

DEPARTMENT OF MECHANICAL ENGINEERING

SCHEME OF INSTRUCTIONS AND SYLLABUS FOR POST GRADUATE STUDIES

M. Tech. in INDUSTRIAL Engineering



Visvesvaraya National Institute of Technology, Nagpur

February 2016

**MISSION AND VISION
OF
VISVESVARAYA NATIONAL INSTITUTE OF TECHNOLOGY, NAGPUR**



MISSION

The Mission of VNIT is to achieve high standards of excellence in generating and propagating knowledge in engineering and allied disciplines. V.N.I.T. is committed to providing an education that combines rigorous academics with joy of discovery. The Institute encourages its community to engage in a dialogue with society to be able to effectively contribute for the betterment of humankind.

VISION

To contribute effectively to the national endeavour of producing quality human resource of world class standard by developing a sustainable technical education system to meet the changing technological needs of the Country, incorporating relevant social concerns and to build an environment to create and propagate innovative technologies for the economic development of the Nation.

**MISSION AND VISION
OF
DEPARTMENT OF MECHANICAL ENGINEERING, V. N. I. T. Nagpur**

VISION

The vision of the department is to produce quality human resources of high standard in mechanical engineering who can contribute favorably to the technological and socio economic development of the nation.

MISSION

Mission of the Department of Mechanical Engineering is

- 1. To develop state of the art facilities related to mechanical engineering**
- 2. To attract highly qualified faculty to the department**
- 3. To promote participation of industries in academics, research and consultancy**
- 4. To undertake research at regional and national level**

Department of Mechanical Engineering offers three M. Tech program, namely, ***M. Tech. in CAD-CAM Engineering, Heat Power Engineering and Industrial Engineering***. These are four semester program, wherein student has to complete certain number of credits as indicated in Table 1. Each subject (or course) has certain number of credits. There are two types of subjects: Core and elective. Core courses are compulsory and some courses from electives are to be taken to complete the required credits.

TABLE 1. CREDIT REQUIREMENTS FOR INDUSTRIAL ENGINEERING

Postgraduate Core (PC)		Postgraduate Elective (PE)	
Category	Credit	Category	Credit
Departmental Core (DC)	36	Departmental Electives (DE)	16
Basic Science (BS)	00	Other Courses (OC)	00
Total	36	Total	16
Grand Total PC + PE			52

The number of credits attached to a subject depends on number of classes in a week. For example a subject with 3-1-0 (L-T-P) means it has 3 Lectures, 1 Tutorial and 0 Practical in a week. This subject will have eight credits ($3 \times 1 + 1 \times 1 + 0 \times 1 = 4$). If a student is declared pass in a subject, then he/she gets the credits associated with that subject. Depending on marks scored in a subject, student is given a Grade. Each grade has got certain grade points as follows:

Grades	AA	AB	BB	BC	CC	CD	DD	FF
Grade Points	10	09	08	07	06	05	04	Fail

The performance of a student will be evaluated in terms of two indices, viz. the Semester Grade Point Average (SGPA) which is the Grade Point Average for a semester and Cumulative Grade Point Average (CGPA) which is the Grade Point Average for all the completed semesters at any point in time. SGPA & CGPA are:

$$SGPA = \frac{\sum_{\text{semester}} (\text{Course credits} \times \text{Grade points}) \text{ for all courses except audit}}{\sum_{\text{semester}} (\text{Course credits}) \text{ for all courses except audit}}$$

$$CGPA = \frac{\sum_{\text{All semester}} (\text{Course credits} \times \text{Grade points}) \text{ for all courses with pass grade except audit}}{\sum_{\text{All semester}} (\text{Course credits}) \text{ for all courses except audit}}$$

Students can Audit a few subjects. i.e., they can attend the classes and do home work and give exam also, but they will not get any credit for that subject. Audit subjects are for self enhancement of students.

Details about Faculty members teaching to M.Tech. INDUSTRIAL ENGINEERING

Name of Faculty Member	Designation	Qualifications	Areas of specialization
A.M. Kuthe	Professor	Ph.D.	Layered Manufacturing, Bio-Medical Engineering
Y.M. Puri	Associate Professor	Ph.D.	Unconventional manufacturing, Computer aided and integrated manufacturing
A.B.Andhare	Associate Professor	Ph.D.	Machine Condition Monitoring, Manufacturing Processes
A.K.Singh	Assistant Professor	Ph.D.	Contact and friction mechanics, Tribology,
A.A. Thakre	Assistant Professor	M.Tech.	Tribology, Optimization
M.S. Kotambkar	Assistant Professor	Ph.D.	Vibrations, FEM and Machine Design
T.V.K. Gupta	Assistant Professor	Ph.D.	Manufacturing Engineering
D. Ravikumar	Assistant Professor	Ph.D.	Surface Engineering
P.V. Kane	Assistant Professor	M.Tech.	CIM, Reliability
K.M.Ashtankar	Assistant Professor	Ph.D.	Industrial engineering and Management
D.A. Jolhe	Assistant Professor	M.Tech.	Methods Engineering and Optimization

Scheme of Instructions for M. Tech. in INDUSTRIAL Engineering

I Semester				II Semester			
CORE				CORE			
Code	Course	L-T-P	Cr	Code	Course	L-T-P	Cr
MEL517	Quantitative Techniques in Industrial Management	3-0-0	3	MEL445	Automation in Production	3-0-0	3
MEP517	Quantitative Techniques in Industrial Management Lab	0-0-2	1	MEP445	Automation in Production Lab	0-0-2	1
MEL502	Methods Engineering and Ergonomics	3-0-0	3	MEL506	Marketing Management	3-0-0	3
MEP502	Methods Engineering and Ergonomics Lab	0-0-2	1	MEL501	Statistics Quality Assurance	3-0-0	3
MEL553	Personnel Management and Industrial Relations	3-0-0	3				
MEL505	Materials Management	3-0-0	3				
ELECTIVE (Any One)				ELECTIVE (Any One from each group)			
MEL503	1. Production Planning and Control	3-0-0	3	MEL530	1. Machine Condition Monitoring	3-0-0	3
MEL450	2. Advanced Machining Processes			MEL510	2. Manufacturing System Simulation and Design		
MEL408	3. Supply Chain Management			MEL532	1. Layered Manufacturing		
				MEL442	2. Computer & Database Management	3-0-0	3
				MEP532	1. Layered Manufacturing Lab	0-0-2	1
				MEP442	2. Computer & Database Management Lab		
		17				17	
III Semester				IV Semester			
Core				Core			
MED401	Project Phase-I	-	3	MED503	Project Phase-II	-	9
ELECTIVE (Any Two)							
MEL555	1. Project Evaluation & Management	3-0-0	6				
MEL439	2. Product Design and Development						
MEL433	3. Design for Manufacturing and Assembly						
MEL425	4. Reliability and Maintenance Engineering						
MEL402	5. Surface Engineering						
			9				9

Programme Educational Objectives of M. Tech. in INDUSTRIAL Engineering

1. To impart concepts of INDUSTRIAL Engineering through the use of analytical techniques, experiments, computer simulation methods, and other modern engineering tools in the analysis and design of variety of mechanical engineering systems and their industrial applications effectively.
2. Spreading the recent developments in INDUSTRIAL Engineering field through educating the students using new technologies, softwares and recent trends in INDUSTRIAL Engineering .
3. To develop habit of individual critical thinking in analyzing a complex problem in the INDUSTRIAL Engineering.
4. Student's capacity building in up-coming areas of research in INDUSTRIAL Engineering.

