DEPARTMENT OF MECHANICAL ENGINEERING

Course Book for

M. Tech. in

Industrial Engineering

For

Academic Year: 2020 - 2021

Visvesvaraya National Institute of Technology,

Nagpur-440 010 (MH)

Institute Vision Statement

To contribute effectively to the National and International 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 and the World incorporating relevant social concerns and to build an environment to create and propagate innovative technologies for the economic development of the Nation.

Institute Mission Statement

The mission of VNIT is to achieve high standards of excellence in generating and propagating knowledge in engineering and allied disciplines. VNIT 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.

Department Vision Statement

To produce quality human resource of high standard in mechanical engineering who can contribute favorably to the technological and socio-economic development of the nation.

Department Mission Statement

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

Brief about Mechanical Department

Department of Mechanical Engineering is one of the oldest department started in 1960, scurrently department is offering 1 UG and 3 PG programmes. Faculty members of the department are highly motivated for teaching and conducting research in the diversified fields of mechanical engineering.

List of faculty Members

Sr No	Faculty Name	Areas of specialization
1	Dr. P. M. Padole	Design Engineering
2	Dr. H. T. Thorat	Design and Industrial Engineering
3	Dr. S. B. Thombre	Thermal Engineering
4	Dr. A. M. Kuthe	Manufacturing
5	Dr. V. R. Kalamkar	Thermal Engineering
6	Dr. A. Chatterjee	Design Engineering
7	Dr. Y. M. Puri	Manufacturing and Industrial Engineering
8	Dr. D. B. Zodpe	Thermal Engineering
9	Dr. A. B. Andhare	Manufacturing
10	Dr. J. G. Suryawanshi	Thermal Engineering
11	Dr. S. S. Chiddarwar	Manufacturing and Design Engineering
12	Dr. R. V. Uddanwadikar	Design Engineering
13	Dr. A. S. Dhoble	Thermal Engineering
14	Dr. H.P. Jawale	Design Engineering
15	Dr. M. S. Kotambkar	Design Engineering
16	Dr. A. K. Singh	Design and Thermal Engineering
17	Dr. Trushar B Gohil	Thermal Engineering
18	Dr. T. V. K. Gupta	Manufacturing
19	Dr. Ravikumar Dumpala	Manufacturing
20	Dr. R. K. Peetala	Thermal Engineering
21	Dr. P. V. Kane	Industrial Engineering
22	Dr. D. A. Jolhe	Industrial Engineering
23	Dr. V. M. Nistane	Design Engineering
24	Dr. G. Tiwari	Design Engineering
25	Dr. S Roga	Thermal Engineering
26	Dr. A. A. Thakre	Design and Industrial Engineering
27	Dr. K. M. Asthankar	Industrial Engineering
28	Dr. P. D. Sawarkar	Thermal Engineering
29	Dr. N. K. Lautre	Industrial Engineering

UG/ PG Programmes Offered by Mechanical Department:

The department offers following undergraduate and postgraduate programmes

	Program	Description
UG	B. Tech in Mechanical Engineering	Intake: 115
PG	M. Tech. in 1. Computer Aided Design & Manufacturing 2. Industrial Engineering 3. Heat Power Engineering	Intake : 25 each

Credit System at VNIT :

Education at the Institute is organized around the semester-based credit system of study. The prominent features of the credit system are a process of continuous evaluation of a student's performance / progress and flexibility to allow a student to progress at an optimum pace suited to his/her ability or convenience, subject to fulfilling minimum requirements for continuation. A student's performance/progress is measured by the number of credits he/she has earned, i.e. completed satisfactorily. Based on the course credits and grades obtained by the student, grade point average is calculated. A minimum number of credits and a minimum grade point average must be acquired by a student in order to qualify for the degree.

Course credits assignment

Each course, except a few special courses, has certain number of credits assigned to it depending on lecture, tutorial and laboratory contact hours in a week.

For Lectures and Tutorials: One lecture hour per week per semester is assigned one credit and

For Practical/ Laboratory/ Studio: One hour per week per semester is assigned half credit.

Example: Course XXXXXX with (3-0-2) as (L-T-P) structure, i.e. 3 hr Lectures + 0 hr Tutorial + 2 hr Practical per week, will have (3x1 + 0x1 + 2x0.5 =) 4 credits.

Grading System

The grading reflects a student's own proficiency in the course. While relative standing of the student is clearly indicated by his/her grades, the process of awarding grades is based on fitting performance of the class to some statistical distribution. The course coordinator and associated faculty members for a course formulate appropriate procedure to award grades. These grades are reflective of the student's performance

vis-à-vis instructor's expectation. 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, a student is given a Grade. Each grade has got certain grade points as follows:

Grade	Grade points	Description
AA	10	Outstanding
AB	9	Excellent
BB	8	Very good
BC	7	Good
CC	6	Average
CD	5	Below average
DD	4	Marginal (Pass Grade)
FF	0	Poor (Fail) /Unsatisfactory / Absence from end-sem exam
NP	-	Audit pass
NF	-	Audit fail
SS	-	Satisfactory performance in zero credit core course
ZZ	-	Unsatisfactory performance in zero credit core course
W	-	Insufficient attendance

Performance Evaluation

The performance of a student is 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. CGPA is rounded up to second decimal.

