADVANCED METROLOGY/WORK MEASUREMENT TECHNIQUES LAB	ME	HARD	CORE	0	0	2	0	2	1
MES506B	RESEARCH METHODOLOGY	ME	SOFT	CORE	1	0	2	0	3	2
TOTAL (L-T-P/CONTACT HOURS/CREDITS)					**13**	**0**	**10**	**0**	**23**	**18**

SEMESTER-2										
SUBJECT CODES	**SUBJECT NAME**	**OFFERING DEPARTMENT**	**COURSE NATURE (HARD/SOFT/ WORKSHOP/NTCC**	**COURSE TYPE (CORE/ELECTIVE/ UNIVERSITY COMPULSORY**	**L**	**T**	**P**	**O**	**NO. OF CONTACT HOURS PER WEEK**	**NO. OF CREDITS**
MEH507B-T	PRODUCTION ERGONOMICS & WORK PLACE DESIGN	ME	HARD	CORE	3	0	0	0	3	3
MEH507B-P	PRODUCTION ERGONOMICS & WORK PLACE DESIGN LAB	ME	HARD	CORE	0	0	2	0	2	1
MEH508B-T	ADVANCED WELDING TECHNIQUES	ME	HARD	CORE	3	0	0	0	3	3
MEH508B-P	ADVANCED WELDING TECHNIQUES LAB	ME	HARD	CORE	0	0	2	0	2	1
MEH509B/ MEH510B-T	CIM/INDUSTRIAL AUTOMATION	ME	HARD	ELECTIVE	3	0	0	0	3	3
MEH509B/ MEH510B-P	CIM LAB/INDUSTRIAL AUTOMATION LAB	ME	HARD	ELECTIVE	0	0	2	0	2	1
MEH511B/ MEH512B-T	RAPID PROTOTYPING/ADVANCED FOUNDRY TECHNOLOGY	ME	HARD	ELECTIVE	3	0	0	0	3	3
MEH511B/ MEH512B-P	RAPID PROTOTYPING LAB/ADVANCED FOUNDRY TECHNOLOGY LAB	ME	HARD	ELECTIVE	0	0	2	0	2	1
MES513B	TECHNICAL RESEARCH PAPER WRITING	ME	SOFT	CORE	1	0	2	0	3	2
MES515B	PEDAGOGICAL SKILLS	ME	SOFT	CORE	2	0	0	0	0	0
TOTAL (L-T-P/CONTACT HOURS/CREDITS)					**15**	**0**	**10**	**0**	**23**	**18**
MEN516B	SUMMER TRAINING POST 2nd SEMESTER									3

SEMESTER-3										
SUBJECT CODES	**SUBJECT NAME**	**OFFERING DEPARTMENT**	**COURSE NATURE (HARD/SOFT/ WORKSHOP/NTCC**	**COURSE TYPE (CORE/ELECTIVE/ UNIVERSITY COMPULSORY**	**L**	**T**	**P**	**O**	**NO. OF CONTACT HOURS PER WEEK**	**NO. OF CREDITS**
MEH601B-T	THEORY OF METAL CUTTING	ME	HARD	CORE	3	0	0	0	3	3
MEH601B-P	THEORY OF METAL CUTTING LAB	ME	HARD	CORE	0	0	2	0	2	1
MES602B	ADVANCED OPTIMISATION TECHNIQUES	ME	SOFT	CORE	1	0	2	0	3	2
MEH603B/ MEH604B-T	GLOBAL LOGISTICS SYSTEMS/ ADVANCED MATERIAL SCIENCE	ME	HARD	ELECTIVE	3	0	0	0	3	3
MEH603B/ MEH604B-P	GLOBAL LOGISTICS SYSTEMS LAB/ ADVANCED MATERIAL SCIENCE LAB	ME	HARD	ELECTIVE	0	0	2	0	2	1
MEH605B-T/P/MEH606B-T	CAD/CAM IN ENGG. PROCESS/MACHINE TOOL DESIGN	ME	HARD	ELECTIVE	3	0	0	0	3	3
MEH605B-T/P/MEH606B-P	CAD/CAM IN ENGG. PROCESS LAB/MACHINE TOOL DESIGN LAB	ME	HARD	ELECTIVE	0	0	2	0	2	1
MES607B	SEMINAR	ME	HARD	SOFT	0	0	2	0	2	2
MEN608B	DISSERTATION PREPARATION / PROJECT REPORT	ME	HARD	NTCC	0	0	6	0	6	3
TOTAL (L-T-P/CONTACT HOURS/CREDITS)					**10**	**0**	**16**	**0**	**23**	**19**

SEMESTER-4										
SUBJECT CODES	**SUBJECT NAME**	**OFFERING DEPARTMENT**	**COURSE NATURE (HARD/SOFT/ WORKSHOP/NTCC**	**COURSE TYPE (CORE/ELECTIVE/ UNIVERSITY COMPULSORY**	**L**	**T**	**P**	**O**	**NO. OF CONTACT HOURS PER WEEK**	**NO. OF CREDITS**
MEH609B/ MEH610B	LEAN MANUFACTURING/ STATISTICAL QUALITY CONTROL	ME	HARD	CORE	3	0	0	0	3	3
MEN611B	DISSERTATION WORK	ME	HARD	NTCC	0	0	24	0	24	12
TOTAL (L-T-P/CONTACT HOURS/CREDITS)					**3**	**0**	**24**	**0**	**27**	**15**

Total Credits Scheme

S. No.	Semester	Contact Hours	Credits
1	I	23	18
2	II	23	18
3	Summer Training (Post II Sem) 60 to 90 hrs		3
4	III	21	19
5	IV	15	15
Total		83	73

M.Tech Mechanical Engineering- MEP01B

SEMESTER - 1										
SUBJECT CODES	**SUBJECT NAME**	**OFFERING DEPARTMENT**	**COURSE NATURE (HARD/SOFT/ WORKSHOP/NTCC**	**COURSE TYPE (CORE/ELECTIVE/ UNIVERSITY COMPULSORY**	**L**	**T**	**P**	**O**	**NO. OF CONTACT HOURS PER WEEK**	**NO. OF CREDITS**
MEH501B-T	MODERN MANUFACTURING PROCESSES	ME	HARD	CORE	3	0	0	0	3	3
MEH501B-P	MODERN MANUFACTURING PROCESSES LAB	ME	HARD	CORE	0	0	2	0	2	1
MEH502B-T	PRODUCTION SYSTEM & MANAGEMENT	ME	HARD	CORE	3	0	0	0	3	3
MEH502B-P	PRODUCTION SYSTEM & MANAGEMENT LAB	ME	HARD	CORE	0	0	2	0	2	1
MEH503B-T	METAL FORMING ANALYSIS	ME	HARD	CORE	3	0	0	0	3	3
MEH503B-P	METAL FORMING ANALYSIS LAB	ME	HARD	CORE	0	0	2	0	2	1
MEH504/ MEH505B-T	ADVANCED METROLOGY/WORK MEASUREMENT TECHNIQUES	ME	HARD	CORE	3	0	0	0	3	3
MEH504/ MEH505B-P	ADVANCED METROLOGY/WORK MEASUREMENT TECHNIQUES LAB	ME	HARD	CORE	0	0	2	0	2	1
MES506B	RESEARCH METHODOLOGY	ME	SOFT	CORE	1	0	2	0	3	2
TOTAL (L-T-P/CONTACT HOURS/CREDITS)					**13**	**0**	**10**	**0**	**23**	**18**

Course Title/Code	MODERN MANUFACTURING PROCESSES/MEH501B-T
Course Type	Core
Course Nature	Hard
L-T-P structure	3-0-0
Credit	3

Course Outcome	Mapping
CO1: To Understand about various unconventional machining processes, their various process parameters and influence on performance and their applications.	Employability
CO2: Apply the concept of Modern Casting Processes and its important Potential Applications, Factors affecting Process & Process Parameters.	Employability
CO3: To understand the various types of Modern Welding Processes and its application.	Employability
CO4: Implementation of Modern Metal Forming Processes in industry.	Employability

SECTION A

Introduction: Advanced manufacturing processes, need of advanced manufacturing processes. Modern Machining Processes: Introduction, Principle, Process, Material removal mechanism, Parametric analysis and applications of processes such as ultrasonic machining (USM), Abrasive jet machining (AJM), Water jet machining (WJM), Abrasive water jet machining (AWJM), Electrochemical machining (ECM), Electro discharge machining (EDM), Electron beam machining (EBM), Laser beam machining (LBM), Wire-cut Machining, Plasma Jet Machining.

SECTION-B

Modern Casting Processes: Introduction, Classification, Principle, Design Guidelines, Equipment & Process Set-up, Process Parameters and its analysis, Advantages & Disadvantages, Potential Applications, Factors affecting Process & Process Parameters of Metal mould casting, Continuous casting, Squeeze casting, Vacuum mould casting, Evaporative pattern casting, Ceramic shell casting.

SECTION-C

Modern Welding Processes: Introduction, Classification, Principle, Design Guidelines, Equipment & Process Set-up, Process Parameters and its analysis, Advantages & Disadvantages, Potential Applications, Factors affecting Process & Process Parameters of electron beam welding (EBW), laser beam welding (LBW), ultrasonic welding (USW).

SECTION-D

Modern Metal Forming Processes: Details of high energy rate forming (HERF) process, Introduction, Classification, Principle, Design Guidelines, Equipment & Process Set-up, Process Parameters and its analysis, Advantages & Disadvantages, Potential Applications, Factors affecting Process & Process Parameters of Electro-magnetic forming, Explosive forming, Electro-hydraulic forming, Stretch forming and Contour Roll forming.

Environmental Impact Assessment and ISO 14000: Role of EIA in modern manufacturing, Procedure for EIA, Case studies.

TEXT BOOKS & REFERENCES:

1. Materials and Processes in Manufacturing (8th Edition), E.P. DeGarmo, J. T Black, R.A. Kohser, Prentice Hall of India, New Delhi (ISBN 0-02-978760).
2. Manufacturing Science A. Ghosh, and A.K. Mallik, Affiliated East-West Press Pvt. Ltd. New Delhi.
3. V.K.Jain – Advanced Machining Processes , Allied Publishers Pvt. Limited, India.
4. Mikell P.Groover – Fundamental of Modern Manufacturing: Materials, Processes and System, Willey.

Mapping of Course Outcomes and Program Outcomes

Course Outcomes	Program Outcomes						Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
CO1	3	-	2	-	-	-	-	-	2
CO2	3	2	2	2	-	-	-	-	2
CO3	3	2	2	2	-	-	-	-	3
CO4	3	1	2	2	-	-	-	-	3

Course Title/Code	MODERN MANUFACTURING PROCESSES LAB/MEH501B-P
Course Type	Core
Course Nature	Hard
L-T-P structure	0-0-2
Credit	1

Course Outcome	Mapping
CO1: To demonstrate working principles of different unconventional machining processes and their needs.	Employability
CO2: to identify tools required for different machining requirement with the knowledge of modern machining.	Employability
CO3: to select the appropriate modern manufacturing process and provide solution with economical consideration.	Employability
CO4: to select the appropriate manufacturing parameter and provide solutions with consideration of environmental issue.	Employability

LIST OF EXPERIMENTS:

1. Assessment of Micro-structural (Surface finish, grain boundaries, hardness, impact strength) changes due to different machining processes while preparing a job.
2. To compare welding parameters (current, voltage, electrode diameter, welding speed) for at least two materials through MIG Welding.
3. To compare MRR for at least two materials on
   a. Electro-discharge Machining
   b. Wire-EDM
4. Optimal analysis of process parameters to achieve desired surface finish by machining a job on EDM.

TEXT BOOKS & REFERENCES:

1. Materials and Processes in Manufacturing (8th Edition), E.P. DeGarmo, J. T Black, R.A. Kohser, Prentice Hall of India, New Delhi (ISBN 0-02-978760).
2. Manufacturing Science A. Ghosh, and A.K. Mallik, Affiliated East-West Press Pvt. Ltd. New Delhi.
3. V.K.Jain – Advanced Machining Processes , Allied Publishers Pvt. Limited, India.
4. Mikell P.Groover – Fundamental of Modern Manufacturing: Materials, Processes and System, Willey.

Mapping of Course Outcomes and Program Outcomes

Course Outcomes	Program Outcomes						Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
CO1	3	-	2	-	-	-	-	-	
CO2	3	2	2	2	-	-	-	-	
CO3	3	2	2	2	-	-	-	-	
CO4	3	1	2	2	-	-	-	-	

Course Title/ Code	PRODUCTION SYSTEM & MANAGEMENT/ MEH502B-T
Course Type:	Core
Course Nature:	Hard
L-T-P Structure	(3-0-0)
Credit	3

Course Outcome	Mapping
CO1: Competence with a set of tools and methods for product design and development.	Skill Development
CO2: Confidence in your own abilities to create a new product	Startup/Skill Development
CO3: Awareness of the role of multiple functions in creating a new product (e.g. marketing, finance, industrial design, engineering, production).	Skill development
CO4: Ability to coordinate multiple, interdisciplinary tasks in order to achieve a common objective enhanced team working skills	Startup/Employability

SECTION A

Systems Theory and concepts: Introduction to Systems, functional elements of a system, General System Theory and organization, systems concept and management. Systems approach, planning and Control, Disseminating Information in systems.

Production systems: Introduction to production system, generalized model and types of production systems, features compiling service organizations, life cycle approach to production management. Introduction to Flow system, Automation in Production System

SECTION B

Quantitative techniques of system analysis: Systems analysis, problem solving, scientific method, mathematical analysis, models, computer techniques for analysis. Linear programming input output analysis, queuing Monte-Carlo techniques, and Industrial dynamics.

