MANAV RACHNA UNIVERSITY

FACULTY OF ENGINEERING

DEPARTMENT OF MECHANICAL ENGINEERING

PROGRAM STRUCTURE

&

DETAILED SYLLABUS

M.Tech. Mechanical Engineering

BATCH: 2017-2019

MANAV RACHNA UNIVERSITY

DEPARTMENT OF MECHANICAL ENGINEERING

M.TECH (MEP01)

SEMESTER - 1

SUBJECT CODES	SUBJECT NAME	**OFFERING DEPARTMENT	*COURSE NATURE (Hard/Soft/	COURSE TYPE (Core/Elective /	L	T	P	O	NO. OF CONTACT HOURS PER	NO. OF CREDITS
MEH501-T	MODERN MANUFACTURING PROCESSES	ME	HARD	CORE	3	0	0	1	4	4
MEH501-P	MODERN MANUFACTURING PROCESSES LAB	ME	HARD	CORE	0	0	2	0	2	1
MEH502-T	PRODUCTION SYSTEM & MANAGEMENT	ME	HARD	CORE	3	1	0	1	4	4
MEH502-P	PRODUCTION SYSTEM & MANAGEMENT LAB	ME	HARD	CORE	0	0	2	0	2	1
MEH503-T	METAL FORMING ANALYSIS	ME	HARD	CORE	3	0	0	1	4	4
MEH503-P	METAL FORMING ANALYSIS LAB	ME	HARD	CORE	0	0	2	0	2	1
MEH504/ MEH505	ELECTIVE OFFERED BY PARENT DEPARTMENT	ME	HARD	CORE	3	0	2	1	6	5
PHS501	RESEARCH METHODOLOGY	PHY	SOFT	CORE	1	0	2	0	3	2
MEW506	WORKSHOP	ME	HARD	CORE	0	0	3	0	3	2
	TOTAL (L-T-P-O/CONTACT HOURS/CREDITS)				**13**	**1**	**13**	**4**	**30**	**24**

	SEMESTER-2									
SUBJECT CODES	**SUBJECT NAME**	****OFFERING DEPARTMENT**	***COURSE NATURE (Hard/Soft/**	**COURSE TYPE (Core/Elective /**	**L**	**T**	**P**	**O**	**NO. OF CONTACT HOURS PER**	**NO. OF CREDITS**
MEH507-T	PRODUCTION ERGONOMICS & WORK PLACE DESIGN	ME	HARD	CORE	3	0	0	1	4	4
MEH507-P	PRODUCTION ERGONOMICS & WORK PLACE DESIGN LAB	ME	HARD	CORE	0	0	2	0	2	1
MEH508-T	WELDING & ALLIED PROCESSES	ME	HARD	CORE	3	0	0	1	4	4
MEH508-P	WELDING & ALLIED PROCESSES LAB	ME	HARD	CORE	0	0	2	0	2	1
MEH509/ MEH510	ELECTIVE OFFERED BY PARENT DEPARTMENT	ME	HARD	CORE	3	0	2	1	6	5
MEH511/ MEH512	ELECTIVE OFFERED BY PARENT DEPARTMENT	ME	HARD	CORE	3	0	2	0	5	4
MES515	RESEARCH PAPER WRITING /SEMINAR	ME	HARD	CORE	1	0	2	0	3	2
MEW513	WORKSHOP (CNC PROGRAMMING)	ME	HARD	CORE	0	0	3	0	3	2
MEN514	SEMINAR (PROBLEM IDENTIFICATION & LITERATURE REVIEW)	ME	HARD	CORE	0	0	0	1	1	1
	TOTAL (L-T-P-O/CONTACT HOURS/CREDITS)				**13**	**0**	**13**	**4**	**30**	**24**
MEW104	SUMMER TRAINING POST 2nd SEMESTER									6

	SEMESTER-3									
SUBJECT CODES	**SUBJECT NAME**	****OFFERING DEPARTMENT**	***COURSE NATURE (Hard/Soft/**	**COURSE TYPE (Core/Elective /**	**L**	**T**	**P**	**O**	**NO. OF CONTACT HOURS PER**	**NO. OF CREDITS**
MEH616-T	THEORY OF METAL CUTTING	ME	HARD	CORE	3	0	0	1	4	4
MEH616-P	THEORY OF METAL CUTTING LAB	ME	HARD	CORE	0	0	2	0	2	1
MEH617-T	ADVANCED OPTIMISATION TECHNIQUES	ME	HARD	CORE	3	0	0	0	3	3
MEH617-P	ADVANCED OPTIMISATION TECHNIQUES LAB	ME	HARD	CORE	0	0	2	0	2	1
MEH618/ MEH619	ELECTIVE OFFERED BY PARENT DEPARTMENT	ME	HARD	CORE	3	0	2	0	5	4
MEH620/ MEH621	ELECTIVE OFFERED BY PARENT DEPARTMENT	ME	HARD	CORE	3	0	2	0	5	4
MEW622	WORKSHOP	ME	HARD	CORE	0	0	3	0	3	2
MES624	RESEARCH PAPER WRITING/ SEMINAR	ME	HARD	CORE	1	0	2	0	3	2
MEN623	DISSERTATION PREPARATION / PROJECT REPORT	ME	HARD	CORE	0	0	0	3	3	3
	TOTAL (L-T-P-O/CONTACT HOURS/CREDITS)				**13**	**0**	**13**	**4**	**30**	**24**