The Earned Credits (ECR) are defined as the sum of course credits for courses in which students have been awarded grades between AA to DD. Grades obtained in the audit courses are not counted for computation of grade point average.

e point) for courses in which AA- DD grade has been obtained
credits) for courses registered in a semester in which AA- FF grades are awarded

CGPA= EGP / Σ(Course credits) for courses passed in all completed semesters in which AA- DD grades are awarded

Overall Credits Requirement for Award of Degree

SN	Category of Course	Symbol	Credit Requirement			
			B. Tech. (4-Year)	B. Arch. (5 Year)	M. Tech. (2 Year)	M. Sc. (2 Year)
	Program Core					
1	Basic Sciences (BS)	BS	18	04	-	-
2	Engineering Arts & Sciences (ES)	ES	20	18	-	-
3	Humanities	HU/ HM*	05	06	-	-
4	Departmental core	DC	79-82	168	33-39	54-57
	Program Elective					
3	Departmental Elective	DE	33-48	17-23	13-19	06-09
4	Humanities & Management	HM	0-6	0-3	-	-
5	Open Course	OC	0-6	0-3	-	-
Total requirement :BS + ES + DC+ DE + HM + OC =			**170**	**219**	**52**	**63**
Minimum Cumulative Grade Point Average required for the award of degree			**4.00**	**4.00**	**6.00**	**4.00**

Attendance Rules

1. All students must attend every class and 100% attendance is expected from the students. However, in consideration of the constraints/ unavoidable circumstances, the attendance can be relaxed by course coordinator only to the extent of not more than 25%. Every student must attend minimum of 75% of the classes actually held for that course.
2. A student with less than 75% attendance in a course during the semester, will be awarded W grade. Such a student will not be eligible to appear for the end semester and re-examination of that course. Even if such a student happens to appear for these examinations, then, answer books of such students will not be evaluated.
3. A student with W grade is not eligible to appear for end semester examination, reexamination & summer term.

Program Outcomes for M. Tech (Common to all PG programmes):

a. An ability to independently carry out research /investigation and development work to solve practical problems.
b. An ability to write and present a substantial technical report/document.
c. Students should be able to demonstrate a degree of mastery over the area as per the specialization of the program. The mastery should be at a level higher than the requirements in the appropriate bachelor program.

Department of Mechanical Engineering

List of courses for the PG Programme

M. Tech. in Industrial Engineering

I. To be offered in Odd semester

S. No	Code	Title	DC/DE	Structure L-T-P	Credit	Pre- requites
1	MEL517	Quantitative Techniques in Industrial Management	DC	3-0-0	3	
2	MEP517	Quantitative Techniques in Industrial Management Lab	DC	0-0-2	1	
3	MEL502	Methods Engineering and Ergonomics	DC	3-0-0	3	
4	MEP502	Methods Engineering and Ergonomics Lab	DC	0-0-2	1	
5	MEL553	Personal Management and Industrial Relations	DC	3-0-0	3	
6	MEL505	Materials Management	DC	3-0-0	3	
7	MED 501	Project Phase I	DC		3	25 Credits
8	MEL521	Production Planning and Control	DE	3-0-0	3	
9	MEL450	Advanced Machining Processes	DE	3-0-0	3	
10	MEL408	Supply Chain Management	DE	3-0-0	3	
11	MEL533	Failure Analysis	DE	3-0-0	3	
12	MEL439	Product design and Development	DE	3-0-0	3	
13	MEL433	Design for Manufacturing and Assembly	DE	3-0-0	3	
14	MEL425	Reliability and Maintenance Engineering	DE	3-0-0	3	
15	MEL402	Surface Engineering	DE	3-0-0	3	
16	MEL537	Product Ideation and Design	DE	3-0-0	3	

II. To be offered in Even semester

S. No	Code	Title	DC/DE	Structure L-T-P	Credit	Pre requites/Remark
1	MEL445	Automation in Production	DC	3-0-0	3	
2	MEP445	Automation in Production Lab	DC	0-0-2	1	
3	MEL506	Marketing Management	DC	3-0-0	3	
4	MEL501	Statistics and Quality Assurance	DC	3-1-0	4	
5	MED502	Project Phase-II	DC		9	35 Credits+ Project Phase I
6	MEL530	Machine Condition Monitoring	DE	3-0-0	3	
7	MEL510	Manufacturing System Simulation and Design	DE	3-0-0	3	
8	MEL529	Industrial Product Development	DE	3-0-0	3	
9	MEL532	Layered Manufacturing	DE	3-0-0	3	
10	MEP532	Layered Manufacturing Lab	DE	0-0-2	1	
11	MEL442	Computer and Database Management	DE	3-0-0	3	
12	MEP442	Computer and Database Management Lab	DE	0-0-2	1	
13	MEL555	Project Evaluation and Management	DE	3-0-0	3	
14	MEL***	Design of Fixtures in Manufacturing	DE	3-0-0	3	

III. Total credits to be earned for completion of the degree program:
a) Through DC category courses = 37 credits
b) Through DE category courses = 15 credits +1

Total = 52 Credits +1

IV. This DC/DE categorization of the courses for the M. Tech Program in Heat Power Engineering and is applicable for the students admitted to the first semester during the academic year 2020-2021.