Behavioral Aspects of System Design: The motivation factors in System design, leadership factors in system design. The need for systematic human relationships, the need for systems change, resistance to change, behavioral consequences of system changes, Microanalysis of complex, man-machine open systems, concept as a basis of human integration, meeting the human and social problems. Impact of advancing Technology, large scale integrating system

SECTION C

Production management concepts and philosophies, Deployment of strategy, Introduction to Lean production, Lean thinking and Toyota Production System, Supply Chain Management and extended enterprise, Sourcing decisions, Program Management Product cost calculation and allocation models, Investment calculation and decision process, Profitability analysis based on production improvements, Production support management, Management Cybernetics.

SECTION D

Productivity and standardized work, Allowances and Work sampling, Productivity Potential Assessment (PPA), Production improvement methods in an organization. Management of projects for improvement,

change management, Practical production management, Union relations and negotiations and incentive systems, Manufacturing Execution Systems.

TEXT BOOKS & REFERENCES:

1. Automatic Production system and computer integrated manufacturing by Groover; Prentice Hall.
2. Automation, Production Systems and CIM, Groover M.P.
3. Management of systems by Nauhria, R.N. & Parkash, Rajnish.
4. Modern Production Management by Elwood, S. BuffaWiley, Eastern (1984).
5. Production/ Operations Management by Rishards I. Koin TMH (1979).

Mapping of Course Outcomes and Program Outcomes

Course Outcomes	PO's						Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
CO1	0	3	-	2	1	-	-	-	3
CO2	-	1	-	3	1	-	-	-	3
CO3	0	-	1	2	-	-	-	-	3
CO4	-	1	2	1	2	-	-	-	3

Course Title/ Code	PRODUCTION SYSTEM & MANAGEMENT LAB/ MEH502B-P
Course Type:	Core
Course Nature:	Hard
L-T-P Structure	(0-0-2)
Credit	1

Course Outcome	Mapping
CO1: Identify the elements of operations management and various transformation processes to enhance productivity and competitiveness.	Skill Development
CO2: Develop aggregate capacity plans and MPS in operation environments	Startup/Skill Development
CO3: Plan and implement suitable materials handling principles and practices in the operations.	Skill development

LIST OF EXPERIMENTS:

1. Industry visit of student with focus on variety of manufacturing systems and report submission on same.
2. To study and map information, men and material flow in a manufacturing unit.
3. To do line planning for a given real life situation in class room.
4. To prepare time and action plan for given order execution.
5. To execute a case study on production management in a production company and submit the report.

TEXT BOOKS & REFERENCES:

1. Automatic Production system and computer integrated manufacturing by Groover; Prentice Hall.
2. Automation, Production Systems and CIM, Groover M.P.
3. Management of systems by Nauhria, R.N. & Parkash, Rajnish.
4. Modern Production Management by Elwood, S. BuffaWiley, Eastern (1984).
5. Production/ Operations Management by Rishards I. Koin TMH (1979).

Mapping of Course Outcomes and Program Outcomes

Course Outcomes	Program Outcomes						Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
CO1	0	-	-	2	2	-	-	-	
CO2	2	-	0	2	1	-	-	-	
CO3	-	0	2	3	1	-	-	-	

Course Title/ Code	METAL FORMING ANALYSIS/ MEH503B-T
Course Type:	Core
Course Nature:	Hard
L-T-P Structure	(3-0-0)
Credit	3

Course Outcome	Mapping
CO1 Determine major process/processes of manufacturing used for given application.	Skill Development/ Employability
CO2 Analyze effect of parameters influencing metal forming and compare hot working and cold working with applications.	Skill Development/ Employability
CO3 Outline tooling and equipments required for important metal forming processes.	Skill Development/ Employability

SECTION A

Introduction to hot forming, cold forming, warm forming its advantages and disadvantages Typical stress strain diagram for ductile materials Forming properties of metals and alloys (yield strength/flow stress,ductility, strain hardening, strain rate sensitivity, effect of temperature and hydrostatic pressure on yield strength) Classification of forming processes and advantages of metal forming

Stress of stress at a point, stresses on an inclined plane, Principal stress, Two dimensional Mohr's circle for stress analysis, Deformation and strain, Stress of strain at a point.Yield conditions, Von Mises' hypothesis of yielding, Tresca's hypothesis of yielding, graphical representation of yield criteria, Elastic stress strain relations for isotropic elastic materials, Idealized stress strain relations in plastic deformations, Isotropic and kinematic work hardening

SECTION B

Introduction to; (i). Theory of slip lines, (ii). upper bound theorem and (iii). lower bound theorem FORGING processes: Introduction, classification of forging, forging machines, metal flow in forging, Analysis of plane strain compression, analysis of compression of circular disc with Slab Method

SECTION C

EXTRUSION Processes: Introduction, calculation of extrusion load using slab method, slip line method & upper bound method. Defects in extrusion. Direct & indirect extrusion. WIRE DRAWING Processes: Introduction, defects, maximum possible reduction. Wire drawing load calculation using slab method.

6 ROLLING Processes: Classification, types of mill, Analysis of longitudinal strip or sheet rolling process (calculation of roll separating force, torque & power, angle of bite, maximum reduction in rolling), rolling defects, roll flattening, roll camber

SECTION D

SHEET METAL FORMING Processes: various sheet metal operations, Blanking and punching operations, compound and progressive dies, nesting, clearance, forces in blanking, Bending of plates, bendability, spring back, bending force, bending moment for real material, stress and strain in bending, stress in deep drawing, drawability. drawing load, Anisotropy in sheetmetal

Introduction to forming limit diagram, Friction and lubrication in forming processes

TEXT BOOKS & REFERENCES:

1. Mechanical Metallurgy- Dieter, McGraw Hill Inc.
2. Metal Forming Handbook by H Frontzek, M Kasparbauer, Springer Verleg.
3. G. W. Rowe, Principles of Industrial Metal working processes, CBS publishers and Distributors, New Edition
4. Metal Forming Analysis- R. H. Wagoner, Cambridge University Press.
5. Row, Principles Industrial metal working processes , Prentice Hall of India

Mapping of Course Outcomes and Program Outcomes

Course Outcomes	PO's						Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
CO1					1			1	
CO2	1				2			2	
CO3	2				2			2	

Course Title/ Code	METAL FORMING ANALYSIS LAB/ MEH503B-P
Course Type:	Core
Course Nature:	Hard
L-T-P Structure	(0-0-2)
Credit	1

Course Outcome	Mapping
CO1 Explain when and why metal forming is chosen compared to other compatible methods	Skill Development/ Employability
CO2 Explain capabilities and applications of bulk metal forming processes and sheet metal work	Skill Development/ Employability
CO3 Examine effects of friction & lubrication and causes of common defects in metal forming.	Skill Development/ Employability

LIST OF EXPERIMENTS:

1. Die design for a simple forged component including calculations and drawing.
2. Designing a "drawing die" for making of a symmetrical cup shaped part.
3. Numerical exercise on Roll Pass Design including calculations and schematic drawing.
4. Designing layout for multi-pass wire drawing.
5. Analysis of flat rolling for an aluminum sheet.
6. To study the effects of material properties (ductility, types, strength) on the bend radius, spring-back and bending force.

TEXT BOOKS & REFERENCES:

1. Mechanical Metallurgy- Dieter, McGraw Hill Inc.
2. Metal Forming Handbook by H Frontzek, M Kasparbauer, Springer Verleg.
3. G. W. Rowe, Principles of Industrial Metal working processes, CBS publishers and Distributors, New Edition
4. Metal Forming Analysis- R. H. Wagoner, Cambridge University Press.
5. Row, Principles Industrial metal working processes , Prentice Hall of India

Mapping of Course Outcomes and Program Outcomes

Course Outcomes	Program Outcomes						Program Specific Outcomes		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PSO1**	**PSO2**	**PSO3**
CO1					1			1	
CO2	1				2			2	
CO3	2				2			2	

Course Title/ Code	ADVANCED METROLOGY/ MEH504B-T
Course Type:	Elective
Course Nature:	Hard
L-T-P Structure	(3-0-0)
Credit	3

Course Outcome	Mapping
CO1: demonstrate different measurement techniques	Employability/Skill Development
CO2: Use of different measuring methods in Industrial environment.	Employability/Skill Development
CO3: Understand the application of sensors & transducers	Employability/Skill Development
CO4: Student will know the advance measuring systems	Employability/Skill Development

SECTION A

Computer Aided Inspection: High precision measurements – interfacing – software metrology – Automated visual inspection in manufacturing, contact and non – contact type inspection methods, Electrical field techniques, radiation techniques, ultrasonic – Atomic Force Microscopes (AFM), Talysurf instruments. Laser Metrology: Laser Interferometer, Alignment Telescope, laser scanners. On-line and in – process measurements – diameter, surface roughness, Micro holes, surface topography measurements, straightness and flatness measurement, speckle measurements.

SECTION B

Coordinate Measuring Machine: CMM Types, Applications – Non-contact CMM using Electro optical sensors for dimensional metrology – Non-contact sensors for surface finish measurements – Measurements / programming with CNC CMM – Performance evaluations – Measurement integration. Machine Vision: Image Acquisition and Processing – Binary and gray level images, image segmentation and labelling, representation and interpretation of colours.

SECTION C

Edge detection techniques, Normalization, Grey scale correlation – Reflectance map concepts; surface roughness and texture characterization – photogrammetry. Application of Machine Vision in inspection – Measurement of length, diameters, Surface roughness – automated visual inspection – 3D and dynamic feature extraction.

SECTION D

On-line Quality control: On-line feedback quality control variable characteristics – control with measurement interval, one unit, and multiple units control systems for lot and batch production.

TEXT BOOKS & REFERENCES:

1. I. C. Gupta- Metrology.
2. Engineering Metrology and Instrumentation by R. K. Rajput.
3. Jain, R.K., “Engineering Metrology” Khanna Publishers.
4. PSG design data book for Gauge design.

Mapping of Course Outcomes and Program Outcomes

Course Outcomes	Program Outcomes (POs)						PSO's		
	1	2	3	4	5	6	PSO1	PSO2	PSO3
CO1	2			1		1		2	
CO2	2			2		2		2	
CO3	3			2		2		2	
CO4	3			3		2		3	

Course Title/ Code	ADVANCED METROLOGY LAB/ MEH504B-P
Course Type:	Elective
Course Nature:	Hard
L-T-P Structure	(0-0-2)
Credit	1

Course Outcome	Mapping
CO1: Understand application of different linear and angular measuring devices.	Employability/Skill Development
CO2: Understand application of slip gauges, limit gauges and comparators.	Employability/Skill Development
CO3: Understand application of optical flat, optical projector / toolmaker microscope.	Employability/Skill Development
CO4: Study of different pressure measuring instruments and its applications	Employability/Skill Development

LIST OF EXPERIMENTS:

1. To study different types of Linear Measurements and Angular Measurements and their application.To study Profile Projector and its working.
2. To study Direct and Indirect measuring instruments like Screw Pitch Gauge, Radius Gauge, Small Hole Gauge, Telescopic Gauge, Feeler Gauge etc.
3. Gear Teeth Measurement using Gear Teeth Vernier Caliper.
4. Study and understanding of Limits, Fits and Tolerances.
5. To study about Co-ordinate Measuring Machine (CMM) and list its application.
6. Measurement of Roughness and Surface Finish.

TEXT BOOKS & REFERENCES:

1. I.C.Gupta- Metrology.
2. Engineering Metrology And Instrumentation by R.K.Rajput.
3. Jain, R.K., “Engineering Metrology” Khanna Publishers.
4. PSG design data book for Gauge design.

Mapping of Course Outcomes and Program Outcomes

Course Outcomes	Program Outcomes (POs)						PSO1	PSO2	PSO3
	1	2	3	4	5	6			
CO1	2			1		1		2	
CO2	2			2		2		2	
CO3	3			2		2		2	
CO4	3			3		2		3	

Course Title/ Code	WORK MEASUREMENT TECHNIQUES/ MEH505B-T
Course Type:	Elective
Course Nature:	Hard
L-T-P Structure	(3-0-0)
Credit	3

Course Outcome	Mapping
CO1: Apply the theorem of motion and work study method in the industrial problems.	Employability
CO2: Calculate required data of ergonomics for any work system.	Employability
CO3: State the industrial engineering principles that influence the productivity improvement in organizations, process and proper utilization of equipment with scheduling.	Employability
CO4: Students will have the ability to select critical path and desired time calculation for any project with reliability.	Employability

SECTION-A

Work Study: Historical background; Definition, objectives and areas of application of work study in industries; Role of work study in improving productivity; Ergonomics and work study.

Work Study Procedure: Selection of jobs; Information, collection and recording; Recording techniques-charts and diagrams; Critical analysis; Developing better method; Installation and follow up of standard method, Economic analysis, Profit and competitiveness, 3 S's, Break Even Analysis, Economics of a new design, Production aspects.

Method Study and Motion Study: Introduction to Method Study, Data collection, recording, examining, and improving work, Material flow and material handling study, Charts to record movements in shop operation – process charts, flow diagram, flow process charts, travel chart and multiple activity charts (With simple problems).

SECTION-B

Work Measurement: Introduction & definition, Objectives and basic procedure of work measurement; Benefits and Application of work measurement in industries.

Work Measurement Techniques: Work sampling, need, confidence levels, sample size determinations, random observation, and conducting study with the simple problems.