SEMESTER-4

SUBJECT CODES	SUBJECT NAME	**OFFERING DEPARTMENT	*COURSE NATURE (Hard/Soft/	COURSE TYPE (Core/Elective /	L	T	P	O	NO. OF CONTACT HOURS PER	NO. OF CREDITS
MEH626-T	LEAN MANUFACTURING	ME	HARD	CORE	3	0	0	0	3	3
MEH626-P	LEAN MANUFACTURING LAB	ME	HARD	CORE	0	0	2	0	2	1
MEH627/ MEH628	ELECTIVES OFFERED BY PARENT DEPARTMENT	ME	HARD	CORE	3	0	2	0	5	4
MEN629	DISSERTATION WORK	ME	HARD	CORE	0	0	0	12	12	12
	TOTAL (L-T-P-O/CONTACT HOURS/CREDITS)				**6**	**0**	**4**	**12**	**22**	**20**

***COURSE NATURE**	**Hard course (H)**: A course having L-T-P and/or O component ; L(Lecture), T(Tutorial), P(Practical) and O(Outcome)
	Soft Course (S): A course aimed at development of a person's emotional, social, ethical, professional and creative potentials. The course shall have L-P and/or O component
	Workshop course(W): A completely 'hands on' course conducted in laboratory, aimed at developing application/ implementation/ designing skills of a person. The course shall have P component
	Non Teaching Credit Course(N): The course involves no teaching and has P and O component. Shall include projects, seminars, dissertations etc.

*** Electives are subject to change according to expertise available/ required.

PROGRAMME BOOKLET

M.Tech. Mechanical Engineering (MEP01)

(Batch: 2017-19)

Department of Mechanical Engineering
Faculty of Engineering
Manav Rachna University

MECHANICAL ENGINEERING

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.**

MECHANICAL ENGINEERING

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.

MECHANICAL ENGINEERING

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.

MECHANICAL ENGINEERING

Semester 1 (Total Credit-24)

Nature of the course/ Type of the course	Hard Course (3-0-2-1) Name (Offering Department)	Soft Course (2-0-0) Name (Offering Department)	Workshop (0-0-3) name (Offering Department)
Domain Core	Modern Manufacturing Processes & Analysis (ME)		
	Production Systems & Management (ME)		Manufacturing Operations in Workshop (ME)
	Metal Forming Analysis (ME)	Research Methodology (ME)	
Domain Elective	Advanced Metrology (ME)		
	Work Measurement Techniques (ME)		
Allied Elective			
Credits	20	2	2
AUDIT COURSE			
Total credits	24		
Total no of hours	30		

MECHANICAL ENGINEERING

Semester 2 (Total Credit-24)

Nature of the course/ Type of the course	Hard Course (3-0-2-1) NTCC Course (0-0-0-1)/(00-0-6) Name (Offering Department)	Soft Course (1-0-2-0) / Name (Offering Department)	Workshop (0-0-3-0) name (Offering Department)
Domain Core	Production Ergonomics & Work Place Design (ME)		
	Welding & Allied Processes (ME)		
		Research Paper Writing/Seminar (ME)	CNC Programming (ME)
Allied Core			
Domain Elective-I	Computer Integrated Manufacturing (ME)		
	Industrial Automation (ME)		
Domain Elective-II	Rapid Prototyping (ME)		
	Advanced Foundry Technology(ME)		
Allied Elective			
NTCC	Seminar (Problem Identification & Literature Review) (ME)		
Credits	20	2	2
Audit Course			
Total Credits	24		
No of Hours	30		

MECHANICAL ENGINEERING

Semester 3 (Total credit – 24)

Nature of the course/ Type of the course	Hard Course (3-0-2-1) Domain Elective (3-0-2-0) NTCC Course (0-0-0-3) Name (Offering Department)	Soft Course (1-0-2-0) / Name (Offering Department)	Workshop (0-0-3-0) name (Offering Department)
Domain Core	Theory of Metal Cutting (ME)		
	Advanced Optimization Techniques (ME)	Research Paper Writing/ Seminar (ME)	MATLAB (ME)
Allied Core			
Domain Elective	Production Logistics & Supply Chain Management		
	Advanced Material Science (ME)		
	CAD/ CAM in Engg. Process		
	Machine Tool Design (ME)		
Allied Elective			
NTCC	Dissertation Preparation Project Course (ME)		
Credits	20	2	2
Audit Course			
Total Credits	24		
No of Hours	30		

MECHANICAL ENGINEERING

Semester 4 (Total credit – 20)

Nature of the course/ Type of the course	Hard Course (3-0-2-0) NTCC Course (0-0-0-12) Name (Offering Department)	Soft Course (1-0-2) Name (Offering Department)	Workshop (0-0-3) name (Offering Department)
Domain Core	Lean Manufacturing (ME)		
Allied Core			
Domain Elective	Reliability Engineering (ME)		
	Statistical Quality Control (ME)		
Allied Elective			
NTCC	Dissertation Work (ME)		
Credits	20	0	0
Total Credits	20		
Total Hours	22		

Semester 1-2	24+24 credits respectively
Summer Training Post 2nd Semester	6 credits : 60 hours module
Semester 3-4	24+20 credits respectively
Manav Rachna Life Skill Development	1 credit
Total	99 Credits

MECHANICAL ENGINEERING

Semester 1 (Total Credit-24)

Nature of the course/ Type of the course	Hard Course (3-0-2-1) Name (Offering Department)	Soft Course (2-0-0) Name (Offering Department)	Workshop (0-0-3) name (Offering Department)
Domain Core	Modern Manufacturing Process & Analysis (ME)		
	Production Systems & Management (ME)		Manufacturing Operations in Workshop (ME)
	Metal Forming Analysis (ME)	Research Methodology (ME)	
Domain Elective	Advanced Metrology (ME)		
	Work Measurement Techniques (ME)		
Allied Elective			
Credits	20	2	2
AUDIT COURSE			
Total credits	24		
Total no of hours	30		

Course Title/Code	MODERN MANUFACTURING PROCESSES & ANALYSIS (MEH501)
Course Type	Core
Course Nature	Hard
L-T-P-O structure	3-0-2-1
Prerequisite	NIL

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 Setup, 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.