COURSES TO BE OFFERED
IN
ODD SEMESTER

MEL517QUANTITATIVE TECHNIQUES IN INDUSTRIAL MANAGEMENT

3 credits (3-0-0)

Pre-requisites: Nil

Overlaps with:

Course Outcomes/ Objectives :

Be able to model non linear constrained and unconstrained engineering problems

Be able to solve multi-objective non linear constrained or unconstrained engineering problems

Develop the skills for the formulation and solution of mathematical models in their own research.

Content:

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

Multi objective optimization, Grey relational analysis, principal component analysis, Weighted sum optimization, Weak and strong dominance, Pareto front computation, Goal programming and iso-performance, Multi-attribute Utility Theory

Text Books/ Reference Books:

Gupta, P. K., Hira D. S., “Operation Research”, S. Chand and Company

Rao, S. S., “Engineering Optimization (Theory and Practice)”, John Wiley & Sons,

Taha, H. A. ,“Operations Research”, Prentice Hall of India, New Delhi, 9th Edition

MEP517QUANTITATIVE TECHNIQUES IN INDUSTRIAL MANAGEMENT

1 credit (0-0-2)

Pre-requisites: Nil

Overlaps with:

Course Outcomes/ Objectives :

To present the basic theory of non linear constrained and unconstrained problems that arose in engineering.

To give a thorough understanding of getting solution to these problems and some experience in solving them.

To develop the skills for the formulation and solution of mathematical models in their own research.

Content:

Assignment of Project Management

Assigment on Simplex method

Assignment on linear programming

Assignment on transportation.

Assignment on non linear problem.

Assignment on Taguchi technique.

Assignment on Response surface methodology.

Assignment on Simulation.

Assignment on Multiple objective optimization.

. Power point presentation on an operation research software.

Text Books/ Reference Books:

MEL502 METHODS ENGINEERING AND ERGONOMICS

3 credits (3-0-0)

Pre-requisites: Nil

Overlaps with:

Course Outcomes/ Objectives :

Upon successful completion students will be able to:

understand work improvement and work measurement techniques like method study, stop watch time study, work sampling, etc.

understand ergonomics with the viewpoints of human comfort, product design and system design.

Content:

Method study (including various recording techniques), Principles of motion economy, Micromotion study, Work measurement- Stop watch time study, Work sampling, MTM, PMTS, MOST, Concepts of performance rating, allowances and learning curve.

Man-machine system, Human physiology and anatomy, Human limitations, Anthropometry (including statistical treatment), Anthropometric design procedure, Behavior, perception and psychological aspects of ergonomics, Information processing, Cognitive ergonomics, Mental workload.

Occupational hazards & ergonomic intervention, WSMD, Ergonomic assessments such as REBA, RULA, Single action biomechanics analysis, HAMA, Stress indexes, etc., NIOSH &OSHA guidelines, Postural and movement analysis.

Environmental factors, Effect of noise, illumination, ventilation and vibrations on human performance, Thermal comfort, Heat exchange process, Acclimatization, Metabolism, Physiological costs and energy expenditure.

Design of workplace and work systems, Reach envelop analysis, Applications of ergonomics in product/system development such as automotive design, Usability analysis, Design of displays and controls, Speech intelligibility and communication design, Manual material handling and its biomechanics.

Digital human modelling and analysis in virtual environment using appropriate software. Case studies/mini projects in ergonomics and work study.

Text Books/ Reference Books:

Kanawaty, George (Ed.), Introduction to Work study, ILO

Bridger, R. S., Introduction to Ergonomics, CRC Press

G. Salvendy (Ed.), Handbook of Human Factors and Ergonomics, John Wiley & Sons.

Sanders, M. S. and McCormick, E. J., Human Factors in Engineering and Design, McGraw-Hill.

MEP502 METHODS ENGINEERING AND ERGONOMICS

1 credit (0-0-2)

Pre-requisites: Nil

Overlaps with:

Course Outcomes/ Objectives:

To understand work measurement and work improvement techniques like stop watch time study, work sampling, method study, etc.

To understand ergonomics with human comfort point of view.

Content:

Study of charting techniques

Study of diagramming techniques

Study of Therbligs

Critical examination of a job

Study of principles of motion economy

Stop watch time study

Work sampling study

Training for performance rating

Application of MOST

. Ergonomic assessment of different types of chair/tables

. Response time measurement

. Speech intelligibility test

. Design of workstation

. Design of displays

. Design of controls

. Physiological cost of activity

. Rapid Upper Limb Assessment (RULA)

. Rapid Entire Body Assessment (REBA)

. Anthropometric data collection and application

. Physiological cost of an activity

Text Books/ Reference Books:

MEL553PERSONNEL MANAGEMENT AND INDUSTRIAL RELATIONS

3 credits (3-0-0)

Pre-requisites: Nil

Overlaps with:

Course Outcomes/ Objectives:

Student can answer/solve questions/quizzes/case studies on personal management.

Student can answer/solve questions/quizzes/case studies on labour legislation.

Student can discuss on Human behavior.

Mapping with POs

POs → / **COs ↓**	**a**	**b**	**c**

CO1	H	H	H
CO2	H	H	H
CO3	M	H	M
Overall	H	H	H

Content:

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.

Personnel management: Scope and objectives of personnel management, personnel planning, recruitment and selection, training and development, wages and salary administration, incentive plans, trade unions and collective bargaining, labour welfare.