Stop Watch Time Study: Time study: Basic procedure, Equipments needed, Methods of measuring time, Selection of jobs, Breaking a job into elements; Numbers of cycles to be timed; Rating and methods of rating, Allowances, Concept of normal time, Calculation of standard time. Work sampling: Basic procedure, Design of work sampling, Study conducting work sampling study and establishment of standard-time.

Memo motion and Micro motion study: Charts to record movements at work place – principles of motion economy, Therbligs and classification of movements, Two Handed process chart, SIMO chart, Cyclegraph and Chronocyclegraph, and micro motion study. Development, definition and installation of the improved

method, brief concept about synthetic motion studies. Design of work place layout. Pre-determined Motion Time System Method Time Measurement (MTM)

SECTION-C

Quality: Introduction and definitions of quality, Evolution of Quality: Inspection, Quality Control, Customer-Orientation: Internal & External Customer Concept, Life cycle approach to quality costs-Prevention; Appraisal and Failure costs. Seven QC tools (Histogram, Check sheets, Ishikawa diagrams, Pareto, Scatter diagrams, Control charts). Process capability concepts.

Reliability: Introduction, Definitions, Reliability evaluation, Maintainability and Availability concepts.

Capacity Planning: Introduction, measures of capacity, capacity strategies, A systematic approach for capacity decisions, Capacity planning and control (Long range, Medium range, and Short range)

SECTION-D

CPM/PERT: Introduction, Project scheduling with CPM, Project scheduling with PERT.

Loading and Scheduling: General scheduling problem, Significance of loading and scheduling, Factors affecting scheduling, Scheduling system, Flow shop scheduling, Job shop scheduling, Sequencing, Line balancing.

TEXT BOOKS & REFERENCES:

1. Groover, Mikell 2007. Work Systems and the Methods, Measurement, and Management of Work.
2. Introduction to Work Study: International Labour Organization Geneva

Mapping of Course Outcomes and Program Outcomes

Course Outcomes	Program Outcomes						PSO1	PSO2	PSO3
	1	2	3	4	5	6			
CO1	3	2	3		1		2	1	
CO2	1	2	3		2		1	2	
CO3	1	3	3		2		2		
CO4	1	2	2		1		2		1

Course Title/ Code	WORK MEASUREMENT TECHNIQUES LAB/MEH505B-P
Course Type:	Elective
Course Nature:	Hard
L-T-P Structure	(0-0-2)
Credit	1

Course Outcome	Mapping
CO1: Apply the method study guidelines in the analysis and redesigning of processes.	Employability
CO2: Model work systems using standard tools for purposes of work system documentation, analysis, and design.	Employability
CO3: Apply various types of engineering work measurements in analyzing the time of tasks.	Employability
CO4: Analyze the work processes using advanced work study tools and techniques.	Employability

LIST OF EXPERIMENTS:

1. Work study Lab Experiments
    1. To draw Outline Flow Process Chart of any Activity using Standard Chart Symbols.
    2. Left and Right Hand Process Chart for an assembly of Pin, Washer and Collar.
    3. To Calculate the Basic Time requires completing the assembly task using Stop watch.
    4. Particular task observations were taken. To verify these observations are sufficient for ±5% accuracy also indicates the minimum number of observation required.
    5. To calculate the basic Time, standard time from the given observations for a desire accuracy ±5% with confidence level 95% for activity.
2. Methods Engineering Lab Experiments on
    1. Method Analysis
    2. Micro motion study
    3. Facility layout design
    4. Ergonomics'

TEXT BOOKS & REFERENCES:

1. Groover, Mikell 2007. Work Systems and the Methods, Measurement, and Management of Work.
2. Introduction to Work Study: International Labour Organization Geneva

Mapping of Course Outcomes and Program Outcomes

Course Outcomes	Program Outcomes						PSO1	PSO2	PSO3
	1	2	3	4	5	6			
CO1	1	1	2				1	3	
CO2	1	2	1		1		1	3	
CO3	1	3	2		1		1	1	
CO4	2	1	3		1		1	1	

Course Title	RESEARCH METHODOLOGY / MES506B
Course Type	Core
Course Nature	Soft
L-T-P structure	1-0-2
Credits	2

Course Outcome	Mapping
CO1: write hypothesis; generate and choose alternatives; and test hypothesis.	Skill development
CO2: select a sample; generate data and present it.	Skill development
CO3: Calculate averages and dispersion for the given data.	Skill development
CO4: Calculate correlation and regression for the given data.	Skill development

SECTION-A

Basic Concepts of Research; Formulation & steps of Research: Decision-making: identifying the problem & Steps of decision-making process. Research: Its objectives and types. Formulation of Research Problem; its components and sources. Steps of research & Research ethics. Performance monitoring in research.
Research Design: Requirements of Research Design; Types of Research Design; Factors affecting Research Design; Hypothesis Formulation; Hypothesis Testing.

SECTION-B

Sampling Methods and Techniques: Sampling design; Scope of sampling method; Laws of sampling; Determination of sample size; Techniques of sampling.
Properties of Data Collection and Measurement: Basic Characteristics of data; Types of data and Scaling measurement. Methods of primary data collection; Editing Raw Data; Coding of Data; Tabulation of Data; Constructing Charts.
Presentation of Results: Report writing: Purpose of a Report; Essentials of a Good Report; Format of a Report; Types of Report Presentation.

SECTION-C

Measures of Central Tendency: Types of Averages: The Arithmetic Mean; The Weighted Arithmetic Mean; The Median; The Mode; The Geometric Mean; The Harmonic Mean,
Measures of Dispersion**:** Definition; Methods of Measuring Dispersion; The Range; The Inter-quartile Range; The Mean/Average Deviation ; The Standard Deviation; The Coefficient of Variation; The Gini Coefficient and the Lorenz Curve
Matrix Algebra : Matrix Multiplication; Matrix Addition; Matrix Substitution; Transpose of the Product of Two Matrices; Inverse of a Square Matrix; Matrix Notation in Case of Regression Analysis

SECTION-D

Multivariate Analysis; Correlation & Regression Analysis: Factor Analysis; Discriminant Analysis; Cluster Analysis; Dimensional Analysis; Meta-Analysis; Conjoint Analysis. Introduction to Correlation Analysis; Rank Correlation; Linear Regression Analysis; Multiple Regression Analysis.

LIST OF EXPERIMENTS:

1. Identifying the hypothesis; alternatives and situations in given abstracts/reports.
2. Writing a research proposal as per research design fundamentals.
3. Coding, tabulating and drawing charts for a given data.
4. Calculating & plotting averages for the given data
5. Measuring dispersion for the given data.
6. Calculating correlation for the given data.
7. Calculating regression for a given data.

Books Recommended:-

1. Business Research Methods – Donald Cooper & Pamela Schindler, TMGH, 9th edition
2. Business Research Methods – Alan Bryman & Emma Bell, Oxford University Press.
3. Research Methodology – C.R.Kothari

Mapping of Course Outcomes and Program Outcomes

Course Outcomes	Program Outcomes						PSO1	PSO2	PSO3
	1	2	3	4	5	6			
CO1	3	3					2		
CO2	3	2					3		
CO3	3	2					3		
CO4	3	3					3		

SEMESTER-2										
SUBJECT CODES	**SUBJECT NAME**	**OFFERING DEPARTMENT**	**COURSE NATURE (HARD/SOFT/ WORKSHOP/NTCC**	**COURSE TYPE (CORE/ELECTIVE/ UNIVERSITY COMPULSORY**	**L**	**T**	**P**	**O**	**NO. OF CONTACT HOURS PER WEEK**	**NO. OF CREDITS**
MEH507B-T	PRODUCTION ERGONOMICS & WORK PLACE DESIGN	ME	HARD	CORE	3	0	0	0	3	3
MEH507B-P	PRODUCTION ERGONOMICS & WORK PLACE DESIGN LAB	ME	HARD	CORE	0	0	2	0	2	1
MEH508B-T	ADVANCED WELDING TECHNIQUES	ME	HARD	CORE	3	0	0	0	3	3
MEH508B-P	ADVANCED WELDING TECHNIQUES LAB	ME	HARD	CORE	0	0	2	0	2	1
MEH509B/ MEH510B-T	CIM/INDUSTRIAL AUTOMATION	ME	HARD	ELECTIVE	3	0	0	0	3	3
MEH509B/ MEH510B-P	CIM LAB/INDUSTRIAL AUTOMATION LAB	ME	HARD	ELECTIVE	0	0	2	0	2	1
MEH511B/ MEH512B-T	RAPID PROTOTYPING/ADVANCED FOUNDRY TECHNOLOGY	ME	HARD	ELECTIVE	3	0	0	0	3	3
MEH511B/ MEH512B-P	RAPID PROTOTYPING LAB/ADVANCED FOUNDRY TECHNOLOGY LAB	ME	HARD	ELECTIVE	0	0	2	0	2	1
MES513B	TECHNICAL RESEARCH PAPER WRITING	ME	SOFT	CORE	1	0	2	0	3	2
MES515B	PEDAGOGICAL SKILLS	ME	SOFT	CORE	2	0	0	0	0	0
TOTAL (L-T-P/CONTACT HOURS/CREDITS)					**15**	**0**	**10**	**0**	**23**	**18**
MEN516B	SUMMER TRAINING POST 2nd SEMESTER									3

Course Title/ Code	PRODUCTION ERGONOMICS AND WORKPLACE DESIGN/ MEH507B-T
Course Type:	Core
Course Nature:	Hard
L-T-P Structure	(3-0-0)
Credit	3

Course Outcome	Mapping
CO1: Calculate the different types of energy expenditure.	Employability
CO2: Develop competency in designing of ergonomically correct work place as per anthropometry.	Employability
CO3: Develop competency in understanding of designing of ergonomically correct display products.	Employability
CO4: Students will have the ability to Select Suitable rest & break for industrial working conditions.	Employability

SECTION A

Introduction to Human Factors: Human criteria's, human physical activities, features of the human body, Measures of physiological, functions such as: energy expenditure, gross body activity, local muscular activity, functions such as: energy expenditure, gross body activity, local muscular activity, work load, work efficiency, work and rest, Type of movements of body members. Performance criteria for physical activity such as: Strength & endurance, speed of movements, accuracy of movements.

Applied Anthropometry and Work Space Introduction to anthropometry, use & principles of anthropometry data, work spaces, work space envelopes for seated persons, design of work spaces such as: work surface height, seated & standing, principles of seat design, workplace design.

SECTION B

Design of Displays and Controls: Information input & processing, visual displays of static & dynamic information. Auditory, textual & factory displays, general location of controls & displays within workspace, concept of visibility.

Functions of controls, types of controls, factors in control design, design of specific hand operated controls, foot controls and special control devices.

SECTION C

Energy Expenditure: Muscle mechanism, BMR, Heart Rate variations, Oxygen consumption, Rest allowances, Rate of energy expenditure, Manual Material Handling Capacity determination, Effect of environmental conditions and work design on Energy Expenditure, Physical space & arrangement, principles of arrangement of component.

SECTION D

Ergonomics and Work Organization: Human factors and ergonomics standards, Human factors applications in system design, characteristics of system design, human factors data for interface design, ergonomic safety

and health management, case studies of ergonomically designed product, manual material handling (MMH).

TEXT BOOKS & REFERENCES:

1. Sanders M. S. and McCormick E. J., "Human Factors in Engineering and Design", McGraw-Hill International Editions.
2. Bridger R. S., "Introduction to Ergonomics", McGraw-Hill International Editions.

Mapping of Course Outcomes and Program Outcomes

Course Outcomes	Program Outcomes						PSO1	PSO2	PSO3
	1	2	3	4	5	6			
CO1	1	2	2		1		2	1	
CO2	1	2	1		2		1	3	
CO3	1	3	2		2		2		
CO4	1	2	2		1		2		1

Course Title/ Code	PRODUCTION ERGONOMICS AND WORKPLACE DESIGN LAB/ MEH507B-P
Course Type:	Core
Course Nature:	Hard
L-T-P Structure	(0-0-2)
Credit	1

Course Outcome	Mapping
CO1: Apply the ergonomics guidelines in the analysis and redesigning of working posture.	Employability
CO2: Ergonomically correct standard tools for purposes of work system documentation, analysis, and design.	Employability
CO3: Apply various types of ergonomic measurements in analyzing the tasks for minimum occupational health hazards.	Employability
CO4: Analyze the work place design and plant layout using advanced work study tools and techniques.	Employability

LIST OF EXPERIMENTS:

1. Static Anthropometry, Standing Heights: This experiment focuses on standing height & measurement landmarks.
2. Arm Forward Reaches, Standing Erect & Forward Bend: This experiment focuses on comfortable arm reaches, standing erect & forward bending measurement landmarks & animated experiments.
3. Horizontal Work Surface At Around Elbow Height: This experiment aims at understanding the various horizontal work surfaces effect in our daily life, may be the office table or any interactive work counter & various work component layout etc.
4. Human Dimensional Consideration For General Seating:This experiment focuses on anthropometric considerations for seating.
5. Body Movement Ranges: This experiment focuses on body movement ranges with special emphasis on Head, Leg, Arm.
6. Analysis of Biomechanical model for safe Lifting using Matlab Simulation.
7. Case –Studies involving ergonomic applications in small scale industries

TEXT BOOKS & REFERENCES:

1. Sanders M. S. and McCormick E. J., “Human Factors in Engineering and Design”, McGraw-Hill International Editions.
2. Bridger R. S., “Introduction to Ergonomics”, McGraw-Hill International Editions.