Programme Outcomes of M. Tech. in INDUSTRIAL Engineering

- a. Acquire knowledge of INDUSTRIAL Engineering and be able to discriminate, evaluate, analyze and integrate existing and new knowledge
- b. Be able to critically analyze and carry out independent research on complex problems of INDUSTRIAL Engineering
- c. Be able to carry out systematic research, design appropriate experiments and tools, and interpret experimental and analytical data for development of technological knowledge in INDUSTRIAL Engineering
- d. Be able to function productively with others as part of collaborative and multi-disciplinary team
- e. Be able to communicate effectively with written, oral and visual means, the design and research outcomes to the stakeholders
- f. Be able to recognize state-of-the-art need and will be able to engage in life-long learning
- g. Be able to understand professional and ethical responsibility while carryout out research and design activities
- h. Be able to critically analyze, scrutinize and rectify one's decisions and actions and apply self corrective measures

COURSE SYLLABUS FOR M.TECH. (INDUSTRIAL Engineering)

Course Name: MEL517-Quantitative Techniques in Industrial Management

Offered in: I Semester (Odd Semester)

Scheme and Credit: [(3-0-0); Credits: 3]

Type of Course: Core

Course Assessment Method: Sessional I (15%), Sessional II (15%), Internal assessment through assignments (10%), End Semester exam (60%).

Course Objectives:

1. To present the basic theory of non linear constrained and unconstrained problems that arose in engineering.
2. To give a thorough understanding of getting solution to these problems and some experience in solving them.
3. To develop the skills for the formulation and solution of mathematical models in their own research.

Syllabus:

Historical overview of operations research, fundamentals of OR Modeling, Overview of Project Management, Network analysis for time management (CPM, PERT, Crashing and Simulation).

Project Resource Management: Allocation, Leveling and Smoothing methods.

Linear Programming: Basic assumptions, formulation, graphical method Simplex method, duality theory, primal-dual relationships, sensitivity analysis. Transportation and Assignment Problems: Specific features of transportation problem, streamlined simplex method for solving transportation problems, special features of assignment problems, Hungarian method for solving assignment problems.

Nonlinear programming, Sequential Linear Programming, Indirect method, Interior and exterior penalty

Function, Karush-Kuhn-Tucker conditions, Applications

Design of experiments, Introduction to Factorial Designs, Regression models, Response Surface Methodology, Random Effects Models, Nested and Split Plot Designs, Transformations, unbalanced ANOVA and ANCOVA, Taguchi optimization technique, Applications.

Introduction to robust design, Monte-Carlo Sampling, Design under uncertainty, Reliability analysis, Taguchi methods

Multiobjective optimization, Grey relational analysis, principal component analysis, Weighted sum optimization, Weak and strong dominance, Pareto front computation, Goal programming and isoperformance, Multiattribute Utility Theory

REFERENCES

1. Gupta, P. K., Hira D. S., "Operation Research", S. Chand and Company
2. Rao, S. S., "Engineering Optimization (Theory and Practice)", John Wiley & Sons,
3. Taha, H. A. , "Operations Research", Prentice Hall of India, New Delhi, 9th Edition

Course outcomes: On completion of this course, student should

1. be able to model non linear constrained and unconstrained engineering problems
2. be able to solve multi-objective non linear constrained or unconstrained engineering problems
3. develop the skills for the formulation and solution of mathematical models in their own research.

Course Name: MEP517-Quantitative Techniques in Industrial Management

Pre-requisites: Nil

Offered in: I Semester (Odd Semester)

Scheme and Credit: [(3-0-0); Credits: 3]

Type of Course: Core

Course Assessment Method: Sessional I (15%), Sessional II (15%), Internal assessment through assignments/seminar/quizzes (10%), End Semester exam (60%).

Course Objectives:

1. To present the basic theory of non linear constrained and unconstrained problems that arose in engineering.
2. To give a thorough understanding of getting solution to these problems and some experience in solving them.
3. To develop the skills for the formulation and solution of mathematical models in their own research.

Syllabus:

1. Assignment of Project Management
2. Assignment on Simplex method
3. Assignment on linear programming
4. Assignment on transportation.
5. Assignment on non linear problem.
6. Assignment on Taguchi technique.
7. Assignment on Response surface methodology.
8. Assignment on Simulation.
9. Assignment on Multiple objective optimization.
10. Power point presentation on an operation research software.

Course Name: MEL502-Methods Engineering and Ergonomics

Pre-requisites: Nil

Offered in: I Semester (Odd Semester)

Scheme and Credit: [(3-0-0); Credits: 3]

Type of Course: Core

Course Assessment Method: Sessional I (15%), Sessional II (15%), Internal assessment through assignments/seminar/quizzes (10%), End Semester exam (60%).

Course Objectives:

1. To understand work measurement and work improvement techniques like stop watch time study, work sampling, method study, etc.
2. To understand ergonomics with human comfort point of view.

Syllabus:

Method Study :Analysis of Operations, job work, systems involving man and machines. Schematic methods, charts and other aids for analysis.

Work Study :Method of work measurement, stopwatch study; PMTS; work sampling, setting of time standards.

Motion Study :Principles of motion economy and work center design.

Ergonomics :Basic anatomy of human body and its functional systems; principles of ergonomics, design of display and controls in relation to information processing by human being

Anthropometry :Experimental and laboratory treatment of selected topics such as study and effects of personal factors environment of human performance. Determination of physiological works, concepts of efficiency and effectiveness

REFERENCES

1. ILO, " Introduction to Work Study (4th Ed)," Universal Book Corporation
2. Barnes, R. M., " Motion and Time Study Design and Measurement of Work ", 7th Ed, Wiley India
3. Helander, M., "A Guide to Human Factors and Ergonomics," Taylor & Francis
4. Kearney, D. S., " Ergonomics Made Easy", Government Institutes (The Scarecrow Press)

Course Outcomes:

Upon successful completion students will be able to:

1. understand work measurement and work improvement techniques like stop watch time study, work sampling, method study, etc.
2. understand ergonomics with human comfort point of view.

Course Name: MEP502-Methods Engineering and Ergonomics Lab

Pre-requisites: Nil

Offered in: I Semester (Odd Semester)

Scheme and Credit: [(0-0-2); Credits: 1]

Type of Course: Core

Course Assessment Method: Continuous evaluation

Course Objectives:

1. To understand work measurement and work improvement techniques like stop watch time study, work sampling, method study, etc.
2. To understand ergonomics with human comfort point of view.

List of Experiments:

1. Study of charting techniques
2. Study of principles of motion economy
3. Study of Therbligs
4. Stop watch time study
5. Work sampling study
6. Training for performance rating
7. Application of MTM & PMTS
8. Application of MOST
9. Ergonomic assessment of different types of chair/tables
10. Response time measurement
11. Speech intelligibility test
12. Design of workstation
13. Design of displays
14. Design of controls
15. Physiological cost of activity
16. Rapid Upper Limb Assessment (RULA)
17. Rapid Entire Body Assessment (REBA)
- 18. Anthropometric data collection and application**

Course Name: MEL553-Personnel Management and Industrial Relations

Pre-requisites: Nil

Offered in: I Semester (Odd Semester)

Scheme and Credit: [(3-0-0); Credits: 3]

Type of Course: Core

Course Assessment Method: Sessional I (15%), Sessional II (15%), Internal assessment through assignments/seminar/quizzes (10%), End Semester exam (60%).