Job evaluation: Job evaluation, merit rating, employee health, security and welfare, morale and motivation, leadership, organization, industrial disputes, voluntary and compulsory settlement.

Labour legislations

Performance appraisal and evaluation

Text Books/ Reference Books:

Knouse S.B., "Human Resources Management Perspectives", ASQC Quality Press, 1996

Schuler R.S. "Managing Human Resources", 4th Ed., West Publishing Co.,1992

Venkat Tatnam C. S., Dhal Manoranjan "Industrial Relations", second edition, Oxford University Press, 2017.

MEL505 MATERIALS MANAGEMENT

3 credits (3-0-0)

Pre-requisites: Nil

Overlaps with:

Course Outcomes/ Objectives:

1. To know importance of integrated material management
2. To know different inventory models and inventory control technique
3. To know and improve material management functions involved in material management
4. To give introduction to different philosophies like JIT, MRP, SCM etc.

Program Outcomes (POs)

An ability to independently carry out research /investigation and development work to solve practical problems.

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

Students should be able to demonstrate a degree of mastery over the area as per the specialization of the program. The mastery should be at a level higher than the requirements in the appropriate bachelor program.

Mapping with POs:

POs → / COs ↓	a	b	c
CO1	L	H	L
CO2	H	H	H
CO3	H	M	H
CO4	H	M	M
Overall	H	M	M

Content:

Materials Management**[CO1]**, Integrated Materials Management**[CO1]**, Inventory Management Models**[CO2]**, Selective Inventory Models, **[CO2]**

Classification and Codification of Materials **[CO3]**, Specification in Materials Management **[CO3]**, Standardisation and variety reduction**[CO3]**, Management of Material Waste**[CO3]**, Budgeting and Materials Planning**[CO3]**, Storage and warehousing**[CO3]**,

Purchase : policies and procedures**[CO3]**, Public buying **[CO3]**, International Purchasing **[CO3]**, Import substitution**[CO3]**, Source Selection**[CO3]**, Performance Rating and Development**[CO3]**, Negotiation**[CO3]**, Purchasing of Capital equipment's**[CO3]**, Make or Buy Decision**[CO3]**, Incoming Material Quality Assurance**[CO3]**, Value analysis for material cost reduction**[CO3]**, Evaluation of Materials Management effectiveness**[CO3]**

Multi-echelon Inventory Models**[CO4]**, Supply Chain Management **[CO4]**, MRP**[CO4]**, MRP-II **[CO4]**, Just in Time **[CO4]**, Kanban**[CO4].**

Text Books/ Reference Books:

P Gopalkrishnan & M. Sudarshan, "Materials Management", PHI learning pvt ltd.

A. K. CHITALE, R. C. GUPTA, "Materials Management: Texts and Cases", PHI learning pvt ltd.

Tony Arnold, "Introduction to Materials Management", Pearsons

MED501PROJECT PHASE I

3 credits
Pre-requisites: Nil
Overlaps with:
Course Outcomes/ Objectives:

Content:

Text Books/ Reference Books:

MEL521PRODUCTION PLANNING AND CONTROL

3 credits (3-0-0)

Pre-requisites: Nil

Overlaps with:

Course Outcomes/ Objectives:

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

Describe (identify/write) the various components that make up the manufacturing planning and control system and the interaction among them.

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.

Develop the algorithms that are appropriate for solving single-machine, two-machine, parallel-machines and flow shop scheduling problems.

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.

Identify, discuss, and implement important research topics within production planning and control.

Content:

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.

Text Books/ Reference Books:

Boeuf, M..L., " Essence of Time Management", Jaico Publication House, 1995

Gupta A.K., Sharma S.J , "Management of System"

MEL450ADVANCED MACHINING PROCESSES

3 credits (3-0-0)

Pre-requisites: Nil

Overlaps with:

Course Outcomes/ Objectives:

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

Illustrate advanced machining processes, cutting tools and cutting fluids for a specific material and part features.

Relate the difference in material removal mechanisms in electron beam machining, laser beam machining, comparison of thermal and non-thermal processes.

Will be able to understand the difficulties and challenges in spark erosion process, chemical etching process.

Correlate the parameters for machining a particular material with a specific process.

Content:

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 and Grinding: Introduction to nano-precision mechanical manufacturing: M4 processes. Machine & tool; Brittle / ductile transition; Ductile mode cutting of brittle materials. Grinding, 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)

Text Books/ Reference Books:

Boothroyd, G and Knight, W A., “Fundamentals of Machining and Machine Tools”, 3rd Third Edition, Saint LuicePr, 2005.

G.F. Benedict, “Non-traditional Manu. Processes”, Marcel Dekker, Inc. New York, 1987.

P.C. Pandey, and H.S. Shan, “Modern Machining Processes”, Tata McGraw-Hill Publishing Co. Ltd, New Delhi, 1980.

J.A. McGeough, “Adv. Methods of Machining”, Chapman and Hall, London, 1988.

MEL408SUPPLY CHAIN MANAGEMENT

3 credits (3-0-0)

Pre-requisites: Nil

Overlaps with:

Course Outcomes/ Objectives:

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

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.

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

Content:

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

Text Books/ Reference Books:

Sunil Chopra and Peter Meindl , “Supply Chain Management”, Pearson – Prentice Hall publication. Ist and IInd edition

Janat Shah, “Supply Chain Management”, Pearson education Publication, Ist edition.