Mapping of Course Outcomes and Program Outcomes

Course Outcomes	Program Outcomes						PSO1	PSO2	PSO3
	1	2	3	4	5	6			
CO1	1	3	2				1	2	
CO2	1	2	3		1		1	2	
CO3	1	3	2		1		1	1	
CO4	1	2	3		1		1	1	

Course Title/ Code	ADVANCED WELDING TECHNIQUES/ MEH508B-T
Course Type:	Core
Course Nature:	Hard
L-T-P Structure	(3-0-0)
Credit	3

Course Outcome	Mapping
CO1 Explain metal transfer mechanism and classify different types of welding process on the basis of heat sources.	**Skill Development/ Employability**
CO2 Explain the mechanism of modern welding process and their Parameters and control.	**Skill Development/ Employability**
CO3 Explain different Non Destructive Testing methods for welds.	**Skill Development/ Employability**
CO4 Explain different Inspection codes for weldments.	**Skill Development/ Employability**
CO5 Design and failure analysis of Weldment for pressure vassels, Off-shore structures and Submarine Pipe lines, Heavy structures	**Skill Development/ Employability**

SECTION-A

Introduction: Welding & its various types: Arc welding, electrical resistance welding, solid state welding, welding consumables, gas welding, brazing and soldering.

Metallurgical effects in the weld metal: Gas-metal reactions, Absorption, Reaction, Evolution, Dilution and uniformity of the weld deposit, Weld pool solidification, Weld cracking and its types, Microstructural changes in the heat-affected zone, Precipitation and embrittlement in the heat-affected zone, Contraction and residual stress

Metallurgical issues in weld joint: Mechanisms, causes and remedy of cold cracking, solidification cracking, nonmetallic inclusions; lamellar tearing; hydrogen damage, banding, segregation.

SECTION-B

Welding Procedure and Performance Qualifications: Standard procedure for specification and qualification of welding procedure, operator qualification, standard method of recording of qualification tests, welding procedure specification (WPS), procedure qualification record (PQR) and Welding performance qualification (WPQ).

Inspection of Weldments: Duties and requirement of an inspector before, during and after welding, codes governing welding inspection, ASME (American Society of Mechanical Engineers) Code.

SECTION-C

Joining of ferrous and non ferrous metals: Plain carbon structural steels, high strength low alloy steels, alloy steels, cast iron, stainless steels, aluminium alloys, copper alloys, titanium alloys, nickel alloys, characterization, defects and remedial measures.

Joining of non metallic materials: Structural polymers, structural ceramics, composites, defects and remedial measures.

Joining of dissimilar materials: Structural steel-stainless steel, aluminium-copper, metal-polymer, metal-ceramic, microstructure, defects and remedial measures

SECTION-D

Quality assessment of joint: Inspection, mechanical testing, Destructive and Nondestructive testing of weldments, standards and codes for joint testing and qualification of joints

Automation in Welding: Automatic lines for welding; Automation of weld components in automobile industry.

TEXT BOOKS & REFERENCES:

1. Parmer R.S., Welding Engineering and Technology, Khanna Publishers 1997.
2. DeGarmo P.E., Black J.T. and Kohser R.A., Materials and Processes in Manufacturing, 8th Ed., Prentice-Hall India 2000
3. Modern welding technology:- carry H. B. (PH).
4. Larry J., Welding Principles and Applications, 4th Ed., Delmar Publishers 1999.
5. "Welding Inspection", 3rd Ed., American Welding Society.

Mapping of Course Outcomes and Program Outcomes

Course Outcomes	Program Outcomes						Program Specific Outcomes		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PSO1	PSO2	PSO3
CO1			1	2				1	
CO2			1	2		2		1	
CO3	1		2	1		2		2	
CO4	2					2		2	
CO5	2					3		3	

Course Title/ Code	ADVANCED WELDING TECHNIQUES LAB/ MEH508B-P
Course Type:	Core
Course Nature:	Hard
L-T-P Structure	(0-0-2)
Credit	1

Course Outcome	Mapping
CO1 Apply the knowledge of welding fundamentals to solve welding problems	**Skill Development/ Employability**
CO2 Select a suitable welding process for a particular application	**Skill Development/ Employability**
CO3 Prepare a WPS for a particular application	**Skill Development/ Employability**
CO4 Understand the impact of welding operations on environment and need for sustainable development	**Skill Development/ Employability**
CO5 Apply the ethical principles regarding health, safety and legal issues during operations of welding machines	**Skill Development/ Employability**

LIST OF EXPERIMENTS:

1. To study Heat flow in Welding (Equipment for use-Gas Welding equipment)
2. To study Bead Geometry, Hardness of Bead, Micro structure of welding Bead in case of:
   i). MIG Welding
   ii). SAW Welding
   iii). FCAW Welding (By changing electrode diameter & carriage speed)
3. To conduct under water welding (to study bead shape & microstructure)
4. Visual inspection for weld quality

TEXT BOOKS & REFERENCES:

1. Parmer R.S., Welding Engineering and Technology, Khanna Publishers 1997.
2. DeGarmo P.E., Black J.T. and Kohser R.A., Materials and Processes in Manufacturing, 8th Ed., Prentice-Hall India 2000
3. Modern welding technology:- carry H. B. (PH).
4. Larry J., Welding Principles and Applications, 4th Ed., Delmar Publishers 1999.
5. "Welding Inspection", 3rd Ed., American Welding Society.

Mapping of Course Outcomes and Program Outcomes

Course Outcomes	Program Outcomes						Program Specific Outcomes		
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PSO1**	**PSO2**	**PSO3**
CO1			1	2				1	
CO2			1	2		2		1	
CO3	1		2	1		2		2	
CO4	2					2		2	
CO5	2					3		3	

Course Title/ Code	COMPUTER INTEGRATED MANUFACTURING/ MEH509B-T
Course Type:	Elective
Course	Hard
L-T-P Structure	(3-0-0)
Credit	3

Course Outcome	Mapping
CO1 Explain the knowledge about role of computer and automation in manufacturing.	**Skill Development/ Employability**
CO2 Describe the automation, types of automation and automation strategies	**Skill Development/ Employability**
CO3 Explain computer based integration between various functions - manufacturing, sales, design, and materials.	**Skill Development/ Employability**
CO4 Explain the concept of group technology, FMS, concurrent engineering, Simulation and AI in CIM systems	**Skill Development/ Employability**

SECTION A

INTRODUCTION Brief introduction to CAD and CAM – Manufacturing Planning, Manufacturing control Introduction to CAD/CAM – Concurrent Engineering - CIM concepts – Computerised elements of CIM system –Types of production - Manufacturing models and Metrics – Mathematical models of Production Performance – Simple problems – Manufacturing Control – Simple Problems – Basic Elements of an Automated system – Levels of Automation – Lean Production and Just-In Time Production.

SECTION B

PRODUCTION PLANNING AND CONTROL AND COMPUTERISED PROCESS PLANNING Process planning – Computer Aided Process Planning (CAPP) – Logical steps in Computer Aided Process Planning – Aggregate Production Planning and the Master Production Schedule – Material Requirement planning – Capacity Planning- Control Systems-Shop Floor Control Inventory Control – Brief on Manufacturing Resource Planning-II (MRP-II) & Enterprise Resource Planning (ERP) - Simple Problems.

SECTION C

CELLULAR MANUFACTURING Group Technology (GT), Part Families – Parts Classification and coding – Simple Problems in Opitz Part Coding system – Production flow Analysis – Cellular Manufacturing – Composite part concept – Machine cell design and layout – Quantitative analysis in Cellular Manufacturing – Rank Order Clustering Method - Arranging Machines in a GT cell – Hollier Method – Simple Problems.

SECTION D

FLEXIBLE MANUFACTURING SYSTEM (FMS) AND AUTOMATED GUIDED VEHICLE SYSTEM (AGVS) Types of Flexibility - FMS – FMS Components – FMS Application & Benefits – FMS Planning and Control– Quantitative analysis in FMS – Simple Problems. Automated Guided Vehicle System (AGVS) – AGVS Application – Vehicle Guidance technology – Vehicle Management & Safety.

INDUSTRIAL ROBOTICS Robot Anatomy and Related Attributes – Classification of Robots- Robot Control systems – End Effectors – Sensors in Robotics – Robot Accuracy and Repeatability - Industrial Robot Applications – Robot Part Programming – Robot Accuracy and Repeatability – Simple Problems.

TEXT BOOKS & REFERENCES:

1. Andrew Kusiak, Intelligent Manufacturing Systems, Prentice Hall Publications (2005).
2. Simons, G. L., Introducing Artificial Intelligence, NCC Pub., 1990.
3. Andrew Kusiak, Computational Intelligence in Design and Manufacturing, John Wiley and Sons, 2000.
4. Mikell P Groover, Automation, Production Systems and Computer Integrated Manufacturing, 3rd Edition, Prentice Hall Inc., New Delhi, 2007

Mapping of Course Outcomes and Program Outcomes

Course Outcomes	PO's						Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
CO1				2	2	2		1	
CO2				2	3	2		2	
CO3				3	3	3		2	
CO4				3	3	3		3	

Course Title/ Code	COMPUTER INTEGRATED MANUFACTURING LAB/ MEH509B-P
Course Type:	Elective
Course	Hard
L-T-P Structure	(0-0-2)
Credit	1

Course Outcome	Mapping
CO1 Understand the basic concepts of automation, computer numeric control	**Skill Development/ Employability**
CO2 Understand the algorithms of line generation, circle generation, transformation	**Skill Development/ Employability**
CO3 Understand group technology, computer aided process planning, flexible	**Skill Development/ Employability**
CO4 Develop CNC program for simple operations	**Skill Development/ Employability**

LIST OF EXPERIMENTS:

1. To understand the Automated Assembly systems.
2. To understand the Automatic Material Handling and Storage systems.
3. To understand the Automated Inspection systems.
4. To understand the Group Technology, Cell Design and Cellular Manufacturing Systems.
5. To understand the Computer Aided Process Planning.
6. To understand the Flexible Manufacturing Systems.
7. To understand the fundamentals of Robotics, Joints, Arm configurations, Wrists, effectors, actuators, modular robots, Robot sensors and Machine vision.
8. To understand the Inverse kinematics, trajectory planning, manipulator dynamics-simple cases.
9. To understand the Robot various programming languages, Robot Industrial and Non industrial applications.
10. To understand the Knowledge Based Systems (KBS) and Applications of KBS for Assembly.
11. To understand the Fuzzy Logic and Sets, Multi layered networks and applications of Fuzzy systems

TEXT BOOKS & REFERENCES:

1. Andrew Kusiak, Intelligent Manufacturing Systems, Prentice Hall Publications (2005).
2. Simons, G. L., Introducing Artificial Intelligence, NCC Pub., 1990.
3. Andrew Kusiak, Computational Intelligence in Design and Manufacturing, John Wiley and Sons, 2000.
4. Mikell P Groover, Automation, Production Systems and Computer Integrated Manufacturing, 3rd Edition, Prentice Hall Inc., New Delhi, 2007

Mapping of Course Outcomes and Program Outcomes

Course Outcomes	PO's						Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
CO1				2	2	2		1	
CO2				2	3	2		2	
CO3				3	3	3		2	
CO4				3	3	3		3	

Course Title/ Code	INDUSTRIAL AUTOMATION/ MEH510B-T
Course Type:	Elective
Course Nature:	Hard
L-T-P Structure	(3-0-0)
Credit	3

Course Outcome	Mapping
CO1: To introduce the importance of automation techniques manufacturing and process industries.	Employability/Skill Development/Entrepreneurship
CO2: To impart the role of PLC in industry automation.	Employability/Skill Development/Entrepreneurship
CO3: To expose to various control techniques employed in process automation.	Employability/Skill Development/Entrepreneurship
CO4: To develop automation system for manufacturing and process industries.	Employability/Skill Development/Entrepreneurship

SECTION-A

Introduction: Automation in production and manufacturing systems, Mechanization ; Types or Levels of automation; Principles and Strategies of Automation; Mechanical, Electrical, Hydraulic and Pneumatic automation devices and controls; Economics of automation; Benefits and Impact of Automation in Manufacturing and Process Industries;

Building Blocks of Automation Systems (Introduction): LAN, Analog & Digital I/O Modules, SCADA (supervisory control and data acquisition) Systems & RTU (Remote Terminal Units).

SECTION-B

Assembly Automation: Types and configurations, Parts delivery at workstations- Various vibratory and non-vibratory devices for feeding and orientation, Calculations of feeding rates, Cycle time for single station assembly machines and partially automated systems; Product design for automated assembly; Performance evaluation and economics of assembly systems.Control Technologies in Automation: Industrial Control Systems, Process Industries Verses Discrete-Manufacturing Industries, Continuous Verses Discrete Control, Computer Process and its Forms; Sensors, Actuators and other Control System Components

SECTION-C

Material handling and Identification Technologies: Overview of Material Handling Systems, Principles and Design Consideration, Material Transport Systems, Storage Systems, Overview of Automatic Identification Methods.

Programmable Manufacturing Automation: CNC machine tools; Machining centers; Programmable robots; Robot time estimation in manufacturing operations; Robot Programming - Level of robot programming, Language based programming, task level programming, Robot programming synthesis; Robot integration with CAD/CAM/CIM.