Course Objectives:

1. To understand the various functions of personnel management and its applications.
2. To understand various labour legislation and trade unions related acts.

Syllabus:

Human behavior

Human behavior of an individual as a member as a small group and as a member of an organization, Influence of culture organizational, social, national and international on individual.

Analysis

Analysis of dynamic behaviour of organization by simulation structure of organization and flow of men, money, material, information capital, equipment and order, system models on the basis of policy of management to evolve effective policies for management.

Personnel management

Scope and objectives of personnel management, personnel planning, labor market, recruitment training and placement

Job evaluation

Job evaluation, merit rating, wage incentives, employee health, security and welfare, morale and motivation, industrial disputes, voluntary and compulsory settlement trade unionism

Labour legislations

Performance appraisal and evaluation

Reference Books/ Material:

1. Knouse S.B., "Human Resources Management Perspectives", ASQC Quality Press, 1996
2. Schuler R.S. "Managing Human Resources", 4th Ed., West Publishing Co.,1992
3. Mamoaria, "Dynamics of Industrial relations", Himalaya Publishing House, New Delhi, 1989

Course Outcomes:

- Students would know about the man power planning and sustaining the workforce
- Students will be familiar with the industrial work environment.

Course Name: MEL505-Materials Management

Pre-requisites: Nil

Offered in: I Semester (Odd Semester)

Scheme and Credit: [(3-0-0); Credits: 3]

Type of Course: Core

Course Assessment Method: Sessional I (15%), Sessional II (15%), Internal assessment through assignments/seminar/quizzes (10%), End Semester exam (60%).

Course Objectives:

1. To apply knowledge of materials management in practice.
2. To understand various tools of materials management.

Syllabus:

Materials: Profit Centre :

Role of materials management techniques in material productivity improvement, cost reduction and value improvement.

Purchase management :

Purchase management, incoming material control. Acceptance sampling and inspection. Vendor rating system. Inventory management, various inventory control models.

MRP :

Material requirement planning systems. Discrete lot sizing techniques. Wagner and whitin algorithm. Silver and Metal algorithm. Algorithms for multi-product lot sizing with constraints inventory management of perishable commodities.

JIT :

Design of inventory distribution systems. Inventory management in Kanban and Just-in-time.

Reference Books/Material:

1. Gopalkrishnan, P. "Purchasing & Materials Management", TMH, New Delhi, 2004
2. Tersine R.J, "Material Management & Inventory Control", Worth Holand, New York, 1976

Course Outcomes:

1. Students will learn about the dynamics of materials management.
2. Students will learn the importance of materials in Industry.
3. Students will learn about the optimum Inventory management.
4. Student get exposure to use computers in materials management.

Course Name: MEL503 -PRODUCTION PLANNING AND CONTROL**Pre-requisites:** Nil**Offered in:** I Semester (Odd Semester)**Scheme and Credit:**[(3-0-0); Credits: 3]**Type of Course:** Elective**Course Assessment Method:** Sessional I (15%), Sessional II (15%), Internal assessment through assignments/seminar/quizzes (10%), End Semester exam (60%).**Course Objectives :**

1. To understand various types of manufacturing systems and their associated planning and control problems.
 2. To understand the advantages and disadvantages of various manufacturing systems.
 3. To understand the product life cycle concepts and capacity determination for the product
 4. To understand various factors that govern plant location and layout.
 5. To understand assembly line balancing.
 6. To understand group technology and its applications in manufacturing systems.
 7. To understand problems related with planning and control in FMS and CIMS.
 8. To understand aggregate production planning, scheduling and sequencing.
 9. To understand various replacement and repair aspects of manufacturing facilities.
- To know MAPI and other approaches thereof.

Syllabus :

Manufacturing Planning And Control : Material flow characteristics in manufacturing systems, Types of manufacturing systems and their associated planning and control problems, Life cycle concepts. Product selection and design, facility, location and layouts.

Line Balancing & G.T. :Material handling, balancing of fabrication and assembly lines, modular assembly concepts, group technology and cellular manufacturing systems.

CIMS & FMS: Problem of planning and control in CIMS and FMS. Aggregate production planning. Operations scheduling, MRP. Machine assignment and allocation of jobs. Sequencing problems. Flow shops scheduling and sequencing. Simulation of job shop priority rules. Gantt charts, production control with LOB.

Other Approaches & Case Studies: Maintenance / replacement and repair aspects of manufacturing facilities. MAPI and other approaches. Case studies of constraints. Supply chain management.

Reference Books / Material:

1. Boeuf, M.L., " Essence of Time Management", Jaico Publication House, 1995
2. Gupta A.K., Sharma S.J , "Management of System"

Course Outcomes:

The student, upon completion of this course, will be able to:

1. Describe (identify/write) the various components that make up the manufacturing planning and control system and the interaction among them.
2. Develop the models that are applicable for supply chain inventory management, including those for quantity discounts, safety stocks, and order quantity and reorder point interactions.
3. Develop the algorithms that are appropriate for solving single-machine, two-machine, parallel-machines and flow shop scheduling problems.
4. Show how (i) the material requirement plans, manufacturing resource plans, and capacity requirement plans can be developed, and (ii) lot sizing decisions can be made for a manufacturing system.
5. Identify, discuss, and implement important research topics within production planning and control.

Course Name: MEL450- ADVANCED MACHINING PROCESSES**Pre-requisites:** Nil**Offered in:** I Semester (Odd Semester)**Scheme and Credit:**[(3-0-0); Credits: 3]**Type of Course:** Elective**Course Assessment Method:** Sessional I (15%), Sessional II (15%), Internal assessment through assignments/seminar/quizzes (10%), End Semester exam (60%).**Course Objectives :**

The aim of the course is to enrich the fundamentals of machining processes both conventional and unconventional processes. The course elaborates the mathematical formulations of various machining processes and analyse the influence of various process parameters in each process. This also enables the student to understand the process and further the course provides an insight to choose his research career.

Syllabus :

Advanced Metal Cutting and Grinding :Modeling of cutting process: Review of cutting mechanism; Cutting force model; Oblique Cutting; Temperature analysis (Finite Difference Method); Wear model; Evaluation of surface quality; Cutting processes for producing various shapes

Gear machining: Hobbing , Modeling of grinding process: Grinding force model; Temperature analysis; Wheel life model., Introduction of finishing process: Machining mechanism in finishing: Honing, Lapping, Super finishing, etc.

Micro-Nano Precision Machining: Introduction to nano-precision mechanical manufacturing: M4 processes

Nano-precision cutting: Machine & tool; Brittle / ductile transition; Ductile mode cutting of brittle materials

Nano-precision grinding: Machine & grinding wheel; Truing & dressing; Cutting edge evaluation; Applications to extreme optics, Nano-precision polishing: Conventional polishing; Non-conventional polishing; Plane honing; Field-assisted fine finishing

Unconventional Machining Processes :Electric Discharge Machining (EDM); Electron Beam Machining (EBM); Plasma Arc Machining (PAM); Laser Beam Machining (LBM); Ultrasonic Machining (USM); Abrasive Jet Machining (AJM); Water Jet Cutting (WJC), Abrasive Water Jet Machining (AWJM); Electro-Chemical Machining (ECM); Chemical Machining (CHM)

Reference Books / Material:

1. Boothroyd, G and Knight, W A., "Fundamentals of Machining and Machine Tools", 3rd Third Edition, Saint Luice Pr, 2005.
2. G.F. Benedict, "Non-traditional Manu. Processes", Marcel Dekker, Inc. New York, 1987.
3. P.C. Pandey, and H.S. Shan, "Modern Machining Processes", Tata McGraw-Hill Publishing Co. Ltd, New Delhi, 1980.
4. J.A. McGeough, "Adv. Methods of Machining", Chapman and Hall, London, 1988.