Spigel M.R , “Probability and statistics”, McGraw Hill Book Co, 1980

MEL533FAILURE ANALYSIS

3 credits (3-0-0)

Pre-requisites: Nil

Overlaps with:

Course Outcomes/ Objectives:

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

apply knowledge of science and engineering in the solution of failure investigation.

design a system or a component of a system for a specific task within realistic constraints

Content:

General principle and procedure of failure analysis, Causes of failure: material selection, defective process, environment condition, load variables, temperatures, defective design and assembly, surface micro and macro cracks

Failure of brittle and ductile material: Details of fractographic, Crack initiation and propagation in ductile and brittle material, Griffith theory, Irwin's modification, surface and embedded cracks, Surface treatments to minimize the surface cracks, Crack growth mechanism for plane stress and plain strain, Notch sensitivity, stress tri-axiality, Failure due to tension and torsion, Modulus of rupture, stress intensity factor, Fatigue crack growth, striations, identifications and remedies

Material and process defects: Significance and corrective actions against material and process defects, Inclusions, Casting defects, forging defects, welding defects, Heat affected zone, Defects in coatings,

Non-destructive testing: Principle and methodology of different NDT methods, Liquid Penetration Testing, Ultrasonic Testing, Radiographic Testing, Magnetic Particle Testing

Case Studies and mini project: Failure investigations of crack shaft, boiler tube, turbine rotor, blades, aircraft fuselage

Students will work in groups to provide a preliminary investigation of a failure, including macroscopic inspection and photographic documentation. A report detailing the initial findings and development of a proposal for a more detailed analysis will be required.

Text Books/ Reference Books:

Charlie R. Brooks, Ashok Choudhury, "Failure Analysis of Engineering Materials", McGraw Hill, Second Edition

Richard W. Hertzberg, Richard P. Vinci, Jason L. Hertzberg, "Deformation and Fracture Mechanics of Engineering Materials", John Wiley & Sons, Fifth Edition

V. Ramachandran, "Failure Analysis of Engineering Structures: Methodology and Case Histories", ASM International, 2005 - TECHNOLOGY & ENGINEERING

MEL439PRODUCT DESIGN & DEVELOPMENT
3 credits (3-0-0)
Pre-requisites: Nil
Overlaps with:
Course Outcomes/ Objectives:

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.

Content:

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.

Text Books/ Reference Books:

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

MEL433DESIGN FOR MANUFACTURING & ASSEMBLY

3 credits (3-0-0)

Pre-requisites: Nil

Overlaps with:

Course Outcomes/ Objectives:

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

Content:

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.

Text Books/ Reference Books:

Boothroyd, G., Dewhurst, P., Knight, W. A. "Product Design for Manufacturing and Assembly", Third Edition, CRC Press, 2011.

Allen, C. W., "Simultaneous Engineering -Integrating Manufacturing and Design", Society of Manufacturing Engineers, Nov. 1990.

James Bralla, "Design for Manufacturability Handbook" McGraw Hill, 2004.

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.

MEL425RELIABILITY AND MAINTENANCE ENGINEERING

3 credits (3-0-0)

Pre-requisites: NIL

Overlaps with:

Course Outcomes/ Objectives :Students successfully completing this course should be able :

To equip the graduate to plan, design, and execute effective maintenance strategy and maintenance practices in various types of industries.

To equip graduates with the state of the art maintenance repair techniques and condition monitoring technologies and instrumentation.

To equip graduates with the essentials of reliability engineering techniques to enable them to develop and enhance reliability programs.

Program Outcomes (POs)

An ability to independently carry out research /investigation and development work to solve practical problems.

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

Students should be able to demonstrate a degree of mastery over the area as per the specialization

of the program. The mastery should be at a level higher than the requirements in the appropriate bachelor program.

Mapping with POs:

POs → / COs ↓	a	b	c
CO1	H	H	M
CO2	H	M	M
CO3	H	M	H
Overall	H	M	M

Content:

Plant Maintenance :A Conceptual Framework **[CO1]** , Maintenance Strategies**:** planned/unplanned maintenance, breakdown, corrective. Opportunistic, routine, preventive, predictive maintenance: condition based maintenance system, design-out maintenance, selection of maintenance system. MaintenancePlanning. Maintenance Scheduling, Spare Parts Management, Replacement Analysis, Codification and cataloguing, history cards, instruction and operation manuals, maintenance work order and work permit etc. Computerized Maintenance Management System, E-Maintenance. **[CO1]**

Maintenance defect failure analysis and repair techniques: Defect recording and failure analysis. breakdown analysis (FTA, FMEA), dismantling and assembling, inspection and adjustment, lubrication. Maintenance cleaning, welding, metal spraying, metal stitching, thread inserts, Electro-disintegration machine etc. **[CO2]**

Machinery condition monitoring: Fundamentals of machine vibrations, Digital Signal Processing, Instrumentation, Vibration Monitoring, Noise Monitoring, Thermography, Wear debris analysis, Motor current signature analysis, other techniques such as Ultrasonic testing, Radiography, Eddy current testing etc. **[CO2]**

Reliability Oriented Maintenance Systems and Evaluation: Elements of Probability, Reliability definition, Failure data analysis, Analysis of Failure Data, Overview of estimation techniques, Distribution Fitting, Hazard Models, System Reliability, Reliability Improvement, FTA and other techniques, Maintainability and Availability, Repairable systems. **[CO3]**