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
    - Electro-discharge Machining
    - Wire-EDM
4. Optimal analysis of process parameters to achieve desired surface finish by machining a job on EDM.

Course Title/Code	PRODUCTION SYSTEM & MANAGEMENT (MEH502)
Course Type:	Core
Course Nature:	Hard
L-T-P-O Structure	(3-0-2-1)
Prerequisite	NIL

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 MonteCarlo 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).

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.

Course Title/ Code	METAL FORMING ANALYSIS (MEH503)
Course Type:	Core
Course Nature:	Hard
L-T-P-O Structure	(3-0-2-1)
Prerequisite	NIL

SECTION-A

Introduction: Stress- Strain relations in Elastic and plastic Deformations, Yield Criteria for Ductile Metals, Work hardening and Anisotropy in Yielding, Flow Curves, Classification of forming process, Forming defects in products and their critical effects, remedies, Friction and lubrication in metal forming processes, Effects of temperature and strain rate in metal working, friction and lubrication in Hot and Cold working.

SECTION-B

Process Analysis: Various methods of analyzing the metal working processes - Slip line field theory. Formulations of plastic deformation problems, application of theory of plasticity for solving metal forming problems using Slab method, Upper and lower Bound methods.

SECTION-C

Mechanics of Forming Processes: Rolling-Determination of rolling pressure, roll separating force, driving torque and power, Power loss in bearings, Forging-Forces in strip forging and disc forging, Drawing-determination of force and power, Maximum allowable reduction, Deep drawing force analysis, Analysis of tube drawing process with fixed and moving mandrel, Tandem tube drawing, Bending- Determination of work load and spring back, ExtrusionDetermination of work load from stress analysis and energy consideration, Power loss, Hydrostatic extrusion, Punching & Blanking-Mode of metal deformation and failure, 2D deformation model and fracture analysis, Determination of work force.

SECTION-D

Application of Finite Element Methods to Metal Forming Processes: Discretization, Shape function, Stiffness matrices and their assembly, Implicit and explicit formulations, Elasto-plastic approximations, Lagrangian Vs Eularian schemes, Material integration schemes, auxiliary equations for contact, friction and incompressibility, Thermo-mechanical problem formulation, steady state solutions for Drawing, Forging, rolling and extrusion problems, Case Studies- analysis and validation of metal forming processes problems by standard software, An introduction to use of International standards in Metal Forming Problem solutions and system Design.

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

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.

Course Title/ Code	ADVANCED METROLOGY (MEH504)
Course Type:	Elective
Course Nature:	Hard
L-T-P-O Structure	(3-0-2-1)
Prerequisite	NIL

SECTION A

Metrological Concepts:Objectives of Metrology, Metrological characteristics of Measuring Instruments, Abbe‟s principle, Precision & Accuracy of Measurement, Factors affecting Accuracy, Need for high precision measurement, Problems associated with high precision measurements, Surface and form metrology - flatness, roughness, waviness cylindricity etc., Dimensioning & Dimensional chains.

SECTION B

Design Consideration for Gauges and Measuring Instruments: Gauging Principles, Material Selection for Gauges, Hardness and Surface Finish, Tolerance for Linear and Dimensional Chains, Limits, Fits Allowances and Tolerance as Per Indian and International Standards, Go Gauge, No Go Gauge, Ring Gauge, Thread Gauge, Snap Gauge. Gauging Assembly.

Form Metrology:Screw thread measurement, Thread size measurement by two wire and three wire methods, Measurement of various elements of thread, Pitch measurement, Thread gauges, Gear measurement, Radius measurement, Vernier gear tooth gauge.

SECTION C

Linear and Angular Measurement: Standards for length measurement and their calibration, Light interference, Method of coincidence, Slip gauge calibration, Measurement errors, Various tolerances and their specifications, Comparators– Mechanical, Mechanical-Optical, Pneumatic, Electrical; Angular measurements - principles and instrument, LVDT & RVDT.

Surface Textures: Components of machined surface texture, Specification of surface texture, Surface roughness measuring device and techniques, Flatness Testing by Interferometry - N.P.L. Flatness Interferometer and The Pitter-N.P.L. Gauge Interferometer.

SECTION D

Computer Aided Metrology: Computer Aided Metrology - Principles and interfacing, Software metrology, Laser metrology - Applications of Lasers in precision measurements, Laser interferometry, Laser scanners. Coordinate Measuring Machine (CMM), Types of CMM, Probes used, Applications, Acoustical measurements, Computer Aided Inspection – Machine Vision, Applications in Metrology. Nanometrology – Introduction, Principles, Nanometer Metrology Systems, Methods of Measuring Length and Surfaces to nano scale result with interferometers and other devices

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.

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.

Course Title/ Code	WORK MEASUREMENT TECHNIQUES (MEH505)
Course Type:	Elective
Course Nature:	Hard
L-T-P-O Structure	(3-0-2-1)
Prerequisite	NIL

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, CustomerOrientation: 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

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

Course Title	RESEARCH METHODOLOGY (PHS501)
Course Type	Core
Course Nature	Soft
L-T-P-O structure	1-0-2-0
Prerequisites	NIL

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.

Course Title/ Code	MANUFACTURING OPERATIONS IN WORKSHOP (MEW506)
Course Type:	Core
Course Nature:	Workshop
L-T-P-O Structure	(0-0-3-0)
Prerequisite	NIL

List of Experiments:

1. Preparation of detailed drawing of the Component(s)/a Product.
2. Study workshop Layout in detail.
3. Locate and justify the Machine Tools Location.
4. Preparation of process sheets of the Component(s)/a Product.
5. Identify tools, fixtures and lubricants required for manufacturing by studying various drawings.
6. Identify different processes involved in manufacturing and prepare a schedule.
7. Identify quality and inspection techniques and tools.
8. Prepare a Prototype of the Component(s)/a Product.
9. Inspection of prepared Prototype with respect to various drawings.
10. Desired modifications are to be done in various drawings according to pointed-out variations on the basis of feedback.
11. Final scheduling will be done with post delivery date.
12. Preparation of final component(s)/product.