Course Outcomes:

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

1. Illustrate advanced machining processes, cutting tools and cutting fluids for a specific material and part features.
2. Relate Generation and control of electron beam for machining, laser beam machining, comparison of thermal and non-thermal processes
3. Differentiate Thermal Metal Removal Processes, characteristics of spark eroded surface, machine tool selection and various finishing techniques.

Course Name: MEL408 -SUPPLY CHAIN MANAGEMENT**Pre-requisites:** Nil**Offered in:** I Semester (Odd Semester)**Scheme and Credit:**[(3-0-0); Credits: 3]**Type of Course:** Elective**Course Assessment Method:** Sessional I (15%), Sessional II (15%), Internal assessment through assignments/seminar/quizzes (10%), End Semester exam (60%).**Course Objectives :**

1. To explain the students about the basics and practical significance of the supply chain
2. To enable students to apply mathematical approaches to solve supply chain problems
3. To train students for using software such as excel/matlab for solving supply chain problems
4. To enable students for higher studies

Syllabus :

Understanding the supply chain, its performance, drivers and its metrics; Design of the supply chain network, Planning demand and supply in a supply chain, Planning and managing inventories in a supply chain, Planning and managing inventories in a supply chain, Designing and planning transportation networks, Managing cross-function drivers in a supply chain, Bullwhip effect, National and International case studies in a supply chain

Reference Books / Material:

1. Sunil Chopra and Peter Meindl , “Supply Chain Management”, Pearson – Prentice Hall publication. Ist and IInd edition
2. Janat Shah, “Supply Chain Management”, Pearson education Publication, Ist edition.
3. Spigel M.R , “Probability and statistics”, McGraw Hill Book Co, 1980

Course Outcomes:

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

1. select and apply scientific methods and theories for collection and analysis of quantitative and qualitative data for description and complex analysis of internal and external conditions of the firm as well as theoretical issues related to these areas.
2. set up new models of analysis and solutions for problems based on the performed analyses. The graduate can communicate his/her knowledge and discuss professional and scientific issues with colleagues, management, and the surrounding society

Course Name: MEL445-Automation in Production**Pre-requisites:** Nil**Offered in:** II Semester (Even Semester)**Scheme and Credit:**[(3-0-0); Credits: 3]**Type of Course:** Core**Course Assessment Method:** Sessional I (15%), Sessional II (15%), Internal assessment through assignments/seminar/quizzes (10%), End Semester exam (60%).**Objectives :**

1. To teach graduates various automation systems and its components, so that they all like to apply it to the various practical situations in industries.

Syllabus :

Automation: Definition, types, reasons for automating, arguments for and against automation. Types of production, functions in manufacturing, Organization and information processing in manufacturing. Automated Flow Lines- Methods of work part transport, Transfer mechanisms, Buffer storage. Analysis of flow lines- General terminology and analysis, analysis of transfer lines without storage, partial automation, automated flow lines with storage buffers, manual assembly lines. Line Balancing Problem, Methods of line balancing -Automated Assembly Systems- Types, parts delivery system

Numerical Control Production Systems: Basic concepts, coordinate system and machine motion-Types of NC systems- Point to point, straight cut and continuous path. Machine control unit and other components, Tape and tape readers.

NC part programming:Punched tape and tape formats, NC words, methods of part programming, manual part programming: APT programming, Direct numerical control. Computer numerical control. Adaptive control. Applications and economics of NC.

Industrial Robotics:Introduction, robot anatomy, robot control systems, accuracy and repeatability and other specifications, end effectors, sensors, introduction to robot programming, safety monitoring.

Robot applications- Characteristics of robot applications, work cell layout, robot applications in material handling, processing, assembly and inspection.

Automated material handling & storage-Conveyor systems:Roller conveyer, Skate wheel conveyer, Belt conveyers, Chain conveyers, Slat conveyers, Overhead trolley conveyers, Infloor towline conveyers, Cart on track conveyers.

Automated Guided Vehicle Systems:Types, driverless trains, AGVS pallet trucks, AGVS unit-load carriers. Vehicle guidance & Routing, Traffic control & safety, System management, Analysis of AGVS systems, AGVS applications.

Automated Storage & Retrieval System:Types, Unit load AS/RS, mini load ASI{S , man on board AS/RS , automated item retrieval system, deep lane AS/RS -Basic components & special features of AS/RS, Carousel storage systems, Work in process storage, quantitative analysis.

Automated inspection & Group technology:Automated inspection principles & methods -100% automated inspection, off -line & on -line inspection, distributed inspection & final inspection; Sensor technologies for automated inspection, coordinate measuring machines -construction, operation & benefits; Machine vision -image acquisition & digitization, image processing & analysis, interpretation.

Machine vision applications:Other optical inspection methods -Scanning laser systems, linear array devices, optical triangulation techniques.

Group Technology: Part families, parts classification & coding, Opitz classification systems, production. Flow analysis; Machine cell design -composite part concept, types of cell design, best machine arrangement, benefits of group technology.

1. Computer aided manufacturing -Manufacturing planning, manufacturing control; Computer integrated manufacturing;
2. Flexible manufacturing systems -Components, Types of systems, FMS layout configuration computer functions, data files, system reports, FMS benefits.
3. Computer aided process planning: Retrieval CAPP systems, generative CAPP systems, benefits of CAPP.
4. Shop floor controls.
5. Computer Process Control

Reference Books / Material:

1. Groover M.P , “Automation, production System & CIMS”, Prentice Hall of India, 2nd Ed, 2002
2. Zimmers, Groover , “CAD/CAM”, Prentice Hall of India, 9th Ed.; 1998
3. Kundra, Rao, Tiwari, “ Numerical Control and Computer Aided Manufacturing”, TMH
4. Koren Yoram, “Computer Control of Manufacturing Systems”, McGrawHil, 3rd Ed, 1986

Course Outcomes:

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

1. understand various automation systems and its components,
2. implement the learned techniques to the various practical situations in industries.

Course Name: MEP445-Automation in Production

Pre-requisites: Nil

Offered in: II Semester (Even Semester)

Scheme and Credit:[(0-0-2); Credits: 1]

Type of Course: Core

Course Assessment Method: Continuous assessment

Course Objectives :

1. Performance, Simulation on CNC lathe (at least two Complex Geometries)
2. Performance, Simulation on CNC milling (at least two Complex Geometries)
3. Practice Programming on Manual Part Program
4. Practice Programming on APT
5. Case Study on Automated System of any Industry.
6. Performance/ Practical on Robot.
7. Part Coding and Group Technology

MEL506	Marketing Management
MEL501	Statistics Quality Assurance

Course Name: MEL506-Marketing Management**Pre-requisites:** Nil**Offered in:** II Semester (Even Semester)**Scheme and Credit:**[(3-0-0); Credits: 3]**Type of Course:** Core**Course Assessment Method:** Sessional I (15%), Sessional II (15%), Internal assessment through assignments/seminar/quizzes (10%), End Semester exam (60%).**Objectives :**

1. To teach graduates various automation systems and its components, so that they all like to apply it to the various practical situations in industries.