Other topics: TPM, RCM, Six Sigma Maintenance, Lean Maintenance, Five zero maintenance, 5-S concept, OEE, Software reliability, HAZOP, Human Reliability. Industrial Safety. **[CO3]**

Text Books/ Reference Books

Srivastava S K, “Industrial Maintenance Management”, S. Chand, 1998

L.S. Srinath , “Reliability Engineering”, Affilated East-West Press , 4th Edition 2005

3. Williams, "Condition Based Maintenance and Machine Diagnostics " Chapman & Hall

MEL402SURFACE ENGINEERING
3 credits (3-0-0)
Pre-requisites: Nil
Overlaps with:
Course Outcomes/ Objectives:

Upon completing this course:

Demonstrate an understanding and critical awareness of the concepts of surface engineering

Demonstrate a sound knowledge for the systematic application of alternative technologies used to fabricate coating systems.

Recommend techniques used to characterize the surface and explain the principles behind their operation.

Select the most suitable surface engineering techniques that would give the required properties

Mapping with POs:

POs → COs ↓	**PO1**	**PO2**	**PO3**
CO1		-	H
CO2	-	-	H
CO3	L	-	M
CO4	L	L	H
Overall	L	L	H

Content:

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 and Laser peening. Friction based - friction surfacing and friction stir processing techniques.

Hard facing - selection of hard facing materials and techniques. Laser cladding and laser surface alloying.

Thermal spraying techniques – Flame spraying, Oxy-fuel powder spraying, D-gun spraying, HVOF coating, Plasma spraying and Cold/kinetic spraying. 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.

Structural, microstructural and mechanical characterization techniques with focus on surface engineering.

Text Books/ Reference Books:

Budinski ,K.G., “Surface Engineering for Wear Resistances”, Prentice Hall, Englewood Cliffs, 1988

Ohring, M., “ The Materials Science of Thin Films”, Academic Press Inc, 2005

Morton,P.H., “Surface Engineering & Heat Treatment”, Brooke field, 1991

MEL537 Product Ideation and Design

3 credits (3-0-0)

Pre-requisites: NIL

Overlaps with: NIL

Course Outcomes/ Objectives :

1) To explain students essentials of product design process for engineering product,
2) To make student understand various definitions and theoretical concepts related to engineering product development to PG level students.
3) To explain student the product design strategies and subsequent generalised steps to convert conceptualised idea into a product.
4) To make the students comprehend integration of engineering knowledge, technology tools and other resources to deliver successful product.
5) To analyse successful product with above objectives through case studies

Content:

1. Ideation in Engineering Product

Understanding users, defining their needs and defining the problem to solve. Methods for creating creative concepts - exploration of alternative solutions. Mapping the functional requirements to possibilities of form. Considerations of user requirement like function, materials and processes, sketching and modelling for product ideation

2. Industrial Product Design

Product functions relationship. Situation/ Context of use, users, market research, and product research with a focus on materials and processes. Opportunity Identification, Product development charter, Strategies for handling industrial product, Analysis of research information and identification of problem areas leading to a problem statement and articulation of constraints.

Methods/ Techniques for evolution of creative alternative concepts. Gate clearances, Validation of concepts through Exploratory Mock ups from the point of view of product functions by the users and other stakeholders. Finalisation of the concept, preparation of final model, technical drawings and other supporting documentation

Text Books/ Reference Books:

1 Engineering Design methods strategies for product design, Nigel Cross, Willey Publication

2. Kevin Otto and Kristen Wood, Product design: Techniques in Reverse Engineering and New Product development, Prentice Hall, USA, 2001

3. Product planning and Management by William l Moore and E. A. Pressemier McGraw-Hill International edition 2nd Edition, 2009

4. Product Design and Development by Karl T. Ulrich and Steven D. Eppinger, McGraw-Hill, 5th Edition, 2015 reprint.

COURSES TO BE OFFERED
IN
EVEN SEMESTER

MEL445AUTOMATION IN PRODUCTION

3 credits (3-0-0)

Pre-requisites: Nil

Overlaps with:

Course Outcomes/ Objectives:

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

understand various automation systems and its components,

implement the learned techniques to the various practical situations in industries.

Content:

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 allay devices, optical triangulation techniques.

Group Technology: Part families, parts classification & coding, Opitz classification systems, production. Flow analysis; Machine cell design -composite pat1 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

Text Books/ Reference Books:

Groover M.P , “Automation, production System & CIMS”, Prentice Hall of India, 2nd Ed, 2002

Zimmers, Groover, “CAD/CAM”, Prentice Hall of India, 9th Ed.; 1998

Kundra, Rao, Tiwari, “ Numerical Control and Computer Aided Manufacturing”, TMH

Koren Yoram, “Computer Control of Manufacturing Systems”, McGrawHil, 3rd Ed, 1986

MEP445AUTOMATION IN PRODUCTION

1 credit (0-0-2)

Pre-requisites: Nil

Overlaps with:

Course Outcomes/ Objectives:

Performance, Simulation on CNC lathe (at least two Complex Geometries)

Performance, Simulation on CNC milling (at least two Complex Geometries)

Practice Programming on Manual Part Program

Practice Programming on APT

Case Study on Automated System of any Industry.