MECHANICAL ENGINEERING

Semester 2 (Total Credit-24)

Nature of the course/ Type of the course	Hard Course (3-0-2-1) NTCC Course (0-0-0-1)/(00-0-6) Name (Offering Department)	Soft Course (1-0-2-0) / Name (Offering Department)	Workshop (0-0-3-0) name (Offering Department)
Domain Core	Production Ergonomics & Work Place Design (ME)		
	Welding & Allied Processes (ME)		
		Research Paper Writing/Seminar (ME)	CNC Programming (ME)
Allied Core			
Domain Elective	Computer Integrated Manufacturing (ME)		
	Industrial Automation (ME)		
	Rapid Prototyping (ME)		
	Advanced Foundry Technology(ME)		
Allied Elective			
NTCC	Seminar (Problem Identification & Literature Review) (ME)		
	Summer Training (ME)		
Credits	24	2	2
Audit Course			
Total Credits	24		
No of Hours	30		

Course Title/ Code	PRODUCTION ERGONOMICS AND WORK PLACE DESIGN (MEH507)
Course Type:	Core
Course Nature:	Hard
L-T-P-O Structure	(3-0-2-1)
Prerequisite	NIL

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.

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

Course Title/ Code	WELDING AND ALLIED PROCESS (MEH508)
Course Type:	Core
Course Nature:	Hard
L-T-P-O Structure	(3-0-2-1)
Prerequisite	NIL

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.

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

Course Title/ Code	COMPUTER INTEGRATED MANUFACTURING (MEH509)
Course Type:	Elective
Course Nature:	Hard
L-T-P-O Structure	(3-0-2-1)
Prerequisite	NIL

SECTION A

CNC Systems and Programming: Numerical Control Machines, Classification, Design Considerations of NC machines, Tooling for CNC, NC programming, Computer aided programming, Drives and feedback drives, software and hardware interpolators, NC/CNC controller, DNC systems, adaptive control systems.

SECTION B

Manufacturing Automation: Introduction, Automation strategies, Automated Flow lines, Line Balancing, Automated Assembly systems, Automatic Material Handling and Storage systems, Automated Inspection systems, Group Technology, Cell Design, Cellular Manufacturing Systems, Computer Aided Process Planning, Flexible Manufacturing Systems, Computer Integrated Manufacturing, Components of CIM, Data base For CIM, Planning, Scheduling and Analysis of CIM systems

SECTION C

Robotics: Fundamentals of Robotics, Joints, Arm configurations, Wrists, design of end effectors, actuators, modular robots, Robot sensors and Machine vision. Forward Kinematics, Inverse kinematics, trajectory planning, manipulator dynamics - simple cases. Overview of robotic programming, Robot - Industrial and Non industrial applications

SECTION D

Artificial Intelligence in CIM: Artificial Intelligence (A.I.), Learning and Problem Solving, Knowledge Acquisition and Representation, Learning Systems, Expert systems, Expert system applications for CIM, Knowledge based systems (KBS), Applications of KBS for Assembly, Process Planning and Scheduling. Artificial Neural Networks, Fuzzy Logic and Fuzzy Sets, Multi layered networks, Applications of Fuzzy systems and ANNS for selection of Robots, Fault Diagnostics.

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

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

MECHANICAL ENGINEERING

Course Title/ Code	INDUSTRIAL AUTOMATION (MEH510)
Course Type:	Elective
Course Nature:	Hard
L-T-P-O Structure	(3-0-2-1)
Prerequisite	NIL

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 nonvibratory 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

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

Course Title/ Code	RAPID PROTOTYPING (MEH511)
Course Type:	Elective
Course Nature:	Hard
L-T-P-O Structure	(3-0-2-0)
Prerequisite	NIL

SECTION-A

Introduction: History and development of Rapid Prototyping systems, classification of RP systems, Application areas, Growth of RP industry.

Stereo Lithography Systems: Principle, Process parameter, Process details, Data preparation, Data files and Machine details.

SECTION-B

Selective Laser Sintering and Fusion Deposition Modeling: Types of machine, Principle of operation, process parameters, Data preparation for SLS, Applications, Principle of Fusion deposition modeling, Process parameter.

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

SECTION-C

Concepts Modelers: Principle, Thermal jet printer, Sander's model market. GenisysXs printer HP system 5, object Quadra systems. (SLE: 3-D printer)

Rapid Tooling:. Indirect Rapid tooling -Silicone rubber tooling –Aluminum filled epoxy tooling, Spray metal tooling, Cast kirksite, 3Q keltool, etc Direct Rapid Tooling., AIM, Quick cast process, Copper polyamide, Rapid

Tool, DMILS, Prometal, Sand casting tooling, Laminate tooling. (SLE: Soft Tooling v/s hard tooling)

SECTION-D

RP Process Optimization: Factors influencing accuracy. Data preparation errors, Part building errors, Error in finishing. (SLE: Influence of build orientation.)

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

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

Course Title/ Code	ADVANCED FOUNDRY TECHNOLOGY (MEH512)
Course Type:	Elective
Course Nature:	Hard
L-T-P-O Structure	(3-0-2-0)
Prerequisite	NIL

SECTION A

Solidification of Casting: Solidification of metals, Homogeneous and heterogeneous nucleation, Growth mechanism, Solidification of Pure metals and alloys, Mechanism of columnar and dendritic growth, Coring or Segregation, Solidification time and Chvorinov‟s rule, concept of progressive and directional solidifications, Material processing, castable nature of metals and alloys, Problems in casting materials with poor castability, Test for castability, Influence of plastic material properties on moulding, casting of thermosets.