SECTION D

Modeling and Simulation for Manufacturing Plant Automation: Introduction, need for system Modeling, Building Mathematical Model of a Plant, Modern Tools & Future Perspective. Industrial Control Applications: Automobile, Cement, Thermal, Water Treatment & Steel Plants

TEXT BOOKS & REFERENCES:

1. Automation, Production Systems and Computer Integrated Manufacturing, M.P.Groover, Pearson Education.
2. Industrial Automation: W.P. David, John Wiley and Sons.
3. Anatomy of Automation, Amber G.H & P. S. Amber, Prentice Hall.
4. Principles of Automation & Automated Production Process Malov and Ivanov, Mir Publication
5. Automation in Production Engineering Oates and Georgy Newness

Mapping of Course Outcomes and Program Outcomes

Course Outcomes	Program Outcomes (POs)						PSO1	PSO2	PSO3
	1	2	3	4	5	6			
CO1	1	-	2	-	1	-	1	2	-
CO2	1	-	2	-	1	-	1	2	-
CO3	1	-	2	-	1	-	1	2	-
CO4	1	-	2	-	1	-	1	2	-

Course Title/ Code	INDUSTRIAL AUTOMATION LAB/ MEH510B-P
Course Type:	Elective
Course Nature:	Hard
L-T-P Structure	(0-0-2)
Credit	1

Course Outcome	Mapping
CO1: Identify and classify various elements of Industrial Automation.	Employability/Skill Development/Entrepreneurship
CO2: Select an appropriate automation technique for a specific manufacturing application.	Employability/Skill Development/Entrepreneurship
CO3: Use various inputs and outputs to control operation sequence	Employability/Skill Development/Entrepreneurship

LIST OF EXPERIMENTS:

1. To analyze a manufacturing line for the need for industrial automation
2. To simulate a plant automation in a plant simulation software
3. To automate by using control technologies
4. To utilize the SCADA systems for industrial automation

TEXT BOOKS & REFERENCES:

1. Automation, Production Systems and Computer Integrated Manufacturing, M.P.Groover, Pearson Education.
2. Industrial Automation: W.P. David, John Wiley and Sons.
3. Anatomy of Automation, Amber G.H & P. S. Amber, Prentice Hall.
4. Principles of Automation & Automated Production Process Malov and Ivanov, Mir Publication
5. Automation in Production Engineering Oates and Georgy Newness

Mapping of Course Outcomes and Program Outcomes

Course Outcomes	Program Outcomes (POs)						PSO1	PSO2	PSO3
	1	2	3	4	5	6			
CO1	1	-	2	-	1	-	1	2	-
CO2	1	-	2	-	1	-	1	2	-
CO3	1	-	2	-	1	-	1	2	-

Course Title/ Code	RAPID PROTOTYPING/ MEH512B-T
Course Type:	Elective
Course Nature:	Hard
L-T-P Structure	(3-0-0)
Credit	3

Course Outcome	Mapping
CO1: Define and Identify the different types of Rapid Prototyping Techniques.	Employability/Skill Development/Entrepreneurship
CO2: Understand the operating Principles, Capabilities and Limitations of Rapid Prototyping Techniques.	Employability/Skill Development/Entrepreneurship
CO3: Justify the applications of Rapid Prototyping Techniques.	Employability/Skill Development/Entrepreneurship
CO4: Integrate the Rapid Prototyping Techniques in various emerging fields.	Employability/Skill Development/Entrepreneurship

SECTION-A

Introduction: Introduction to Prototyping, Traditional Prototyping Vs. Rapid Prototyping (RP), Classification of Rapid Manufacturing Processes: Additive, Subtractive, Formative, Generic RP process.Distinction between RP and CNC, other related technologies.

SECTION-B

CAD Modelling and Data Processing for RP: CAD model preparation, Data interfacing: formats (STL, SLC, CLI, RPI, LEAF, IGES, HP/GL, CT, STEP), conversation, validity checks, repair procedures; Part orientation and support generation, Support structure design, Model Slicing algorithms and contour data organization, direct and adaptive slicing, Tool path generation.

SECTION-C

RP Processes: Process Physics, Tooling, Process Analysis, Material and technological aspects, Applications, limitations and comparison of various rapid manufacturing processes. Photopolymerization (Stereolithography (SL), Microstereolithography), Powder Bed Fusion (Selective laser Sintering (SLS), Electron Beam melting (EBM)), ExtrusionBased RP Systems (Fused Deposition Modelling (FDM)), 3D Printing, Sheet Lamination (Laminated Object Manufacturing (LOM), Ultrasonic Consolidation (UC)), Beam Deposition (Laser Engineered Net Shaping (LENS), Direct Metal Deposition (DMD)).

SECTION-D

Errors in RP Processes: Pre-processing, processing, post-processing errors, Part building errors in SLA, SLS. RP Applications: Design, Engineering Analysis and planning applications, Rapid Tooling, Reverse Engineering, Medical Applications of RP.

TEXT BOOKS & REFERENCES:

1. Stereo lithography and other RP & M Technologie- Paul F. Jacobs, SME, NY 1996
2. Rapid Manufacturing- Flham D.T & DinjoyS.S ,Verlog London 2001.
3. Rapid automated- Lament wood, Indus press New York, 1st edition, 1993

Mapping of Course Outcomes and Program Outcomes

Course Outcomes	Program Outcomes (POs)						PSO1	PSO2	PSO3
	1	2	3	4	5	6			
CO1	1	-	2	-	1	-	1	2	-
CO2	1	-	2	-	1	-	1	2	-
CO3	1	-	2	-	1	-	1	2	-
CO4	1	-	2	-	1	-	1	2	-

Course Title/ Code	RAPID PROTOTYPING LAB/ MEH512B-P
Course Type:	Elective
Course Nature:	Hard
L-T-P Structure	(0-0-2)
Credit	1

Course Outcome	Mapping
CO1: Describe rapid product development, rapid prototyping and applications.	**Employability/Skill Development/Entrepreneurship**
CO2: Classify and describe the different RP processes and their applications.	**Employability/Skill Development/Entrepreneurship**
CO3: Select and use correct CAD formats in the manufacture of a 3D printed part	**Employability/Skill Development/Entrepreneurship**
CO4: Demonstrate the 3d printer machine.	**Employability/Skill Development/Entrepreneurship**

LIST OF EXPERIMENTS:

1. To produce a mechanical part by using 3D Printer.
2. To manufacture a mechanical assembly.
3. To create a 3D model of a mechanical part and manufacture the same using 3D printer

TEXT BOOKS & REFERENCES:

1. Stereo lithography and other RP & M Technologie- Paul F. Jacobs, SME, NY 1996
2. Rapid Manufacturing- Flham D.T & DinjoyS.S ,Verlog London 2001.
3. Rapid automated- Lament wood, Indus press New York, 1st edition, 1993

Mapping of Course Outcomes and Program Outcomes

Course Outcomes	Program Outcomes (POs)						PSO1	PSO2	PSO3
	1	2	3	4	5	6			
CO1	1	-	2	-	1	-	1	2	-
CO2	1	-	2	-	1	-	1	2	-
CO3	1	-	2	-	1	-	1	2	-
CO4	1	-	2	-	1	-	1	2	-

Course Title/ Code	ADVANCED FOUNDRY TECHNOLOGY/ MEH511B-T
Course Type:	Elective
Course Nature:	Hard
L-T-P Structure	(3-0-0)
Credit	3

Course Outcome	Mapping
CO1 To promote understanding of basic facts and concepts in foundry process while retaining the excitement of foundry industry.	Skill Development/ Employability
CO2 To make students capable of studying foundry technology in academic and Industrial courses.	Skill Development/ Employability
CO3 To expose the students to various emerging new areas of foundry technology and apprise them with their prevalent in their future studies and their applications in various spheres of manufacturing technology.	Skill Development/ Employability
CO4 To expose the students to different processes used in Foundry Industries and their applications.	Skill Development/ Employability

SECTION A

Melt processing techniques for ferrous and non-ferrous alloys such as stainless steels, nickel, titanium alloys. Vacuum melting equipment and practice.

SECTION B

Elementary aspects of pattern and mould design using CAD softwares. Resinbonded mould and core making processes and machines. Special casting processes and their applications – low pressure die casting, investment casting, squeeze casting, thixo-forming. Illustrations of automotive and aerospace applications.

SECTION C

Gating and riser design – principles of fluid flow, governing equations, heat transfer applied to casting solidification, governing equations, boundary conditions for different casting methods, concept of directional solidification, gating and risers, application of simulation methods. Use of casting software in solving practical problems.

SECTION D

Casting defects and remedies. Inspection methods – visual, penetrant, magnetic, metallurgical, X – ray and Gamma ray radiography and Mechanization and Automation.

TEXT BOOKS & REFERENCES:

1. Principles of Foundry Technology by P.L Jain, Tata McGraw-Hill Education, 2003
2. Foundry Technology by O.P. Khanna, Dhanpat Rai Publications
3. Foundry Technology by Peter R. Beeley

Mapping of Course Outcomes and Program Outcomes

Course Outcomes	PO's						Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
CO1				2	1	1		1	
CO2				2	2	1		1	
CO3				3	3	2		2	
CO4				3	3	2		3	

Course Title/ Code	ADVANCED FOUNDRY TECHNOLOGY LAB/ MEH511B-P
Course Type:	Elective
Course Nature:	Hard
L-T-P Structure	(0-0-2)
Credit	1

Course Outcome	Mapping
CO1 To develop ability to apply the skill and knowledge of contents of principles of foundry technology.	Skill Development/ Employability
CO2 To inquire of new skill and knowledge of foundry technology and developments therein.	Skill Development/ Employability
CO3 To expose and to develop interest in the fields of foundry technology.	Skill Development/ Employability

LIST OF EXPERIMENTS:

1. Prepare mould and measure of mould hardness by mould hardness tester.
2. Measure fluidity of casting metals
3. Measure the graphite flakes size and type in C.I.
4. Identify and understand various casting defects with their causes and remedies.
5. Determine the effect of hardness and moisture on permeability of sand.
6. Determine the effect of grain size and clay content on permeability of sand.
7. Design of gating system for a given component (ferrous / non ferrous)
8. Prepare layout of integrated advance foundry plant.
9. Undertake Industrial visit of any advance foundry plant.

TEXT BOOKS & REFERENCES:

1. Principles of Foundry Technology by P.L Jain, Tata McGraw-Hill Education, 2003
2. Foundry Technology by O.P. Khanna, Dhanpat Rai Publications
3. Foundry Technology by Peter R. Beeley

Mapping of Course Outcomes and Program Outcomes

Course Outcomes	Program Outcomes						Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
CO1				2	1	1		1	
CO2				2	2	1		1	
CO3				3	3	2		2	

Course Tittle/Code	TECHNICAL RESEARCH PAPER SEMINAR WRITING/ MES513B
Course Type	Core
Course Nature	Hard
L-T-P Structure	1-0-2
Credit	2

Course Outcome	Mapping
CO1: To Understand the various approaches/steps for writing research paper	Skill Development
CO2: To understand professional writing by analyzing quantifiable data discovered by doing research and constructing finished research documents.	Skill Development
CO3: To understand how to critically analyze data from research; incorporate it into assigned writing clearly, concisely, and logically; and attribute the source with proper citation	Skill development
CO4: To develop professional skill to write down the full length research Paper in prescribe format	Startup/Employability

SECTION-A

Literature Research: Reference Materials; Literature Research; Internet Research; Bibliography Software
Writing a Literature Review: Deciding on a topic for a paper; Organizing and searching the literature; Preparing an outline; Writing the paper; Evaluating the paper yourself and seeking others‟ feedback on it.
Planning and Writing the Experimental Research Paper: Panning Experimental Research; Executing Experimental Research; Excursion: using the internet to conduct archival research and data collection; Analyzing data from Experimental Research; Reporting Experimental Research
General Introduction to Citation Practices: Reasons for Citing Your Sources; The Requirements of Citation; Two Citation Styles; Electronic Sources; Preparation of Citations; Citation Management Software

SECTION-B

Notes-Bibliography Style: The Basic Form Basic Patterns; Bibliographies; Notes; Short Forms for Notes
Notes-Bibliography Style: Citing Specific Types of Sources Books; Journal Articles; Magazine Articles; Newspaper Articles; Additional Types of Published Sources; Unpublished Sources; Websites, Blogs, Social Networks, and Discussion Groups; Sources in the Visual and Performing Arts; Public Documents; One Source Quoted in Another
Author-Date Style: The Basic Form Basic Patterns; Reference Lists; Parenthetical Citations
Author-Date Style: Citing Specific Types of Sources Books; Journal Articles; Magazine Articles; Newspaper Articles; Additional Types of Published Sources; Unpublished Sources; Websites, Blogs, Social Networks, and Discussion Groups; Sources in the Visual and Performing Arts; Public Documents.

SECTION-C

Spelling: Plurals; Possessives; Compounds and Words Formed with Prefixes; Line Breaks
Punctuation: Periods; Commas; Semicolons; Colons; Question Marks; Exclamation Points; Hyphens and

Dashes; Parentheses and Brackets; Slashes; Quotation Marks; Apostrophes; Multiple Punctuation Marks **Names, Special Terms, and Titles of Works:**Names; Special Terms; Titles of Works **Numbers:**Words or Numerals?; Plurals and Punctuation; Date Systems; Numbers Used outside the Text.

SECTION-D

Abbreviations General Principles; Names and Titles; Geographical Terms; Time and Dates; Units of Measure; The Bible and Other Sacred Works; Abbreviations in Citations and Other Scholarly Contexts Quotations Quoting Accurately and Avoiding Plagiarism; Incorporating Quotations into Your Text; Modifying Quotations

Tables and Figures General Issues; Tables; Figures

LIST OF EXPERIMENTS:

Prepare and publish atleast two Research Papers in prescribed format of a Research Journal, specialized in specific area of student‟s Research Topic with relatively high Impact Factor.

Your research paper must be 4 pages minimum plus reference page, typed (approx. 250 words per page) on the technical topic student‟s choice dealing the Dissertation i.e. Introduction of Dissertation Topic, Literature Review & Research in Gap, Methodologies which will be used during their respective Research Work.