Syllabus :

Changing business orientation, integrated marketing, customer satisfaction, definition of marketing management, basic marketing system model, e-commerce and Internet marketing. Marketing Environment: Marketing opportunity concept, economic, social, political and cultural environment, Buyer behavior and the four P's of marketing mix, brand preference. Measurement and Forecasting of Demand: Concept of Market Forecast and Market potential methods of estimating current demand, Chain ratio, Index of buying power method, estimation of future demand, Survey of buyer intentions, Statistical analysis. Organizing for Marketing: Break up of marketing activities, organization for integrated marketing, Market information systems (MIS), internal accounting and intelligence systems, marketing research and decision making. Marketing Strategies : Product market matching, Product management, Product life cycles, innovations, Promotion strategies in advertising, personal selling, sales promotion and publicity. Price decisions: Reasons, Objectives and Methods; Price setting, Buyer's reaction, demand elasticity of price, distribution trade off analysis, physical distribution methods, concept of level of service and Cost of services, overall marketing mix. Market Segmentation and marketing Control: Concept of segmentation, methods of segmentation, control of management over marketing subsystems, efficiency control, short and long controls.

Reference Books / Material:

1. Modern Marketing: A Manual of Marketing, Salesmanship and advertising : Bombay, Himalaya Publishing House, 1990
2. Guiltima J.P.& Paul, G. W, "Marketing Management Strategies and Progress", Singapore; McGraw Hill, 1985
3. Philips Kotler, " Marketing Management"

Course Outcomes:

1. Students will be able to understand concept of Marketing and model the marketing system.
2. Will be able to formulate form "P" of marketing and understand buyer behavior.
3. Methods of market forecast and demand potential estimate.
4. Will be able to understand market activities such as MIS, Market Research.

MEL501

Statistics Quality Assurance

Course Name: MEL501- Statistics and Quality Assurance**Pre-requisites:** Nil**Offered in:** II Semester (Even Semester)**Scheme and Credit:**[(3-0-0); Credits: 3]**Type of Course:** Core**Course Assessment Method:** Sessional I (15%), Sessional II (15%), Internal assessment through assignments/seminar/quizzes (10%), End Semester exam (60%).**Objectives :**

1. To explain the students about the basics and practical significance of probability and statistics
2. To enable students to apply mathematical approaches to solve quality and industrial engineering problems
3. To train students with software such as excel/matlab for solving quality and industrial engineering problems
4. To enable students for higher studies and research

Syllabus :

Statistics: Probability theory, Random variables (discrete & continuous), binomials, Poissons, normal and other standard distribution. Chebychev's inequality, joint distribution, moment generation function, measure of control tendency, variability, control limit theorem, sampling theory and distribution, estimation theory. Hypothesis testing, χ^2 goodness fit curves, Regression analysis.

Quality Assurance: Concept of quality characteristics, Value of quality, Quality of design and conformance, Process capability, selective assembly, concept in total quality control and quality system, Quality assurances.

SQC: Quality cost aspects. Job plan. Case study in value analysis. Process control - Concept of S.Q.C. control chart for variable additives and attributes. Multi-characteristics control chart. Acceptance sampling plan, single, Double and sequential sampling, ACL, LTPD concept. AOQL and rectification plan. Economic of inspection. Motivation for quality assurance. TQM: Total quality management, Zero-defect program, Quality circle.

Reference Books / Material:

1. Spiegel M.R, "Probability and statistics", McGraw Hill Book Co, 1980
2. Gupta, Kapoor, "Fundamentals of Mathematical Statistics", S.Chand & Sons, 8th Ed, 1998
3. Duncan A.J., Irwin Richard D., "Quality Control and Industrial Statistics", INC, USA, 1965
4. Feigenbaum F.V, "Total Quality Control", McGraw Hill International Edition, 3rd Ed, 1987
5. Halpern S., "The Assurance Sciences", Prentice Hall India Ltd. New Delhi, 1979

Course Outcomes: on completion of this course, students will be able to

1. Understand the applications of Probability distribution in predicting behavior of the process.
2. Develop conceptual understanding of Quality of Product and Process and its Management.
3. Develop Control charts for process control.
4. Develop understanding of sampling plans for acceptance of materials.

Course Name: MEL501- Statistics and Quality Assurance**Pre-requisites:** Nil**Offered in:** II Semester (Even Semester)**Scheme and Credit:**[(3-0-0); Credits: 3]**Type of Course:** Core**Course Assessment Method:** Sessional I (15%), Sessional II (15%), Internal assessment through assignments/seminar/quizzes (10%), End Semester exam (60%).**Objectives :**

1. To explain the students about the basics and practical significance of probability and statistics
2. To enable students to apply mathematical approaches to solve quality and industrial engineering problems
3. To train students with software such as excel/matlab for solving quality and industrial engineering problems
4. To enable students for higher studies and research

Syllabus :

Statistics: Probability theory, Random variables (discrete & continuous), binomials, Poissons, normal and other standard distribution. Chebychev's inequality, joint distribution, moment generation function, measure of control tendency, variability, control limit theorem, sampling theory and distribution, estimation theory. Hypothesis testing, χ^2 goodness fit curves, Regression analysis.

Quality Assurance: Concept of quality characteristics, Value of quality, Quality of design and conformance, Process capability, selective assembly, concept in total quality control and quality system, Quality assurances.

SQC: Quality cost aspects. Job plan. Case study in value analysis. Process control - Concept of S.Q.C. control chart for variable additives and attributes. Multi-characteristics control chart. Acceptance sampling plan, single, Double and sequential sampling, ACL, LTPD concept. AOQL and rectification plan. Economic of inspection. Motivation for quality assurance. TQM: Total quality management, Zero-defect program, Quality circle.

Reference Books / Material:

1. Spiegel M.R, "Probability and statistics", McGraw Hill Book Co, 1980
2. Gupta, Kapoor, "Fundamentals of Mathematical Statistics", S.Chand & Sons, 8th Ed, 1998
3. Duncan A.J., Irwin Richard D., "Quality Control and Industrial Statistics", INC, USA, 1965
4. Feigenbaum F.V, "Total Quality Control", McGraw Hill International Edition, 3rd Ed, 1987
5. Halpern S., "The Assurance Sciences", Prentice Hall India Ltd. New Delhi, 1979

Course Outcomes: on completion of this course, students will be able to

1. Understand the applications of Probability distribution in predicting behavior of the process.
2. Develop conceptual understanding of Quality of Product and Process and its Management.
3. Develop Control charts for process control.
4. Develop understanding of sampling plans for acceptance of materials.

Course Name: MEL530 - MACHINE CONDITION MONITORING

Pre-requisites: Nil

Offered in: II Semester (Even Semester)

Scheme and Credit: [(3-0-0); Credits: 3]

Type of Course: Elective

Course Assessment Method: Sessional I (15%), Sessional II (15%), Internal assessment through assignments/seminar/quizzes (10%), End Semester exam (60%).