Principles of Gating and Risering: Purpose of the gating system, Components of gating system and its functions, Design of gating system, Types of gates, Gating ratio and its functions. Functions, types and applications of the riser, design of riser and its shape, size and location, Use of insulating material and exothermic compounds in risers.

SECTION B

Design of Casting : Factors to be considered in casting design, design considerations in pattern making, Moulding techniques, Core making and assembly, Cooling stresses and hot spots in casting and modification in casting geometry to overcome them.

Casting defects and quality control: Casting defects and factors responsible for them, different inspection and testing methods to evaluate the casting, Quality control activities in a foundry, Salvaging methods of defective casting

SECTION C

Furnace Technology: Study of various furnaces used in foundry, Construction and operation of crucible and hearth furnaces, Arc and induction furnaces- construction, operation and application,

Heat treatment furnaces and drying ovens used in foundry, Real time chemical composition determination-

„Spectroscopy‟

Foundry Mechanization and Modernization: Introduction to modernization, Mechanization of foundry and its advantages, Mechanization of sand plant, Moulding and core making, mechanization in melting, pouring and shakeout units, Material handling equipments and conveyor systems, Brief sketches and description of layouts of job, Captive and mechanized foundries, Pollution control in foundry.

SECTION D

Cast Iron Foundry Practice: Chemical composition and structure of gray CI-Graphite structure in gray CI & graphite distribution, Inoculation of gray CI, Application of gray CI castings, Ductile Cast Iron-Chemical composition and structure of ductile CI, Melting and spherodisation treatment, Inoculation of ductile iron properties and applications of ductilities on casting.

Soft Material foundry Practice: Aluminum casting-Composition, properties and application of common aluminum alloy casting, Melting and casting of aluminum alloys, Gating and risering of Al-alloy casting, Copper alloy foundry. Practice General characteristics of common cast copper alloys, Melting and casting of copper alloys, Gating and risering of copper alloy castings.

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

MECHANICAL ENGINEERING

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.

Title/ Code	CNC PROGRAMMING (MEW513)
Course Type:	Core
Course Nature:	Workshop
L-T-P-O Structure	(0-0-3-0)
Prerequisite	NIL

LIST OF EXPERIMENTS:

1. Demonstration of CNC Milling machine with user interface and calculating the Co-ordinates of given geometry in absolute end increment mode for cutter path.

2. Introduction of G codes and M codes and write the CNC part programming for a given geometry using linear, Circular interpolation. 3. Write the CNC programming for a given geometry using Mirror and Subroutine.

3. Write the CNC programming for a given geometry using Tool Radius Compensation and Peck drilling cycles.
4. Introduction and programming of all canned cycle of milling machine.
5. Demonstration and study of CNC Lathe machine with sample programming.
6. Write CNC programming for given geometry (Lathe) using stock removal cycles.
7. Demonstration of FMS setup

Course Tittle/Code	RESEARCH PAPER WRITING/ SEMINAR (MES515)
Course Type	Core
Course Nature	Soft
L-T-P-O Structure	1-0-2-0
Prerequisite	NIL

Course Tittle/Code	SEMINAR (PROBLEM IDENTIFICATION & LITERATURE REVIEW) (MEN514)
Course Type	Core
Course Nature	NTCC
L-T-P-O Structure	0-0-0-1
Prerequisite	NIL

MECHANICAL ENGINEERING

Semester 3 (Total Credit-24)

Nature of the course/ Type of the course	Hard Course (3-0-2-1) Domain Elective (3-0-2-0) NTCC Course (0-0-0-3) Name (Offering Department)	Soft Course (1-0-2-0) / Name (Offering Department)	Workshop (0-0-3-0) name (Offering Department)
Domain Core	Theory of Metal Cutting (ME)		
	Advanced Optimization Techniques (ME)	Research Paper Writing/ Seminar (ME)	MATLAB (ME)
Allied Core			
Domain Elective	Production Logistics & Supply Chain Management		
	Advanced Material Science (ME)		
	CAD/ CAM in Engg. Process		
	Machine Tool Design (ME)		
Allied Elective			
NTCC	Dissertation Preparation Project Course (ME)		
Credits	20	2	2
Audit Course			
Total Credits	24		
No of Hours	30		

Course Title/ Code	THEORY OF METAL CUTTING (MEH616)
Course Type:	Core
Course Nature:	Hard
L-T-P-O Structure	(3-0-2-1)
Prerequisite	NIL

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

MECHANICAL ENGINEERING

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.

Course Title/Code	ADVANCED OPTIMIZATION TECHNIQUES (MEH617)
Course Type	Core
Course Nature	Hard
L-T-P-O structure	3-0-2-0
Prerequisites	NIL

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 Multidimensional Search Methods: Univariate search method, Method of steepest descent, Conjugate radiant method, Fletcher Reeves method.

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 Hill Inc. 1995.
3. J. S. Arora, Introduction to Optimum Design, McGraw Hill International Edition, 1989

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

Course Title/ Code	PRODUCTION LOGISTICS & SUPPLY CHAIN MANAGEMENT (MEH618)
Course Type	Elective
Course Nature	Hard
L-T-P-O Structure	3-0-2-0
Prerequisites	NIL

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.

LIST OF EXPERIMENTS:

Logistics & Supply Chain Management Laboratory is dedicated to support teaching, evaluation, and research in multiple areas including warehousing, supply chain management, inventory management, financial planning for distribution, logistics, technical sales and sales management and safety. The lab contains demonstration and simulation activities that allow students to manipulate equipment and products in the warehouse space and to identify and utilize supporting technology required for the management of multiple production and distribution strategies. Additionally the lab allows students to simulate the supply chain activities and information that flow between manufacturers, suppliers, and various end users.