Seminar presentation on published Research Papers.

TEXT BOOKS & REFERENCES:

1. Goldbort R (2006) Writing for Science, Yale University Press (available on Google Books)
2. Day R (2006) How to Write and Publish a Scientific Paper, Cambridge University Press
3. Highman N (1998), Handbook of Writing for the Mathematical Sciences, SIAM. Highman'sbook .
4. Adrian Wallwork , English for Writing Research Papers, Springer New York Dordrecht Heidelberg London, 2011

Mapping of Course Outcomes and Program Outcomes

Course Outcomes	Program Outcomes						Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
CO1	2	3							
CO2	3	3							
CO3	3	2					1		
CO4	2	2							

Course Title	PEDAGOGICAL SKILLS/ MES515B
Course Type	Core
Course Nature	Soft
L-T-P structure	2-0-0
Credits	2

Course Outcomes (COs)		Mapping
CO1	Compare and contrast between objectives and outcomes based on revised Bloom's Taxonomy.	Skill Development
CO2	Illustrate a concept based on innovative pedagogies.	Skill Development
CO3	Exhibit growth mindset in group activities.	Employment
CO4	Evaluate projects based on Six Thinking hats.	Entrepreneurship
CO5	Design sessions based on collaborative learning, cooperative learning, and experiential learning.	Entrepreneurship & Skill Development

SECTION-A

Introduction and Methodology:

Aims and rationale, Policy background, Conceptual framework and terminology, Theories of learning, Curriculum, Teacher education, Conceptual framework, Research questions**.** Overview of methodology and Searching.

SECTION-B

Thematic overview: Pedagogical practices are being used by teachers in formal and informal classrooms in developing countries. Curriculum, Teacher education.

SECTION-C

Evidence on the effectiveness of pedagogical practices. Methodology for the in-depth stage: quality assessment of included studies. How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy? Theory of change. Strength and nature of the body of evidence for effective pedagogical practices. Pedagogic theory and pedagogical approaches. Teachers' attitudes and beliefs and Pedagogic strategies.

SECTION-D

Professional development: alignment with classroom practices and follow-up Support, Peer support. Support from the head teacher and the community. Curriculum and assessment. Barriers to learning: limited resources and large class sizes

Research gaps and future directions

Research design**,** Contexts**,** Pedagogy**.** Teacher education**,** Curriculum and assessment**,** Dissemination and research impact.

TEXT BOOKS & REFERENCES:

1. Ackers J, Hardman F (2001) Classroom interaction in Kenyan primary schools, Compare, 31 (2): 245-261.
2. Agrawal M (2004) Curricular reform in schools: The importance of evaluation, Journal of Curriculum Studies, 36 (3): 361-379.
3. Akyeampong K (2003) Teacher training in Ghana - does it count? Multi-site teacher education research project (MUSTER) country report 1. London: DFID.
4. Akyeampong K, Lussier K, Pryor J, Westbrook J (2013) Improving teaching and learning of basic maths and reading in Africa: Does teacher preparation count? International Journal Educational Development, 33 (3): 272–282.
5. Alexander RJ (2001) Culture and pedagogy: International comparisons in primary education. Oxford and Boston: Blackwell.
6. Chavan M (2003) Read India: A mass scale, rapid, 'learning to read' campaign.
7. www.pratham.org/images/resource%20working%20paper%202.pdf.

Mapping of Course Outcomes and Program Outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
CO1				1	3	3	3	3	3
CO2					2	2	1	3	2
CO3	1			2	3	2	2	3	1
CO4	1	1	1		3	2	2	2	3
CO5	1	1	1	1	3	2	1	3	3

Course Title	Summer Training / MEN516B
Course Type	Core
Credits	3

Course Outcomes (COs)		Mapping
CO1	To provide an opportunity for students to apply theoretical concepts in real life world decision making.	Skill Development
CO2	To develop the ability to shoulder responsibility, make sound decisions and apply technical skills effectively	Skill Development

Mapping of Course Outcomes and Program Outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
CO1	3	2		2	1	3		3	3
CO2	2	2	3	2			3	3	3

SEMESTER-3										
SUBJECT CODES	**SUBJECT NAME**	**OFFERING DEPARTMENT**	**COURSE NATURE (HARD/SOFT/ WORKSHOP/NTCC**	**COURSE TYPE (CORE/ELECTIVE/ UNIVERSITY COMPULSORY**	**L**	**T**	**P**	**O**	**NO. OF CONTACT HOURS PER WEEK**	**NO. OF CREDITS**
MEH601B-T	THEORY OF METAL CUTTING	ME	HARD	CORE	3	0	0	0	3	3
MEH601B-P	THEORY OF METAL CUTTING LAB	ME	HARD	CORE	0	0	2	0	2	1
MES602B	ADVANCED OPTIMISATION TECHNIQUES	ME	SOFT	CORE	1	0	2	0	3	2
MEH603B/ MEH604B-T	GLOBAL LOGISTICS SYSTEMS/ ADVANCED MATERIAL SCIENCE	ME	HARD	ELECTIVE	3	0	0	0	3	3
MEH603B/ MEH604B-P	GLOBAL LOGISTICS SYSTEMS LAB/ ADVANCED MATERIAL SCIENCE LAB	ME	HARD	ELECTIVE	0	0	2	0	2	1
MEH605B-T/P/MEH606B-T	CAD/CAM IN ENGG. PROCESS/MACHINE TOOL DESIGN	ME	HARD	ELECTIVE	3	0	0	0	3	3
MEH605B-T/P/MEH606B-P	CAD/CAM IN ENGG. PROCESS LAB/MACHINE TOOL DESIGN LAB	ME	HARD	ELECTIVE	0	0	2	0	2	1
MES607B	SEMINAR	ME	HARD	SOFT	0	0	2	0	2	2
MEN608B	DISSERTATION PREPARATION / PROJECT REPORT	ME	HARD	NTCC	0	0	6	0	6	3
TOTAL (L-T-P/CONTACT HOURS/CREDITS)					**10**	**0**	**16**	**0**	**23**	**19**

Course Title/ Code	THEORY OF METAL CUTTING / MEH601B-T
Course Type:	Core
Course Nature:	Hard
L-T-P Structure	(3-0-0)
Credit	3

Course Outcome	Mapping
CO1 To study the basics of metal machining and mechanics of metal machining	Skill Development/ Employability
CO2 To study the different cutting tool materials and types & geometry of cutting tools	Skill Development/ Employability
CO3 To predict tool life and tool failure	Skill Development/ Employability
CO4 To select suitable cutting fluid for respective materials	Skill Development/ Employability
CO5 To introduce students to the theory of metal cutting, cutting tools and optimization of metal cutting parameters	Skill Development/ Employability

SECTION A

Introduction to Metal Cutting: System of Tool nomenclature, Tool Geometry, Common work and Tool material, Cutting friction, Controlled contact machining. Physical principle in metal cutting: Chip formation and its mechanism, Types of chips, Chip thickness ratio, Radius of chip curvature, Cutting speed, Feed and depth of cut, Types of chip breakers, Work done in cutting, BUE on metal cutting, Curling & contraction of chip, Work hardening, Quality of machines surfaces, Effect of cutting fluid on cutting process, Vibration in metal cutting, Forces and energy calculations (Merchant‟s Analysis), Power consumed, MRR and various factors affecting MRR.

SECTION B

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.

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

SECTION C

Dynamometry: 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 Cutting tool materials: Properties, different types of cutting tool materials e.g. HSS, Carbides, Coated carbides, Ceramics, Cermets, Polycrystalline Cubic Boron Nitride (PCBN) and Diamonds and other advanced cutting tool materials, ISO specification of modern throw away inserts.

SECTION D

Cutting Tools: Analysis of plastic failure (from stability criterion), Analysis failure by brittle fracture, Wear of cutting tools, Flank and crater wear analysis, Optimum tool life, Tool life equations (Taylor‟s, Woxen etc), Tool life test, Machining optimisation, Predominant types of wear; Abrasive, adhesive, Diffusion wear models, Wear measurements and techniques, Theory of tool wear oxidative, Mathematical modeling for wear, Test of machinability and influence of metallurgy on machinability, Economics of Metal machining.

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

TEXT BOOKS & REFERENCES:

1. Metal Cutting theory and Cutting tool design byArshinov Mir Publishers, Moscow, Allekseev Mir Publishers, Moscow
2. Cutting tools: P.H. Joshi, Wheeler Publishing
3. Theory of Metal cutting: E.M. Trent
4. Tool design: Donaldson

Mapping of Course Outcomes and Program Outcomes

Course Outcomes	Program Outcomes						Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
CO1				2				1	
CO2				2				1	
CO3	1		2	1				2	
CO4	2		1			2		2	
CO5	2					3		3	

Course Title/ Code	THEORY OF METAL CUTTING LAB / MEH601B-P
Course Type:	Core
Course Nature:	Hard
L-T-P Structure	(0-0-2)
Credit	1

Course Outcome	Mapping
CO1 Apply the theory of metal cutting for effective machining.	Skill Development/ Employability
CO2 Discuss the working principles of various operations performed in a lathe machine	Skill Development/ Employability
CO3 Explain the working of special type machines	Skill Development/ Employability

LIST OF EXPERIMENTS:

1. To identify various angles and parameters of various single point cutting tools.
2. To identify various angles and parameters of various multipoint cutting tools.
3. To grind various angles on a single point cutting tool
4. Machining of minimum two jobs of different materials i.e. Aluminium, Mild Steel and measurement of surface roughness to study the effect of parameters such as feed, tool nose radius, depth of cut on the surface roughness.
5. To study relative wear of electrode during machining on electro- discharge (EDM).
6. To study wear of cutting tool in turning.
7. To study surface finish by varying cutting parameters on surface grinding machine.
8. To braze carbide tip on a carbon steel tool shank
9. To study effect of cutting fluid on machining.
10. Measurement of Cutting force with the help of Tool Dynamometer (Any Two)

Lathe tool dynamometer
Drill tool dynamometer
Milling tool dynamometer

11. Industrial visit to study applications of tools for different metal cutting processes.

TEXT BOOKS & REFERENCES:

1. Metal Cutting theory and Cutting tool design byArshinov Mir Publishers, Moscow, Allekseev Mir Publishers, Moscow
2. Cutting tools: P.H. Joshi, Wheeler Publishing
3. Theory of Metal cutting: E.M. Trent
4. Tool design: Donaldson

Mapping of Course Outcomes and Program Outcomes

Course Outcomes	Program Outcomes						Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
CO1				2				1	
CO2				2				1	
CO3	1		2	1				2	

Course Title/Code	ADVANCED OPTIMIZATION TECHNIQUES / MES602B
Course Type	Core
Course Nature	Hard
L-T-P structure	1-0-2
Credits	2

Course Outcome	Mapping
CO1: Understand the basic theory and some advanced topics in linear optimization, integer optimization, and convex optimization	Skill Development
CO2: Identify the proper optimization technique(s) to attempt when problems are too large or too complicated to solve in a straightforward way	Skill Development
CO3: Use optimization software and implement solution algorithms involving large scale optimization techniques	Skill development
CO4: Handle large data sets that accompany real-world optimization problems	Startup/Employability

SECTION A

Introduction: Classification of optimization problems, concepts of design vector, Design constraints, constraints surface, objective function surface and multi-level optimization, parametric linear programming

SECTION B

Non-Linear Optimization: Unconstrained, one variable and multi variable optimization, Karush-Kuhn-Tucker Conditions, Constrained optimization, Quadratic programming, Convex programming, Separable programming, Geometric programming, Non-Convex programming.

Non-Traditional Optimization: Overview of Genetic algorithms, Simulated Annealing, Neural network based optimization, Optimization of Fuzzy Systems

SECTION C

Stochastic Optimization Techniques: Introduction, Types: Local Search, Population Based, Introduction to Genetic Algorithms, Motivation from Nature, Genetic Algorithms: Working Principle: Representation, Fitness Assignment, Reproduction, Crossover, Mutation, Constraint Handling, introduction to Ant Colony Optimization and Particle Swarm Optimization (PSO).

SECTION D

Search Techniques: One dimensional Search Methods*:* Uni modal functions, simultaneous uniform search method, Sequential search method, Fibonacci search method, Golden section search method. Unconstrained Multi-dimensional Search Methods: Univariate search method, Method of steepest descent, Conjugate radiant method, Fletcher Reeves method.

LIST OF EXPERIMENTS:

1. Solution of linear programming problem using MATLAB.
2. Solution of non- linear programming problem using MATLAB.
3. Solution of constrained linear programming problem using MATLAB

4. Solution of unconstrained linear programming problem using MATLAB.
5. Programming in MATLAB to find optimum solution of problem using Genetic Algorithm
6. Programming in MATLAB to find optimum solution of problem using Ant colony optimization Algorithm.
7. Programming in MATLAB to find optimum solution of problem using Particle Swarm Optimization Algorithm

TEXT BOOKS & REFERENCES:

1. Singiresu S.Rao, "Engineering optimization – Theory and practices", John Wiley and Sons,1996.
2. Fredrick S.Hillier and G.J.Liberman, "Introduction to Operations Research", McGraw HillInc. 1995.
3. J. S. Arora, Introduction to Optimum Design, McGraw Hill International Edition, 1989

Mapping of Course Outcomes and Program Outcomes

Course Outcomes	Program Outcomes						Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
CO1	2	3					2		
CO2	3	2					3		
CO3	3	2					2		
CO4	2	3					3		

Course Title/ Code	GLOBAL LOGISTICS SYSTEM/ MEH603B-T
Course Type	Elective
Course Nature	Hard
L-T-P Structure	3-0-0
Credits	3

Course Outcome	Mapping
CO1 understand Scope of Logistics	Skill Development/ Employability
CO2 Understands Demand forecasting, Role of aggregate planning, MRP, ERP.	Skill Development/ Employability
CO3 understand effectiveness of supply management	Skill Development/ Employability

SECTION A

Introduction to Logistics and supply chain: - Scope of Logistics, Logistics in the system Life Cycle, Need for Logistics Engineering, Related Terms and Definitions. Introduction of SCM, Key issues in SCM, Logistics network, Data Collection, Transportation, Ware house Management, Strategic location of warehouses, Demand forecasting, Role of aggregate planning, MRP, ERP.