Course Objectives:

1. To know various methods of condition monitoring
2. To know and use various instruments used for condition monitoring
3. To process and analyze machine signal for diagnosis
4. To apply modern methods for machine condition monitoring

Syllabus:

Introduction: Definition, Need and relevance to maintenance, Different techniques and their practical applications. Vibration and AE based condition monitoring, Measurement of vibration and acoustic emission – Measuring parameters, Transducers, selection of appropriate parameters and transducers Data acquisition and signal processing: A/D converters, Filters, Time & Frequency domain analysis, Analysis of stationary and non stationary signals- FFT and Wavelet Transform in machine condition monitoring. Analysis and interpretation of vibration and AE data, trending, indices for condition monitoring, their significance, normal and fault indicating values, ISO and other standards, Oil & wear debris analysis and ferrography: Principles, methods and instruments for wear debris analysis and ferrography. Condition monitoring of various machine components and machines like bearings, gears, pumps, compressors, turbines, machine tools, cutting tools, etc. to diagnose various defects. Machinery prognostics, prediction of failures, concept of integrated analysis

Reference Books/Material:

1. Randall R. B., "Vibration Based Condition Monitoring," Ch.1, Ch. 2, Ch 3, Wiley, New Delhi, 2010.
2. Cempel C., "Ellis Horwood Series in Mechanical Engineering, Vibroacoustic Condition Monitoring," pp. 1 – 43, Michigan
3. Piersol A. and Paez T, "Harris' Shock and Vibration Handbook," Mc-Graw Hill, 2010
4. Alan Davies, "Handbook of Condition Monitoring: Techniques & Methodology," Chapman & Hall, London, 1998.

Course Outcomes:

At the conclusion of this course, it is expected that student will be able to:

1. Know basic machine problems and their monitoring methods.
2. Use of appropriate parameter for monitoring
3. Use of modern tools for monitoring
4. Draw charts, graphs, etc. to indicate machine status

Course Name: MEL510- MANUFACTURING SYSTEM SIMULATION AND DESIGN

Pre-requisites: Nil

Offered in: II Semester (Even Semester)

Scheme and Credit: [(3-0-0); Credits: 3]

Type of Course: Elective

Course Assessment Method: Sessional I (15%), Sessional II (15%), Internal assessment through assignments/seminar/quizzes (10%), End Semester exam (60%).

Course Objectives:

- (i) Understand the concepts in system simulation and underlying statistical theories.
- (ii) Develop the appropriate model of manufacturing systems in system specific context and simulate it to understand system behaviour and further to aid in system design.
- (iii) Differentiate and understand various system simulation strategies.
- (iv) Develop the skills of modelling and simulation using various software / programming languages.

Syllabus:

Systems concepts in manufacturing, Types of systems, Basic concepts in simulation, Probability and statistical distributions, Random numbers and random variates, Monte Carlo simulation, Discrete event simulation, Input and output data analysis, Variance reduction techniques, Model verification and validation, Markov chain model, Introduction to systems dynamics and agent based simulation, Application of simulation in manufacturing system design such as machining, assembling, material handling, queueing systems, warehousing, inventory control, scheduling, line balancing, supply chains, project management, maintenance management, traffic-flow management, etc., Simulation of service systems.

System modelling and simulation using appropriate software / programming language. Case studies and mini projects in system simulation.

Reference Books/Material:

1. Banks, Jerry; Carson II, John; Nelson, Barry and Nicol, David, "Discrete Event System Simulation," 2013, Prentice-Hall
2. Law, Averill, "Simulation Modelling and Analysis," 2007, Tata McGraw Hill
3. Sterman, John, "Business Dynamics: Systems Thinking and Modeling for a Complex World", 2000, McGraw-Hill
4. Gilbert, Nigel, "Agent-based models," SAGE Publication, 2008

Course Outcomes: Upon successful completion of this course, the students will

- (i) appreciate concepts in system simulation and underlying statistical theories.
- (ii) be able to design and simulate the appropriate model of manufacturing systems in system specific context
- (iii) Differentiate and understand various system simulation strategies.
- (iv) have knowledge of modelling and simulation using various software / programming languages.

Course Name: MEL532- LAYERED MANUFACTURING**Pre-requisites:** Nil**Offered in:** II Semester (Even Semester)**Scheme and Credit:** [(3-0-0); Credits: 3]**Type of Course:** Elective**Course Assessment Method:** Sessional I (15%), Sessional II (15%), Internal assessment through assignments/seminar/quizzes (10%), End Semester exam (60%).**Course Objectives:**

1. To Learn the fundamentals of layered manufacturing of polymers, metals, and ceramics, along with those for emerging materials and complex architectures.
2. To Understand the operating principles, capabilities, and limitations of state-of-the-art AM methods, including laser melting, fused deposition modeling, stereolithography, and jetting.
3. To Understand the principles of "Design for layered Manufacturing" and compare and contrast additive processes with conventional manufacturing methods such as machining and molding in terms of rate, quality, cost, and flexibility.

Syllabus:

Importance and overview of Rapid Prototyping, Tooling and Manufacturing ; Typical Process Chain; Introduction to CAD and Data Exchange Formats; Data format details, conversion, checking, repairing and transmission ;Part slicing and orientation. Classification of Rapid Prototyping (RP), Tooling (RT) and Manufacturing (RM) processes; Materials for RP/RT/RM; Operating principles, characteristics and analysis of current and developing R P / R T / R M processes; Selection of RP/RT/RM processes based on the product requirements; Case studies

Course Outcomes: Upon completion of this course, student will have

1. To identify the need for reduction of product development time.
2. Model any complex part for rapid manufacture.
3. Illustrate the working principles of rapid manufacturing technologies.
4. Select the rapid manufacturing process to fabricate a given product.
5. Identify and minimize errors that occur during conversion of CAD models.
6. Optimize the responses in rapid manufacturing process to improve the quality of parts.

Reference Books/Material:

1. Gibson, I, Rosen, D W., and Stucker,B., "Additive Manufacturing Methodologies: Rapid Prototyping to Direct Digital Manufacturing," Springer, 2010.
2. Hopkinson, N, Haque, R., and Dickens, P., "Rapid Manufacturing: An Industrial Revolution for a DigitalAge", Wiley, 2005.
3. Bartolo, P J (editor), "Virtual and Rapid Manufacturing: Advanced Research in Virtual and Rapid Prototyping," Taylor and Francis, 2007.
4. Chua, C K, Leong, KF., Lim CS, "Rapid Prototyping," World Scientific, 2003.
5. Pique,A., Chrisey, DB., "Direct Write Technologies for R P Applications: Sensors, Electronics and Integrated Power Sources", Academic Press, 2002.
6. Venuvinod,P.K., Ma, W., "Rapid Prototyping – Laser Based and Other Technologies," Kluwer, 2004.

Course Name: MEP532- LAYERED MANUFACTURING

Pre-requisites: Nil

Offered in: II Semester (Even Semester)

Scheme and Credit: [(0-0-2); Credits: 1]

Type of Course: Elective

Course Assessment Method: Continuous assessment

Course Objectives:

1. To Learn the fundamentals of layered manufacturing of polymers, metals, and ceramics, along with those for emerging materials and complex architectures.
2. To Understand the operating principles, capabilities, and limitations of state-of-the-art AM methods, including laser melting, fused deposition modeling, stereolithography, and jetting.
3. To Understand the principles of "Design for layered Manufacturing" and compare and contrast additive processes with conventional manufacturing methods such as machining and molding in terms of rate, quality, cost, and flexibility.

List of Experiments:

1. Experiments using FDM
2. Experiments using 3D printer
3. Preparation of part for layered manufacturing

Course Name: MEL442 - COMPUTER & DATABASE MANAGEMENT

Pre-requisites: Nil

Offered in: II Semester (Even Semester)

Scheme and Credit: [(3-0-0); Credits: 3]

Type of Course: Elective

Course Assessment Method: Sessional I (15%), Sessional II (15%), Internal assessment through assignments/seminar/quizzes (10%), End Semester exam (60%).