Course Title/Code	ADVANCED MATERIAL SCIENCE (MEH619)
Course Type	Elective
Course Nature	Hard
L-T-P-O structure	3-0-2-0
Prerequisites	NIL

SECTION-A

Introduction, Demand of advanced materials, design principles and processing. Structural Materials: Porous matrix ceramics- composites, Metallic foam, Cellular Materials, Nano tubes, Nano wires.

SECTION-B

Mechanically alloyed oxide dispersion strengthened superalloys, High strength and ductile bulk quasi crystalline alloys and their composites. Thermal barrier coating for aero engines and gas turbines. Processing of Ni- base superalloys for turbine engine discs, Gamma- Titanium aluminades.

SECTION-C

Functional Materials: Low dielectric constant materials, optoelectronic materials. Glassy and Nano crystalline materials for soft and hard magnetic properties and their applications

SECTION-D

Smart Materials: Shape memory alloys, hydrogen storage alloys, Functionally gradient material (FGM), Self-healing materials. Materials Characterization Techniques: Scanning electron microscopy, transmission electron microscopy, atomic force microscopy, scanning tunneling microscopy, atomic absorption spectroscopy, differential scanning calorimetry etc.

TEXT BOOKS & REFERENCES:

1. Gandhi, M.V., Thompson, B.S., Smart Materials and Structures, Chapman and Hall
2. Ray, A.K. (ed), Advanced Materials, Allied publishers.
3. Rama Rao, P. (ed), Advances in Materials and their applications, Wiley Eastern Ltd.
4. Bhushan, B., Nano Technology (ed), Springer

LIST OF EXPERIMENTS:

1. To measure the tensile properties of several engineering materials. To investigate the relationship between strength, ductility, and fracture surface appearance in materials with a range of mechanical behaviors.
2. To measure and compare the impact toughness of several different materials. To become familiar with the standard toughness measuring tests. To investigate the ductile/brittle transition in engineering materials.
3. To investigate age-hardening in aluminum alloy. To relate the microstructural changes with the aging curve.
4. To study the order-disorder transition in Cu-Au alloy. To investigate the order-disorder kinetics in Cu_3Au .
5. To introduce the basic concepts and the tools of computer simulation through simple exercises. To simulate order-disorder transition. To compare the simulation with the experimental results.
6. To reinforce the understanding of fundamental atomic processes of diffusion in solids through simple exercises. To correlate the simulation and experimental results
7. To observe various stages of creep in metals at different temperatures. To determine stress exponent and the activation enthalpy for creep in pure A.
8. To introduce the basic concepts of slurry preparation, spray drying, dry pressing, binder burn-off and sintering processes. To investigate the sintering kinetics of ZnO.
9. To investigate charge transports in materials and observe the major differences among metals, semiconductors and insulators by evaluating their resistivities as a function of temperature

Course Tittle/Code	CAD/CAM IN ENGINEERING PROCESSES (MEW620)
Course Type	Elective
Course Nature	Hard
L-T-P-O Structure	3-0-2-0
Prerequisite	NIL

SECTION-A

Overview of Transformations, Projections, Curves, Surfaces and Solids.

Mathematical Representations: Intrinsic and Parametric representations, Differential Geometry applied to Curve and Surface Design.

Curves: Non uniform B-Spline (NUB) Curve Models, Rational Curves, Non Uniform Rational B-spline (NURB), Properties of Bezier curves, Manipulation of Curves.

Surfaces: Sculptured, Coons patches, Rational Parametric, NUB, NURB, Polygonal and Quadric Representation of Surfaces. Blending of Surfaces, Curves on Surfaces, Surface with Irregular Boundaries, Manipulation of Surfaces..

SECTION-B

Design of curves and surfaces, Analytical and Relational Properties of Curves and Surfaces, Curves and Surfaces in Solids, Plane, Curve, Surface Intersections, Evaluation of some methods of Geometric Modeling, Mathematical Models of Solids, Constructive Solid Geometry, Boundary Representation, Non-Manifold Geometry, Global Properties of Solid Model.

Applications in product design, Analysis and Manufacturing e.g. Sheet metal working, Tool design, mechanical components, etc. Applications in Assembly, Design of volumes. Intersection of surface and interference of volumes, Shape Grammar

SECTION-C

Automation: Types of automation, Programmed Automation, History of Numerical Control, Components of NC, Punched Tape, MCU, Processing Unit, Axis Designation, NC Motion Control, PTP, Straight cut, Contouring NC Coding System, EIA & ISO format, Application Numerical Control, Advantages, & Disadvantages, Adoptive Control System.

Computer Numerical Control: Block Diagram of CNC operations, Positioning System, Open loop and Closed loop System, Precision in NC Positioning: Control resolution, Accuracy, Repeatability

Part Programming: Procedures Associated with part programming, Cutting process parameter selection, Process planning issues and path planning, Part programming formats, G & M Codes, Interpolations, Canned Cycles and Subprograms, Tool Compensations etc.

SECTION-D

CNC Hardware Basics: Machines Structure, Guidways Requirements, types and design features, Actuation systems, Ball Screws, Introduction of Servo and Stepper Motors, Feedback devices: Encoder, Optical grating, Resolvers, Inductosyn.

Modern CNC Systems: Indexable carbide tools, Modular Tooling & Tool Presetting, Machining Centers, Automatic tool changers.

Computer Aided Part Programming: APT Programming, Part Program Generation through ProE/DelCAM, Post Processors Computations for part programming: Segmentations of free form curves, Consideration for INTOL and OUTTOL, Part programming for Bezier and B-spline Curves, Generating part program from CAD drawings

TEXT BOOKS & REFERENCES:

1. Michael E. Mortenson, Geometric Modeling, Industrial Press Inc. 3rd Edition.
2. Groover M.P., Automation, Production Systems, and Computer-Integrated Manufacturing", Pearsoned Education.
3. S K SINHA,"CNC Programming", Galgotia Pubs.