Performance/ Practical on Robot.

Part Coding and Group Technology.

Content:
Text Books/ Reference Books:

MEL506MARKETING MANAGEMENT

3 credits (3-0-0)

Pre-requisites: Nil

Overlaps with:

Course Outcomes/ Objectives:

Students will be able to understand concept of marketing and model the marketing system.

Students will be able to formulate 4Ps of marketing and understand buyer behavior.

Students will be able to explore distribution channels and social, ethical and legal aspects of marketing.

Students will be able to apply quantitative techniques in marketing

Content:
Introduction to marketing; Basic marketing concepts- needs, wants, demands, values, etc.; 4Ps of marketing; Marketing environment; Segmentation; Targeting; Positioning.

Concept of a product; Classification of products; Critical to customer satisfaction product attributes; Product line and product mix; Product life cycle and appropriate marketing strategies.

Consumer behaviour; Marketing research; Demand and sales forecasting; Marketing planning; Competition analysis.

Distribution channels; Retailing and wholesaling; Direct marketing; Personal selling; Product portfolio analysis; Product pricing; Sales promotion – tools and techniques; Advertising; Branding; Packaging.

Social, ethical and legal aspects of marketing; Marketing of services; International marketing; Green marketing; Cyber marketing; Social marketing; Rural marketing; Service marketing; E-commerce and internet marketing; Customer relationship management.

Quantitative techniques in marketing management. Case studies/ individual or group exercises in various topics of marketing management.

Text Books/ Reference Books:
Kotler, Philip and Keller, Kevin (2012). Marketing Management, Prentice-Hall.

Cant, M. C., Strydom, J. W, Jooste, C. J., du Plessis P. J. (2006). Marketing Management, Juta

Legal & Academic Publishers.
Saxena, Rajan (2009). Marketing Management, Tata McGraw-Hill.
Kazmi, S. H. H. (2007). Marketing Management-Text and Cases, Excel Books, New Delhi.

MEL501STATISTICS AND QUALITY ASSURANCE

3 credits (3-0-0)

Pre-requisites: Nil

Overlaps with:

Course Outcomes/ Objectives:

Understand the applications of Probability distribution in predicting behavior of the process.

Develop conceptual understanding of Quality of Product and Process and its Management.

Develop Control charts for process control.

Develop understanding of sampling plans for acceptance of materials.

Content:

Statistics: Probability theory, Random variables (discrete &continuos), binomials, poisons, 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, x2 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.

Text Books/ Reference Books:

Spigel M.R , “Probability and statistics”, McGraw Hill Book Co, 1980

Gupta, Kapoor ,“Fundamentals of Mathematical Statistics”, S.Chand& Sons, 8th Ed, 1998

Duncan A.J., Irwin Richard D., “Quality Control and Industrial Statistics”, INC, USA, 1965

Feigenbaum F.V, “Total Quality Control”, McGraw Hill International Edition, 3rd Ed, 1987

Halpern S., “The Assurance Sciences”, Prentice Hall India Ltd.New Delhi, 1979

MED502 PROJECT PHASE II

9 credits

Pre-requisites: Nil

Overlaps with:

Course Outcomes/ Objectives: Students will be able

To identify research problem

To review literature

To present research report

To carry out scientific investigation

Mapping with POs*:

POs → COs ↓	PO1	PO2	PO3
CO1	L	M	M
CO2	M	M	M
CO3	H	H	H
CO4	H	H	H
Overall	H	H	H

Content

Text Books/ Reference Books:

MEL530 MACHINE CONDITION MONITORING

3 credits (3-0-0)

Pre-requisites: Nil

Overlaps with:

Course Outcomes/ Objectives:

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

Know basic machine problems and their monitoring methods.

Use of appropriate parameter for monitoring

Use of modern tools for monitoring

Draw charts, graphs, etc. to indicate machine status

Mapping with POs:

POs → / COs ↓	PO1	PO2	PO3
CO1	M	L	H
CO2	H	L	H
CO3	H	M	H
CO4	M	M	H
Overall	H	M	H

Content:

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

Text Books/ Reference Books:

Randall R. B., "Vibration Based Condition Monitoring," Ch.1, Ch. 2, Ch 3, Wiley, New Delhi, 2010.

Cempel C., "Ellis Horwood Series in Mechanical Engineering, Vibroacoustic Condition Monitoring," pp. 1 – 43, Michigan

Piersol A. and Paez T , "Harris' Shock and Vibration Handbook," Mc-Graw Hill, 2010

Alan Davies, "Handbook of Condition Monitoring: Techniques & Methodology," Chapman & Hall, London, 1998.

MEL510 MANUFACTURING SYSTEM SIMULATION AND DESIGN

3 credits (3-0-0)

Pre-requisites: Nil

Overlaps with: Nil

Course Outcomes/ Objectives:

Upon successful completion of this course, the students will

Understand the concepts in system simulation and underlying statistical theories.

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.

Differentiate and understand various system simulation strategies.

Develop the skills of modelling and simulation using various software / programming languages.