Course Objectives:

1. To understand various types of hardware and software used in IT
2. To learn data design and architecture
3. To prepare MIS
4. To learn different methods of data collections and management

Syllabus:

Introduction: Various types of Hardware and Software in common use as applicable to information technology. The different Hardware applications architectures available e.g. Centralized, Distributed, client server. Concept of general system theory and their applications to information system.

Data Design & Architecture: Designing data and information architecture to assist and improve planning decision, making and control.

MIS: Use of information / data for decision making at the various level of the organization and components of the information system which can support those decision i.e. transaction processing system, management information system etc. Cost benefit analysis of I.T.

DBMS: Different methods of data collections. Electronic commerce and its impact on business strategy.

Use of database and planning modules in strategic planning process e.g. external database economic models, forecasting modeling package strategy of information development and management on organization structure.

Data Security: Safety of data, evaluation of database system to avoid fraud.

RDBMS: Use of ERP and relational database management system

Course Outcome: Students successfully completing this course should be able :

1. To understand the different issues involved in the design and implementation of a database system.
2. To study the physical and logical database designs, database modelling, relational, hierarchical, and network models,
3. To understand and use data manipulation language to query, update, and manage a database,
4. To develop an understanding of essential DBMS concepts such as: database security, integrity, concurrency, distributed database, and intelligent database, client/server, data warehousing.

Reference Books/Material:

1. Panneerselvan R, " Database Management System", Prentice Hall of India Pvt. Ltd., 2002
2. Sinha P.K, "Computer Fundamental: Concept, Systems and Applications",
3. Kanter Jerome, "Managing with Information", Prentice Hall of India, 2nd Ed 1994
4. Elmarsi R, Navathe S.B., "Fundamental of database System", Pearson Education Asia
5. Devis Gordon B.,Olson M.H, "Management Information System," TMH, 2nd Ed.
6. Banerjee H.R., "A Profile of Information Technology-Computer Digest", Jaico Publication

Course Name: MEP442 - COMPUTER & DATABASE MANAGEMENT

Pre-requisites: Nil

Offered in: II Semester (Even Semester)

Scheme and Credit: [(0-0-2); Credits: 1]

Type of Course: Elective

Course Assessment Method: Continuous assessment

Course Objectives:

1. To understand various types of hardware and software used in IT
2. To learn data design and architecture
3. To prepares MIS
4. To learn different methods of data collections and management

List of Experiments:

1. Development of software for file handling system.
2. Development of programs using simple SQL commands.
3. Use of DDL commands on Computer (MS-SQL)
4. Use of DML commands
5. Development of database management system for any Industrial application
6. Specific application system progress for detail study.
7. Development of any practical oriented system as applicable in industry

Course Name: MEL555 - Project Evaluation & Management

Pre-requisites: Nil

Offered in: III Semester (Odd Semester)

Scheme and Credit: [(3-0-0); Credits: 3]

Type of Course: Elective

Course Assessment Method: Sessional I (15%), Sessional II (15%), Internal assessment through assignments/seminar/quizzes (10%), End Semester exam (60%).

Course Objectives:

Syllabus:

Course Outcome: Students successfully completing this course should be able :

Reference Books/Material:

Course Name: MEL439– Product Design & Development**Pre-requisites:** Nil**Offered in:** III Semester (Odd Semester)**Scheme and Credit:**[(3-0-0); Credits: 3]**Type of Course:** Elective**Course Assessment Method:** Sessional I (15%), Sessional II (15%), Internal assessment through assignments/seminar/quizzes (10%), End Semester exam (60%).**Course Objectives:**

1. To understand the relationship of art and science to design
2. To develop proficiency in design skills and methodologies
3. To gain first-hand experience of the design process in the context of a 'real', open-ended multidisciplinary design project
4. To work effectively and professionally in a team while executing a design project
5. To apply engineering analysis tools in the design process
6. To understand the holistic context of design, including global, societal, ethical, economic and environmental concerns
7. To improve proficiency in professional communication skills

Syllabus:

Definition of Product Design

Design by Evolution, Design by Innovation, Essential Factors of Product Design, Production-Consumption Cycle.

Product Design Practice and Industry: Introduction, Product Strategies, Time to Market, Analysis of the Product, The Three S's Standardization, Renard Series (Preferred Numbers) Simplification, The Designer and His Role, The Designer: Myth and Reality, The Industrial Design Organization, Basic Design Considerations, Problems faced by Industrial Designer, Procedure adopted by Industrial Designers, Types of Models designed by Industrial Designers What the Designer contributes, Role of Aesthetics in' Product Design, Functional Design Practice.

Economic Factors Influencing Design :Product Value, Design for Safety, Reliability and Environmental Considerations Manufacturing Operations in relation to Design, Economic Analysis, Profit and Competitiveness, Break-even Analysis, Economics of a New Product Design (Samuel Eilon Model).

Human Engineering Considerations in Product Design: Introduction, Human Being as Applicator of Forces, Anthropometrics: Man as Occupant of Space The Design of Controls, The Design of Displays, Man/Machine Information Exchange.

Reference Books/Material:

1. Chitale, Gupta, " Product Design & Manufacturing", 2nd Ed 2002, Prentice Hall of India

Course Outcomes: Upon completing this course,:

1. Students should be able to design a product using computer aided design.
2. Students should be able to carry out product development and planning process.
3. Students should be able to understand the concept of prototyping.

Course Name: MEL433– Design for Manufacturing & Assembly**Pre-requisites:** Nil**Offered in:** III Semester (Odd Semester)**Scheme and Credit:**[(3-0-0); Credits: 3]**Type of Course:** Elective**Course Assessment Method:** Sessional I (15%), Sessional II (15%), Internal assessment through assignments/seminar/quizzes (10%), End Semester exam (60%).**Course Objectives:**

1. To know characteristics of basic manufacturing processes and their capabilities
2. Select appropriate materials, processes and features for various design requirements
3. Design products which are suitable for manufacturing
4. Evaluate the design for available manufacturing alternatives

Syllabus:

Introduction – Definition, History, Advantages and Impact . Selection of materials and processes – General requirements, process capabilities, Systematic selection of processes and materials, design examples

Product design for manual assembly – General guidelines, systematic design for assembly, effect of various design features on manufacturing, design examples

Design for high speed automatic and robotic assembly – Design for high speed feeding and orientating, High speed inspection, Analysis of assembly, design examples

Design for machining – Design for single point / multi point / abrasive machining, assembly of components, accuracy and surface finish, cost estimating, design examples

Design for injection moulding – Injection moulding materials, moulding cycles, estimation of optimum number of cavities, design examples

Design for sheet metal working – Dies and Press working, Press selection, Design rules

Design for sand casting, die casting, investment casting – Materials, Basic characteristics of process and mould features, cost estimating, design rules for different castings.

Design for forging – characteristics, cost estimation and design rules.

Reference Books/Material:

1. Boothroyd, G., Dewhurst, P., Knight, W. A. "Product Design for Manufacturing and Assembly", Third Edition, CRC Press, 2011.
2. Allen, C. W., "Simultaneous Engineering -Integrating Manufacturing and Design", Society of Manufacturing Engineers, Nov. 1990.
3. James Bralla, "Design for Manufacturability Handbook" McGraw Hill, 2004.
4. Anderson, D.M., "Design for manufacturability & concurrent engineering: how to design for low cost, design in high quality, design for lean manufacture, and design quickly for fast production," CIM press, 2nd Edition, 2010.