MECHANICAL ENGINEERING

LIST OF EXPERIMENTS:

First 5 experiment are belong to CAD Software

1. To understand the Transformations, Projections, Curves, Surfaces and Solids with the help of a CAD Software
2. To understand the Intrinsic and Parametric representations.
3. To understand the NUB Curve Models, Rational Curves, NURB, Bezier curves, Manipulation of Curves.
4. To understand the Sculptured, Coons patches, Rational Parametric, Polygonal and Quadric Representation of Surfaces.
5. To understand the mathematical Models of Solids, Constructive Solid Geometry, Boundary Representation, Non-Manifold Geometry, Global Properties of Solid Model.

Next 5 experiment are belong to CAM

6. To understand the types of automation by visiting an industry.
7. To understand the Adoptive Control System.
8. To understand the Positioning System.
9. To understand the indexable carbide tools, Modular Tooling & Tool Presetting
10. To understand the functioning of Automatic tool changers.

Course Tittle/Code	MACHINE TOOL DESIGN (MEH621)
Course Type	Elective
Course Nature	Hard
L-T-P-O Structure	3-0-2-0
Prerequisite	NIL

SECTION A

Layout of Machine tool elements, Introduction to machine tool drives and mechanisms, General principles of machine tool design.

Kinematics of Machine tools: Classifications of motions for shaping surfaces, Kinematic structure of Machine tools having kinematic constraints. Selection of power drives. Design of drives. Transmission ratio, Design and classification of Speed and feed gear boxes, Stepless drives, Bearing selection, Mechanism for rectilinear motion, Reversing devices.

Introduction to Machine tool dynamics.

SECTION B

Design of Machine tool structures: Design of beds, columns, Tables, Cross rails, Carriages, Design of slide ways and Circular ways-Static and Dynamic stiffness, Profiles, application of new materials

– treatment of slide ways. Thermal aspect in machine tool design, Machine tool noise and concepts of noise control, Material selection; Welded vs cast structure, Choice of element sections and their design..

SECTION C

Automatic machine tools and Transfer machines with control systems: Selection of control systems, Control systems with pre-selection of speeds or feeds, Manual and Automatic controls, Remote controls, Safety devices in machine tools. Significance of Machine tool automation, Application of CAD/CAM/CIM in Machine tool design, Transfer machines & their controls. Recent trends in machine tool design

SECTION D

Hydraulic & Pneumatic Systems for machine tools: General principles of Hydraulic and Pneumatic drives. Different types control valves for Hydraulic and Pneumatic circuits, Hydraulic & Pneumatic circuit design for 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

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.

MECHANICAL ENGINEERING

Course Tittle/Code	MATLAB (MEW622)
Course Type	Core
Course Nature	Workshop
L-T-P-O Structure	0-0-3-0
Prerequisite	NIL

LIST OF EXPERIMENTS:

1. To write matlab code for the effect of heat transfer on different materials.

2. To write matlab code to calculate mechanical properties and plots stress-strain curves for thin-walled steel structures at elevated temperatures.

3. To write matlab code to demonstrate the application of the principle of virtual work for calculating the steady state transverse displacement of a rectangular clamped thin plate.

4. To write matlab code to analyze the effects of a load applied to the point of interconnect for two rods forming a truss.

5. To write matlab code to calculate the stresses or strains in a plate using Hooke's law.

6. To write matlab code to determine the deflection in a cantilever beam constructed using two materials.

7. To write matlab code to calculate the deflection of a rigid bar suspended by a set of cables.

8. To write matlab code to calculate the deflection at each point of a cantilever beam subjected to arbitrary loading distribution, and to calculate and plot the bending moment and shear force in the beam.

TEXT BOOKS & REFERENCES:

1. Introduction to MATLAB by Chapman.

MECHANICAL ENGINEERING

Course Tittle/Code	RESEARCH PAPER WRITING / SEMINAR (RPW/S) (MES624)
Course Type	Core
Course Nature	Soft
L-T-P-O Structure	1-0-2-0
Prerequisite	NIL

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; One Source Quoted in Another

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

MECHANICAL ENGINEERING

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.

Course Tittle/Code	DISSERTATION PREPARATION PROJECT COURSE (MEN623)
Course Type	Core
Course Nature	NTCC
L-T-P-O Structure	0-0-0-3
Prerequisite	NIL

MECHANICAL ENGINEERING

Semester 4 (Total credit – 20)

Nature of the course/ Type of the course	Hard Course (3-0-2-0) NTCC Course (0-0-0-12) Name (Offering Department)	Soft Course (1-0-2) Name (Offering Department)	Workshop (0-0-3) name (Offering Department)
Domain Core	Lean Manufacturing (ME)		
Allied Core			
Domain Elective	Reliability Engineering (ME)		
	Statistical Quality Control (ME)		
Allied Elective			
NTCC	Dissertation Work (ME)		
Credits	20	0	0
Total Credits	20		
Total Hours	22		

Course Title / Code	LEAN MANUFACTURING (MEH626)
Course Type	Core
Course Nature	Hard
L-T-P-O Structure	(3-0-2-0)
Prerequisite	NIL

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

LIST OF EXPERIMENTS

1. Value Stream Mapping – Creation of current state diagram using eVSM software
2. Value Stream Mapping – Development of future state map for the above set up
3. Evaluation of cost benefit analysis of implementing lean system – A case study
4. Layout design and study of layout performance
5. Development of a Poka-Yoke (fool proof) system for a process
6. Generation of a Production plan using Pro-Planner
7. Calculation of lead time and WIP using RFID
8. Design of automatic inspection line using Machine Vision System and Pneumatic System
9. Calculating Risk Priority number using XFMEA software

10. Identification of VA, NVA, Standard time calculation and Line balancing using Timer pro Software
11. Ergonomic risk assessment of assembly station using RULA method
12. Process capability evaluation using Minitab software

Course Title / Code	RELIABILITY ENGINEERING (MEH627)
Course Type	Elective
Course Nature	Hard
L-T-P-O Structure	(3-0-2-0)
Prerequisite	NIL

SECTION-A

Reliability: Definition, Probability Concept, Addition of Probabilities, Complimentary Events, Kolmogorov Axioms.