Measures of Logistics: - Reliability, Maintainability, Availability factors, Supply supports, Facility and Software Factors.

SECTION B

Inventory management: Concepts of Materials Management, Economic lot size model, Effect of Demand uncertainty, Fixed order costs, Variable lead frames, Inventory under certainly & uncertainty, Risk Management.

Supply Chain performance: Customer driven strategies in production & distribution systems, customer focus in SCM, management of supply sources, Drivers & obstacles. Measuring logistics costs & performance

SECTION C

Logistics in the System Requirement, Material Recycling and Disposal Logistic Management:

Logistic Planning, Development of a Work Breakdown Structure, Scheduling of Logistics Tasks, Cost Estimation and control, Organization for Logistics, Management and control.

Strategic Considerations for Supply Chain: Porter‟s industry analysis and value-chain models, the concept of total cost of ownership, supply stream strategies, classification and development guidelines, measuring effectiveness of supply management, logistics engineering

SECTION D

Operations Research Models for operational and strategic issues in supply chain management. The bullwhip effect and supply-chain management game. Coordination and technology in supply chain, effect of lack of co-ordination and obstacles – Information Technology and SCM - supply chain-IT framework. E-business and SCM. Metrics for supply chain performance.

Logistics in the Design and Development Phase: Design Process, Related Design Discipline, Supplier Design Activities, Design Integration and Reviews, Test and Evaluation.

TEXT BOOKS & REFERENCES:

1. Supply Chain Management: Strategy, Planning, and Operation by Sunil Chopra and Peter Meindl.

Mapping of Course Outcomes and Program Outcomes

Course Outcomes	Program Outcomes						Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
CO1				1	1	1		1	
CO2				1	1	2		1	
CO3				2	1	2		2	

Course Title/ Code	GLOBAL LOGISTICS SYSTEM LAB/ MEH603B-P
Course Type	Elective
Course Nature	Hard
L-T-P Structure	0-0-2
Credits	1

Course Outcome	Mapping
CO1 Measure logistics costs & performance	Skill Development/ Employability
CO2 apply Operations Research Models for operational and strategic issues in supply chain management	Skill Development/ Employability
CO3 apply logistics in the Design and Development Phase	Skill Development/ Employability

LIST OF EXPERIMENTS:

- warehousing, supply chain management, inventory management, financial planning for distribution, logistics, technical sales and sales management and safety.
- To manipulate equipment and products in the warehouse space
- to identify and utilize supporting technology required for the management of multiple production and distribution strategies.
- To simulate the supply chain activities and information that flow between manufacturers, suppliers, and various end users.

TEXT BOOKS & REFERENCES:

1. Supply Chain Management: Strategy, Planning, and Operation by Sunil Chopra and Peter Meindl.

Mapping of Course Outcomes and Program Outcomes

Course Outcomes							Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
CO1				1	1	1		1	
CO2				1	1	2		1	
CO3				2	1	2		2	

Course Title/ Code	ADVANCED MATERIAL SCIENCE/ MEH604B-T
Course Type	Elective
Course Nature	Hard
L-T-P Structure	3-0-0
Credits	3

Course Outcome	Mapping
CO1: Identify various microstructures of ferrous and non-ferrous metals and alloys.	Skill Development
CO2: Visualize grains and grain boundaries.	Skill Development
CO3: Importance of hardening of steels.	Skill development
CO4: Evaluate hardness of treated and untreated steels.	Startup/Employability

SECTION-A

Nanomaterials Fundamentals: Atomic Structure, molecules and phase, 0-D, 1-D, 2-D and 3-D nanomaterials, nanostructured metals, MOx, MSx, and nanocarbon; structure-property relationships – optical, catalytic, mechanical, thermal, electrical properties; MEMS and NEMS nanoscale

SECTION-B

Optoelectronics Polymers: Types, Commodity Plastics: PE, PP, PVC, PS; Engineering Plastics: PA, Fluoropolymers, Polyesters;

SECTION-C

Thermosets – Phenolics and Epoxy Resins; Rubbers: Natural and Synthetic, Additives; High-Performance Polymers: PEEK; Structure-Property Relationships: Chemical Properties, Solubility, Mechanical Properties, Calorimetric Properties, Electrical Properties, Optical Properties, Acoustic Properties,

SECTION-D

Processability; Smart Materials: Shape Memory Alloys, Super Alloys, High Entropy Alloys, Magnetorheological and Electrorheological Fluids, Gels

TEXT BOOKS & REFERENCES:

1. . Introduction to Materials Science and Engineering, William J Callister, John Wiley & Sons, Inc.
2. K. Vijayamohanan Pillai and Meera Parthasarathi Functional Materials: A Chemist's Perspective by, Orient Blackswan (21 November 2013)
3. Physical Metallurgy Principles Reed-Hill - R. E., and R. Abbaschian, 3rd ed. Boston: PWS-Kent, 1992.
4. Structure and Properties of Engineering Alloys - Smith, W. F., McGrawHill, 1981. .

Mapping of Course Outcomes and Program Outcomes

Course Outcomes	Program Outcomes						Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
CO1			2	2		1		2	
CO2			2	2		1		2	
CO3			3	2		2		2	
CO4			3	3		2		2	

Course Title/ Code	ADVANCED MATERIAL SCIENCE LAB/ MEH604B-P
Course Type	Elective
Course Nature	Hard
L-T-P Structure	0-0-2
Credits	1

Course Outcome	Mapping
CO1: Understand and differentiate conventional and non-conventional machining process	Skill Development
CO2: Understand various Advanced casting, welding, and metal forming process.	Skill Development
CO3: Understand the basics of additive manufacturing and micro machining	Skill development
CO4: Understand the basics of Micro machining Robotics and 3D printing	Startup/Employability

List of Experiments:

1. Study of microstructure of pure metals – Iron, copper and aluminum.
2. Study of microstructure of low carbon steel, mild steel and high carbon steel.
3. Study of microstructure of cast irons.
4. Study of microstructure of non-ferrous alloys – aluminum, copper, titanium, nickel and their alloys.
5. Study hardenability of steels by Jominy End Quench Test.
6. Study of microstructure of heat treated steels.
7. Find hardness of various untreated and treated steels.
8. Study of microstructure of ceramics, polymeric materials.
9. Study of microstructure of super alloy and nano-materials.
10. Find the hardness of ceramics, super alloys, nano-materials and polymeric materials (one sample on each)

TEXT BOOKS & REFERENCES:

1. . Introduction to Materials Science and Engineering, William J Callister, John Wiley & Sons, Inc.
2. K. Vijayamohanan Pillai and Meera Parthasarathi Functional Materials: A Chemist's Perspective by, Orient Blackswan (21 November 2013)
3. Physical Metallurgy Principles Reed-Hill - R. E., and R. Abbaschian, 3rd ed. Boston: PWS-Kent, 1992.
4. Structure and Properties of Engineering Alloys - Smith, W. F., McGrawHill, 1981. .

Mapping of Course Outcomes and Program Outcomes

Course Outcomes	Program Outcomes						Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
CO1			2	2		1		2	
CO2			2	2		1		2	
CO3			3	2		2		2	
CO4			3	3		2		2	

Course Title/ Code	CAD/CAM FOR ENGINEERS/ MEH605B-T
Course Type	CORE
Course Nature	HARD
L-T-P Structure	3-0-0
Credit	3

Course Outcome	Mapping
CO1: Use parametric 3D CAD software tools in the correct manner for making geometric part models.	Employability/Skill Development/Entrepreneurship
CO2: Draft and Assemble the Surface Model by using CAD Software.	Employability/Skill Development/Entrepreneurship
CO3: Justify the solid modeling concepts and techniques in Rapid Prototyping.	Employability/Skill Development/Entrepreneurship
CO4: Generate the Products as per the latest technology.	Employability/Skill Development/Entrepreneurship

SECTION-A

Introduction: Definition and scope of CAD/CAM, Introduction to design process and role of computers in the design process. Transformations: 2D and 3D transformations. Curves and Surfaces: Analytical, Synthetic curves with advantages, Disadvantages, Comparison with parametric curves, Geometric modeling curves and surfaces, Representation, Wire frame models, Parametric representations, Parametric curves and surfaces, Manipulations of curves and surfaces, DDA, Bresenham's /Mid point line, circle, ellipse algorithms.

SECTION-B

Solid modeling: Solid models, Fundamentals of solid modeling, Different solid representation schemes, Half -spaces, Boundary representation (B-rep), Constructive solid geometry (CSG), Sweep representation, Analytic solid modeling, Perspective, Parallel projection, Hidden line removal algorithms. CAD/CAM Data Exchange Formats: Types of file formats & their exchange, Graphics standards.

SECTION-C

Introduction: Need of NC technology, Fundamental concepts in numeric control: structure and functions of NC System, advantages of NC technology over conventional manufacturing. NC Machine Tools: Types, Definition and designation of control axes,Special constructional and design characteristics of NC machine tools, Standard tooling used for NC turning and milling centres. NC Part Programming: Work holding and tool setting procedure for NC turning and milling centres, Tool zero presetting, Block formats and introduction to ISO based G & M codes for NC part programming, Concepts of tool length and radius compensation, Standard canned cycles used in CNC turning and milling centres, Introduction to automatic

SECTION-D

NC part program generation from CAD models using standard CAD/CAM software for machining of surfaces, moulds and dies etc. Computer Numerical Control of Machine Tools: Types and functions of computer numeric control (CNC), Types and functions of direct numeric control (DNC), Need of adaptive control types, functions and types of adaptive control, its uses & benefits, Advantages of combined CNC/DNC systems. System Devices: Drives, Feedback devices, Interpolator systems, Control loop circuit

elements in point to point (PTP) and contouring system, Interpolation schemes for linear and circular interpolations.
Laboratory Work: Graphics programming in C++/MATLAB for geometric modeling of different Curves, Surfaces and Solid primitives. The generated geometric models will have the capability to be modified as per the user's requirements.
Laboratory Work: Exercises in tool presetting and workpiece referencing on CNC machine tools, manual part programming for CNC turning and milling centres, Use of software for simulation of turned and milled parts and simple surfaces, Automatic Cutter location data generation from CAD Models in APT format and post-processing for machining on CNC machines using standard CAD/CAM software.

Recommended Books

1. Zeid, I., CAD/CAM, McGraw Hill (2008).
2. Rogers, D. F. and Adams, J. A., Mathematical Elements for Computer Graphics, McGraw Hill (1989).
3. Rogers, D. F., Procedural Elements for Computer Graphics, McGraw Hill (2008).
4.Groover, M. P. and Zimmers, E. W., CAD/CAM:Computer Aided Design & Manufacturing, 2006, Pearson Education India
5. Hood-Daniel P., and Kelly J.F., Build Your Own CNC Machine, 2009, Springer-Verlag New York

Mapping of Course Outcomes and Program Outcomes

Course Outcomes	Program Outcomes (POs)						PSO1	PSO2	PSO3
	1	2	3	4	5	6			
CO1	1	-	3	-	1	-	-	2	
CO2	1	-	3	-	1	-	-	2	
CO3	1	-	3	-	1	-	-	2	
CO4	1	-	3	-	1	-	-	2	

Course Title/ Code	CAD/CAM FOR ENGINEERS LAB/ MEH605B-P
Course Type	CORE
Course Nature	HARD
L-T-P Structure	0-0-2
Credit	1

Course Outcome	Mapping
CO1: Able to generate Solid 3D Modeling.	Employability/Skill Development/Entrepreneurship
CO2: Able to generate Surface 3D Modeling.	Employability/Skill Development/Entrepreneurship
CO3: Able to connect CAD Software Data and 3D Printer.	Employability/Skill Development/Entrepreneurship
CO4: Able to connect CAD Software Data and CNC Machine.	Employability/Skill Development/Entrepreneurship

List of Experiments

1 Simulation of CNC Step Turning and Facing
2 CNC Step Turning and Facing
3 Simulation of CNC Taper Turning and Chamfering
4 CNC Taper Turning and Chamfering
5 Simulation of CNC Simple Turning and Chamfering and Fillet
6 CNC Simple Turning and Chamfering and Fillet
7 Simulation of CNC Simple Turning and Threading
8 CNC Simple Turning and Threading
9 Simulation of CNC Milling
10 CNC Milling
11 Simulation of CNC Drilling and Reaming
12 CNC Drilling and Reaming

Recommended Books

1. Zeid, I., CAD/CAM, McGraw Hill (2008).
2. Rogers, D. F. and Adams, J. A., Mathematical Elements for Computer Graphics, McGraw Hill (1989).
3. Rogers, D. F., Procedural Elements for Computer Graphics, McGraw Hill (2008).
4.Groover, M. P. and Zimmers, E. W., CAD/CAM:Computer Aided Design & Manufacturing, 2006, Pearson Education India
5. Hood-Daniel P., and Kelly J.F., Build Your Own CNC Machine, 2009, Springer-Verlag New York

Mapping of Course Outcomes and Program Outcomes

Course Outcomes	Program Outcomes (POs)						PSO1	PSO2	PSO3
	1	2	3	4	5	6			
CO1	1	-	3	-	1	-	-	2	
CO2	1	-	3	-	1	-	-	2	
CO3	1	-	3	-	1	-	-	2	
CO4	1	-	3	-	1	-	-	2	

Course Tittle/Code	MACHINE TOOL DESIGN/ MEH606B-T
Course Type	Elective
Course Nature	Hard
L-T-P Structure	3-0-0
Credit	3

Course Outcome	Mapping
CO1: Calculate the forces and stresses in tools.	Employability/Skill Development/Entrepreneurship
CO2: Classify the different types of tools in Industry.	Employability/Skill Development/Entrepreneurship
CO3: Justify the materials of various components of tools.	Employability/Skill Development/Entrepreneurship
CO4: Design the different types of tools in Industry.	Employability/Skill Development/Entrepreneurship

SECTION-A

Introduction: Developments is machine tools, types of machine tools surface, profits and paths produced by machine tools. Features of construction and operations of basic machine tools e.g. lathe, drill, milling shapes and planers, grinding machine etc. General requirement of machine tool design. Machine tool design process. Tool wear, force Analysis.