Course Outcomes: Upon completing this course,:

1. Student will have knowledge of basic manufacturing processes and their capabilities
2. Student will select appropriate material, process and features for a design
3. Student will design products which are easy for assembly & manufacturing
4. Student will evaluate the design for alternatives of manufacturing

Course Name: MEL425 - Reliability and Maintenance Engineering

Pre-requisites: Nil

Offered in: III Semester (Odd Semester)

Scheme and Credit: [(3-0-0); Credits: 3]

Type of Course: Elective

Course Assessment Method: Sessional I (15%), Sessional II (15%), Internal assessment through assignments/seminar/quizzes (10%), End Semester exam (60%).

Course Objectives:

1. To equip the graduate to plan, design, and execute effective maintenance strategy and maintenance practices in various types of industries and apply various RCM based tools to analyse and prioritise various defects.
2. To equip graduates with the state of the art condition monitoring technologies and instrumentation.
3. To equip graduates with the essentials reliability theory and engineering to enable them to develop and enhance reliability programs.

Syllabus:

Introduction to reliability and maintainability: Engineering reliability definition. reliability assurance. reliability through redundancy, maintainability, maintainability improvement. maintainability vis-à-vis Maintenance techniques and defect failure analysis: dismantling and assembling, inspection and adjustment, lubrication. maintenance cleaning, Welding. metal spraying, metal stitching, Defect recording and failure analysis. downtime analysis, breakdown analysis (FTA, FMEA). Maintenance types/systems and Condition monitoring: planned/unplanned maintenance, breakdown, corrective. Opportunistic, routine, preventive, predictive maintenance: condition based maintenance system, design-out maintenance, selection of maintenance system, online/offline monitoring, visual, temperature, leakage, vibration, monitoring. ferrography, spectography, cracks, corrosion, noise/sound, smell/odour monitoring. condition monitoring of lutes and hydraulic systems and cross country pipe lines. Maintenance planning and scheduling: job planning. job manuals, long term and short term plans, overhauls and renovation. corporate turn around planning Codification and cataloguing, history cards, instruction and operation manuals, maintenance work order and work permit, maintenance record and documentation benefits, procedure and steps. Reliability based maintenance: evaluation of RBM programme, mean failure rate. MTTF. MTBF. MTBS, MTBM. MTTR. Hazard models; weibull model, constant hazard. linearly increasing hazard. System reliability; logic diagrams, markov models, use of Boolean algebra, de Morgan's theorem. Reliability in design and manufacture: Design analysis methods, QFD, LSA, FMECA, HAZOPS, part, materials and process (PMP) review. Production Failure Analysis and Corrective Action System (FRACAS). software reliability and analysis methods. reliability management and quality management- approaches.

Reference Books/Material:

1. Srivastava S K, "Industrial Maintenance Management", S. Chand, 1998
2. L.S. Srinath, "Reliability Engineering", Affiliated East-West Press, 4th Edition 2005
3. Higgins L.T., "Maintenance engineering hand book", Mc. Graw Hill Inc, 1995

Course Outcome: Students successfully completing this course should be able :

1. To understand the relationship of key concepts in reliability engineering and application to maintenance strategies in a manufacturing environment;
2. To establish maintenance strategies according to system characteristics and design transition programs to implement these strategies;
3. Manage the manufacturing organisation with highest possible availability.

Course Name: MEL402- Surface Engineering**Pre-requisites:** Nil**Offered in:** III Semester (Odd Semester)**Scheme and Credit:**[(3-0-0); Credits: 3]**Type of Course:** Elective**Course Assessment Method:** Sessional I (15%), Sessional II (15%), Internal assessment through assignments/seminar/quizzes (10%), End Semester exam (60%).**Course Objectives:**

- 1.To educate students on the technologies of surface engineering for wear resistance by introducing different methods for coatings and surface treatments.
- 2.To introduce the concepts of surface heat treatment, thermo chemical diffusion treatment, and mechanical treatment techniques.
- 3.To introduce the concepts of surface alloying and surface composites by laser melting and solid state processing techniques.
- 4.To give various concepts of thermal spraying techniques, PVD/CVD techniques and thermal barrier coatings (TBC).

Syllabus:

Need for surface engineering, Classification of surface engineering methods and Surface Preparation. Surface Hardening without modification of surface chemistry - Induction hardening, Flame hardening, Laser beam hardening and Electron beam hardening.

Thermo Chemical Diffusion Treatments - Carburizing, nitriding and boriding techniques. Mechanical treatments - Cold working, Shot peening and SMAT processes. Laser peening, laser surface alloying, laser cladding, friction surfacing and friction stir processing techniques.

Thermal spraying techniques – Flame spraying, Oxy-fuel powder spraying, D-gun spraying, HVOF coating, Plasma spraying and Cold/kinetic spraying. Electro plating and electroless plating of pure metals and composite materials.

Physical vapour deposition – PVD system, Thermal evaporation, Sputtering, Pulsed laser deposition, Electron beam deposition. Chemical Vapour Deposition (CVD) – CVD system, Hot wall and Cold wall reactors, Thermally activated and Plasma assisted CVD techniques. CVD diamond – A case study. Protective coatings for high temperature applications – Diffusion coatings, Overlay coatings, Pack cementation. Thermal Barrier Coatings (TBC) – Coating architecture, deposition methods and applications.

Reference Books/Material:

1. Budinski ,K.G., “Surface Engineering for Wear Resistances”, Prentice Hall, Englewood Cliffs, 1988
2. Ohring, M., “ The Materials Science of Thin Films”, Academic Press Inc, 2005
3. Morton,P.H., “Surface Engineering & Heat Treatment”, Brooke field, 1991

Course Outcomes: Upon completing this course,:

1. By the end of the course, the students should be able to:
2. Demonstrate an understanding and critical awareness of the concepts of surface engineering
3. Demonstrate a sound knowledge for the systematic application of alternative technologies used to fabricate coating systems.
4. Recommend techniques used to characterise the surface and explain the principles behind their operation.
5. Demonstrate knowledge of why the surface treatment affects the bulk properties of the material.
6. Select the most suitable surface engineering techniques that would give the required properties

Course Name: MED401- Project Phase I

Pre-requisites: Semester I and Semester II credits must be complete

Offered in: III Semester (Odd Semester)

Scheme and Credit:[(3-0-0); Credits: 3]

Type of Course: Core

Course Assessment Method: Sessional I (25%), Sessional II (25%), End Semester exam (50%).

Course Objectives:

1. To define the aim, objective, scope of the project topic from the thorough literature review
2. To design the methodology to be followed for the project
3. To finalize the design of experiments or fabrication of required setup or questionnaire

Course Name: MED503- Project Phase II

Pre-requisites: MED401

Offered in: IV Semester (Even Semester)

Scheme and Credit:[(9-0-0); Credits: 9]

Type of Course: Core

Course Assessment Method: Sessional I (25%), Sessional II (25%), External Examination (50%).

Course Objectives:

1. To perform simulations or experiments or study as designed in MED401
2. To obtain results and analysis of the results
3. To draw conclusions and decide future scope of the work
4. To write and submit thesis based on project work

Course Outcome:

1. On successful completion of this course, student will be eligible for award of master's degree