Failure Data Analysis: Introduction, Mean Failure Rate, Mean Time to Failure (MTTF), Mean Time Between Failures (MTBF), Graphical Plots, MTTF in terms of Failure Density, MTTF in Integral Form.

SECTION-B

Hazard Models: Introduction, Constant Hazard; Linearly Increasing Hazard, the Weibull Model, Density Function and Distribution Function, Reliability Analysis. Distributions and their Choice.

Standard Deviation and Variance, Conditional Probability: Introduction, Multiplication Rule, Independent Events, Vernn Diagram, Hazard Rate as conditional probability, Bayes Theorem.

SECTION-C

System Reliability: Series, Parallel and Mixed Configurations, Complex Systems, Logic Diagrams, Markov Models.

Reliability Improvement & Repairable Systems: Redundancy, Element, Unit and standby Redundancy, Optimization; Reliability – cost trade-off, Introduction to Repairable Systems, Instantaneous Repair Rate, Mean Time To Repair (MTTR), Reliability and Availability Functions, Important Applications.

SECTION-D

Fault-Tree Analysis and Other Techniques: Fault-tree Construction, Calculation of Reliability, Tie-set and Minimal Tie-set. Typical failure analysis, risk priority number and its allocation. Maintainability and Availability: Introduction, Maintenance Planning, Reliability and Maintainability trade –off

TEXT BOOK & REFERENCE BOOK:

1. Reliability Engineering, L.S. Srinath, Affiliated East-West Press.
2. Reliability Engineering, A.K.Govil, Tata Mc-Graw Hill

LIST OF EXPERIMENTS:

1. 1. Life/durability tests of sample devices/components,
2. Environmental testing of components/circuits/equipments,
3. Vibration and endurance tests,
4. Study of degradation characteristics, failure rates of components/devices under environmental factors.
5. Accelerated testing, parameter estimation and calculation of MTTF

Course Title / Code	STATISTICAL QUALITY CONTROL (MEH628)
Course Type	Elective
Course Nature	Hard
L-T-P-O Structure	(3-0-2-0)
Prerequisite	NIL

SECTION-A

Introduction to Quality and its related aspects, Statistics and SQC, Meaning of Quality, Brief History of SQC, Statistical Methods of Quality Control and Improvement, Other Aspects of SQC.

Statistical concepts in Quality Control, Graphical Representation of Grouped Data (The Stem-and-Leaf Plot, The Box Plot), Discrete Probability Distributions and Continuous Probability Distributions alongwith its related aspects,

Control limit Theorem, Inferences about Process Quality Control limit Theorem, Statistical tolerancing

SECTION-B

Introduction to Quality Control, process Control and Product Control, Chance and Assignable causes of Quality variation, Control chart parameters, Control limits and specification limits, Natural tolerance limits, Relationship of a process in Control to upper and lower specification limits, Process Control charts for variables (X, R and Sigma charts), Shewhart control charts for individual measurements, Advantages of Shewhart control charts, fixation of control limits, Type I and Type II Errors, Theory of Runs (Analysis of Pattern on Control Charts), Probability limits, Initiation of Control charts, Trial control limits, Determination of aimed at value of Process Setting, Rational method of sub grouping, process capability studies.

SECTION-C

Special control charts for variables, Group control chart, Arithmetic moving average X and R charts, Geometric moving average chart, Control chart with reject limits, Steady trend in Process average with constant dispersion, trend chart with sloping limits, variable subgroup size. Variables inspection and Attributes inspection, Relative merits and demerits, Control charts for Attributes, p chart and np chart, varying control limits, high defectives and low defectives, special severe test limits, C chart, U chart, Dodge demerit chart, Quality rating, CUmulative SUM (CUSUM) control chart, Average run length (ARL) Relative efficiency or sensitivity of control chart.

SECTION-D

Probability theory, binomial and Poisson distribution, Acceptance Inspection, 100% Inspection, No Inspection and sampling Inspection, Operating characteristic curve (O.C. curve). Effect of sample size and Acceptance number, type A and type B O.C. curves, Single, Double and Multiple sampling Plans, Sequential Sampling Plan. Acceptance/Rejection and Acceptance/Rectification Plans,

Producers Risk and Consumer‟s Risk, Indifference Quality level, Average Outgoing quality (AOQ) curve, AOQL, quality protection offered by a sampling Plan, Average sample Number (ASN) curve, Average Total Inspection (ATI) curve, IS2500 plans.

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

MECHANICAL ENGINEERING

LIST OF EXPERIMENTS:

1. Calculate average, sample standard deviation and sample median of a randomly sampled data using calculator, MSEXCEL.
2. Construct a frequency distribution, histogram, stem-and-leaf plot, box plot, normal probability of data readings of a process, using MS EXCEL.
3. Setup control charts for variables data (x-bar and R charts) using EXCEL.
4. Setup control charts for attribute data (p, np, c, and u charts) using EXCEL.
5. Estimate the variance of a normally distributed population.
6. Calculate and interpret process capability ratios (C_p, C_{pk}, and C_{pkm}).

Course Title/Code	DISSERTATION WORK (MEN629)
Course Type	Core
Course Nature	NTCC
L-T-P-O structure	0-0-0-12
Prerequisite	NIL