SECTION-B

Machine Tools Drives: Classification of machine tool drives, group Vs individual drives, election of electric motor, A brief review of the elements of mechanical transmission e.g. gear, belt and chain drives, slider-crank mechanism, cam mechanism, nut & Screw transmission, Devices for intermittent motion, reversing & differential mechanisms. Couplings and clutches Elements of hydraulic transmission system. e.g. pumps, cylinder, directional control valves, pressure valves etc. Fundamentals of Kinematics structure of machine tools.

SECTION-C

Regulation of Speed and Feed rates: Laws of stepped regulation, selection of range ratio, standard progression ratio, selection of best possible structural diagram, speed chart, Design of feed box, Developing gearing diagrams. Stepless regulation of speed and feed in machine tool, speed and feed control.

SECTION-D

Design of Machine Tool Structure: Requirements and design criteria for machine tool structures, selection of material Basic design procedure for machine tool structures, design of bed, column and housing, Model technique in design. Design of guideways and power screws: Basic guideway profiles, Designing guideway for stiffness a wear resistance & hydrostatic and antifriction guideways. Design of sliding friction power Screws. Design of spindlier & spindle supports. 3 Layout of bearings, selection of bearings machine tools.

TEXT BOOKS & REFERENCES:

1. N.K.Mehta, Machine Tool Design, Tata McGraw Hill Publishing

2. Acherkan, Machine Tool Design, Mir publishing
3. Sen & Bhattacharya, Machine Tool Design, CBS Publications
4. S. K. Basu, Machine Tool Design, Oxford & IBH Publishing
5. Machine Tool Design Handbook, Tata McGraw-Hill Education, 1982

Mapping of Course Outcomes and Program Outcomes

Course Outcomes	Program Outcomes (POs)						PSO1	PSO2	PSO3
	1	2	3	4	5	6			
CO1	1	-	3	-	1	-		2	
CO2	1	-	3	-	1	-		2	
CO3	1	-	3	-	1	-		2	
CO4	1	-	3	-	1	-		2	

Course Tittle/Code	MACHINE TOOL DESIGN LAB/ MEH606B-P
Course Type	Elective
Course Nature	Hard
L-T-P Structure	0-0-2
Credit	1

Course Outcome	Mapping
To study the design process of speed regulatory and driving mechanism of machine tools	Employability/Skill Development/Entrepreneurship
To know the design process of the guide ways of machine tool along with the structures as associated	Employability/Skill Development/Entrepreneurship
To know and select the proper speed and feed mechanism for machine tool	Employability/Skill Development/Entrepreneurship
To know the process of testing and acceptance of machine tools	Employability/Skill Development/Entrepreneurship

LIST OF EXPERIMENTS:

1. Measurement and analysis of cutting forces in orthogonal turning.
2. Process capability determination of a center lathe.
3. Efficiency testing of lathe at various parameters.
4. Accuracy analysis of finished cylindrical work-pieces produced on a lathe.
5. Turning with two simultaneously cutting tool (one from front on usual tool post and the other tool from back on tool-fixture on carriage)
6. Laboratory practice on modelling and numerical analysis of machine components using CATIA, ANSYS

Visit to relevant industries for demonstration on CNC machining centres, special purpose machines and plastic
processing machines.

TEXT BOOKS & REFERENCES:

1. N.K.Mehta, Machine Tool Design, Tata McGraw Hill Publishing
2. Acherkan, Machine Tool Design, Mir publishing
3. Sen & Bhattacharya, Machine Tool Design, CBS Publications
4. S. K. Basu, Machine Tool Design, Oxford & IBH Publishing
5. Machine Tool Design Handbook, Tata McGraw-Hill Education, 1982

Mapping of Course Outcomes and Program Outcomes

Course Outcomes	Program Outcomes (POs)						PSO1	PSO2	PSO3
	1	2	3	4	5	6			
CO1	1	-	3	-	1	-		2	
CO2	1	-	3	-	1	-		2	
CO3	1	-	3	-	1	-		2	
CO4	1	-	3	-	1	-		2	

Course Tittle/Code	**SEMINAR/ MES607B**
Course Type	**CORE**
Course Nature	**Hard**
L-T-P Structure	**0-0-4**
Credit	**2**

Course Outcome	**Mapping**
CO1: To show competence in identifying relevant information, defining and explaining topics in a manner appropriate to the subject and also they will be able to demonstrate use of appropriate methodologies, show insight into a topic, and clarity of purpose.	**Employability/ Skill Development/ Entrepreneurship**

Mapping of Course Outcomes and Program Outcomes

Course Outcomes	**Program Outcomes (POs)**						**PSO1**	**PSO2**	**PSO3**
	1	**2**	**3**	**4**	**5**	**6**			
CO1	**3**	**2**	**2**	**2**	**2**	**2**	**3**	**3**	**3**

Course Tittle/Code	Dissertation/Project report / MEN608B
Course Type	CORE
Course Nature	Hard
L-T-P Structure	0-0-6
Credit	3

Course Outcome	Mapping
CO1: An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering	Employability/ Skill Development/ Entrepreneurship
CO2: An ability to apply engineering design to produce solutions that meet specified needs with consideration of safety, environmental, and economic factors.	Employability/ Skill Development/ Entrepreneurship
CO3: An ability to communicate effectively with a range of audiences	Employability/ Skill Development/ Entrepreneurship
CO4: An ability to develop and conduct appropriate experimentation	Employability/ Skill Development/ Entrepreneurship

Mapping of Course Outcomes and Program Outcomes

Course Outcomes	Program Outcomes (POs)						PSO1	PSO2	PSO3
	1	2	3	4	5	6			
CO1	3	3							
CO2	3	3		3		3			
CO3			3	3		3	3		
CO4			3			3	3	3	3

SEMESTER-4										
SUBJECT CODES	**SUBJECT NAME**	**OFFERING DEPARTMENT**	**COURSE NATURE (HARD/SOFT/ WORKSHOP/NTCC**	**COURSE TYPE (CORE/ELECTIVE/ UNIVERSITY COMPULSORY**	**L**	**T**	**P**	**O**	**NO. OF CONTACT HOURS PER WEEK**	**NO. OF CREDITS**
MEH609B/ MEH610B	LEAN MANUFACTURING/ STATISTICAL QUALITY CONTROL	ME	HARD	CORE	3	0	0	0	3	3
MEN611B	DISSERTATION WORK	ME	HARD	NTCC	0	0	24	0	24	12
TOTAL (L-T-P/CONTACT HOURS/CREDITS)					**3**	**0**	**24**	**0**	**27**	**15**

Course Title / Code	LEAN MANUFACTURING/ MEH609B
Course Type	Elective
Course Nature	Hard
L-T-P Structure	(3-0-0)
Credit	3

Course Outcome	Mapping
CO1 : - To Understand basics of Lean manufacturing	Employability
CO2:- To Identify and apply Lean Manufacturing Tools and Methodologies in Industry	Employability
CO3:-To Understand and analyze concept of just in time manufacturing	Employability
CO4: - To Apply and analyze Six Sigma, Lean and ERP technique in Industry	Employability

SECTION A

Introduction to Lean Manufacturing: Objectives of Lean Manufacturing, Key Principles And Implications Of Lean Manufacturing, Traditional Vs Lean Manufacturing.

Lean Manufacturing Concepts: Value creation and waste elimination, Main kinds of waste, Pull Production, Different models of Pull Production, Continuous flow, Continuous improvement (Kaizen), Worker involvement, Cellular layout, Administrative lean.

SECTION B

Lean Manufacturing Tools And Methodologies: Standard work, Communication of standard work to employees, Standard work and flexibility, Visual controls, Quality at the source, 5S principles.
Preventive maintenance, Total quality management, Total productive maintenance, Changeover/setup time, Batch size reduction, Production leveling.

Value Stream Mapping: The current state diagram, the future state map, Application to the factory simulation scenario, Line Balancing, Poka-Yoke, Kanban, Overall equipment effectiveness.

SECTION C

Just In Time Manufacturing: Introduction, Elements of JIT, Uniform production rate, Pull versus push method, Kanban system, Small lot size, Quick & Inexpensive set-up, Continuous improvement, Optimized production technology.
One-Piece Flow: Process Razing Techniques, Cells for assembly line, Case studies

SECTION D

Implementing Lean: Roadmap, Senior Management Involvement, Best practices.

Reconciling Lean with Other Systems: Toyota production system, Lean & Six Sigma, Lean and ERP, Lean with ISO9001:2000.

TEXT BOOKS & REFERENCES

1. Lean Manufacturing by By Aza Badurdeen

Mapping of Course Outcomes and Program Outcomes

Course Outcomes		PO's					PSO's		
	1	2	3	4	5	6	PSO1	PSO2	PSO3
CO1		3	2	3		2	2		2
CO2		3	3	2		2	2		3
CO3		2	3	2		2	3		3
CO4		2	2	3		3	2		2

Course Title / Code	STATISTICAL QUALITY CONTROL/ MEH610B
Course Type	Elective
Course Nature	Hard
L-T-P Structure	(3-0-0)
Credit	3

Course Outcome	Mapping
CO1 To gain an understanding and appreciation of different dimensions of quality and quality tools	Skill Development/ Employability
CO2 Description of the various philosophies of evolution of quality.	Skill Development/ Employability
CO3 Explain the importance of quality control and apply statistical techniques to measure quality control	Skill Development/ Employability
CO4 To apply various quality improvement techniques and to understand quality management system	Skill Development/ Employability

SECTION-A

The Meaning of Quality and Quality Improvement; Brief History of Quality Methodology; Statistical Methods for Quality Control and Improvement; Total Quality Management (quality philosophy, links between quality and productivity, quality costs, legal aspects of quality implementing, quality improvement).

Mean, Median, Mode, Standard deviation, Calculating area, The Deming funnel experiment, Normal distribution tables, Finding the Z score, Central limit theorem.

SECTION-B

Chance and assignable causes, Statistical Basis of the Control Charts (basic principles, choices of control limits, significance of control limits, sample size and sampling frequency, rational subgroups, analysis of pattern on control charts, warning limits, Average Run Length-ARL)

Control Charts for X-Bar and R- Charts, Type I and Type II errors, the probability of Type II error. Simple Numerical Problems

SECTION-C

The foundation of process capability, Natural Tolerance limits, cp – process capability index, cpk, pp – process performance index, summary of process measures. Numerical problems

Binomial distribution, Poisson distribution (from the point of view of Quality control) Control Chart for Fraction Nonconforming, Control Chart for number Nonconforming, ControlCharts for Nonconformities or Defects, Control Chart for Number of non conformities per unit. Numerical problems

SECTION-D

The acceptance sampling problem, single sampling plan for attributes, Double, Multiple, and Sequential sampling, AOQL, LTPD, OC curves, Military Standard 105E, the Dodge-Romig sampling plans. Numerical problems

CUSUM Control Chart (basic principles of the chart for monitoring the process mean); EWMA control chart (EWMA control chart for monitoring process mean), design of an EWMA control chart.

TEXT BOOK & REFERENCES:

1. Introduction To Statistical Quality Control by Douglas C. Montgomery (Soft Copy available)
2. Statistical Quality control by E.L. Grant
3. Quality control and Industrial Statistics, by A.J. Duncan
4. Quality control by Dale H. Bestefield
5. Total Quality Control by A.Y. Feigenboum
6. Elementary S.O.L. by I.W.Burr, M. Dekkar

Mapping of Course Outcomes and Program Outcomes

Course Outcomes	PO's						Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
CO1				3		2		1	
CO2				3		2		2	
CO3				3		3		2	
CO4				3		3		3	

Course Tittle/Code	Dissertation Work / MEN611B
Course Type	CORE
Course Nature	Hard
L-T-P Structure	0-0-24
Credit	12

Course Outcome	Mapping
CO1: Identify recent technical topics from interested domains	Employability/ Skill Development/ Entrepreneurship
CO2: Analyze the applicability of modern software tools and technology	Employability/ Skill Development/ Entrepreneurship
CO3: Develop Presentation and Communication skills	Employability/ Skill Development/ Entrepreneurship
CO4: Develop Technical report preparation skills	Employability/ Skill Development/ Entrepreneurship

Mapping of Course Outcomes and Program Outcomes

Course Outcomes	Program Outcomes (POs)						PSO1	PSO2	PSO3
	1	2	3	4	5	6			
CO1	3	3	3						
CO2	3		3		3		3		3
CO3	3	3		3	3		3	3	
CO4	3	3	3		3			3	3