Mapping with POs:

POs → / COs ↓	a	b	c
CO1	L	M	H
CO2	H	H	M
CO3	L	-	H
CO4	H	M	-
Overall	M	M	H

Content:

Systems concepts in manufacturing, Types of systems, Basic concepts in simulation, Probability and statistical distributions. [CO1]

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. [CO3]

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. [CO2]

System modelling and simulation using appropriate software / programming language. Case studies and mini projects in system simulation. [CO4]

Text Books/ Reference Books:

Banks, Jerry; Carson II, John; Nelson, Barry and Nicol, David, “Discrete Event System Simulation,”, 2013, Prentice-Hall

Law, Averill, “Simulation Modelling and Analysis,” 2007, Tata McGraw Hill

Sterman, John, “Business Dynamics: Systems Thinking and Modeling for a Complex World”, 2000, McGraw-Hill

Gilbert, Nigel, “Agent-based models,” SAGE Publication, 2008

MEL529 INDUSTRIAL PRODUCT DEVELOPMENT

3 credits (3-0-0)

Pre-requisites: Nil

Overlaps with: NIL

Course Outcomes/ Objectives :

1) To explain students what is an engineering product,
2) To make student understand various definitions and theoretical concepts related to Industrial product development at PG level.
3) To explain student the product development strategies and subsequent steps to manifest conceptualised product idea into an engineering product form Industry perspective.
4) To make the students comprehend the need of organization, integration of engineering knowledge technology tools and other resources to deliver commercial engineering product.
5) To analyse commercial engineering product with above objectives through the case studies.

Content:

1. New Product Development
Basic Concepts in Design, Concept Level, Cost v/s Time evaluation, Necessity of new products, Organizational Strategies to handle new product Development, Management Approaches towards Engineering Design, Emergence of Engineering Product Development, Market Research, Formation of cross functional Teams, Quality Function Development, Product Brief, Business Case preparation and clearance , Budget Planning, Product Costing, Roles of respective CFT members, Stakeholders' meeting, concept gate review.

2. Generation -1
Building first generation aggregate and prototypes, Tooled up exclusive components few, in quantity and percentage wise, 3D Modelling of the components, Validation through CAE rout, Testing and Validations of aggregates, Field testing of prototypes for identified application, Generation 1 gate review.

3. Generation -2
Corrections form generation -1, Tooled up exclusive and prototypes and aggregate build, Capital budget outflow, pre-production approval process, manufacturing location total involvement, role of CFT members from plant, Jury panel evaluation, Progress on validation, issue on capturing and resolution process, Virtual 3D modelling of the product through virtual assembly line, Generation 2 gate review

4. Seeding
Seeding of the product, batch size, Implementation of Quality Function Deployment, Monitoring the performance at customer end, Monitor and ensure Budget utilization, Enhanced role of customer care, Marketing, Component development, quality assurance and product development teams, Monitoring the cost v/s target, capturing the issues and resolution process, Seeding Gate review.

5. Pilot Production
Gradual ramp up in production, ramp up planning, CFT team dynamics, CFT accountability, Product strengthening in the market, Spares availability, certification of the pre-production approval process, Capturing the issues and resolution process, Stakeholders' clearances for production batches, Pilot production gate review.

6. Start of the volume production(SoVP)
Planning for SoVP, enhancement in the accountability of different functions, Spare parts management, Team strengthening for production success, Quality and customer care initiative, Handing over the issue resolution process, Material development function handover, Quality Assurance function handover to plant QA team, Engineering release for production, SoVP gate review. Formal Project Closure
Customer satisfaction Index, Commercial brand Marketing , Stakeholders review meeting

Text Books/ Reference Books:
New product Management, Crawford and Bendetto, Irwin MCGraw Hill, 6th Edition, ISBN 978,

2010 edition Rao, S. S., "Engineering Optimization (Theory and Practice)", John Wiley & Sons,

Product planning and Management by William l Moore and E. A. Pressemier McGraw-Hill

International edition 2nd Edition, 2009

Engineering design methods strategies for product design, Nigel Cross, Willey Publication

Product Design and Development by Karl T. Ulrich and Steven D. Eppinger, McGraw-Hill, 5th

Edition, 2015 reprint

MEL532LAYERED MANUFACTURING

3 credits (3-0-0)

Pre-requisites: Nil

Overlaps with:

Course Outcomes/ Objectives:

To identify the need for reduction of product development time.

Model any complex part for rapid manufacture.

Illustrate the working principles of rapid manufacturing technologies.

Select the rapid manufacturing process to fabricate a given product.

Identify and minimize errors that occur during conversion of CAD models.

Optimize the responses in rapid manufacturing process to improve the quality of parts.

Content:

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), To o l in g (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

Text Books/ Reference Books:

Gibson, I, Rosen, D W., and Stucker,B., “Additive Manufacturing Methodologies: Rapid Prototyping to Direct Digital Manufacturing,” Springer, 2010.

Hopkinson, N, Haque, R., and Dickens, P., “Rapid Manufacturing: An Industrial Revolution for a DigitalAge”, Wiley, 2005.

Bartolo, P J (editor), “Virtual and Rapid Manufacturing: Advanced Research in Virtual and Rapid Prototyping,” Taylor and Francis, 2007.

Chua, C K, Leong, KF., Lim CS, “Rapid Prototyping,” World Scientific, 2003.

Pique,A., Chrisey, DB., “Direct Write Technologies for R P Applications: Sensors, Electronics and Integrated Power Sourses”, Academic Press, 2002.

Venuvinod,P.K., Ma, W., “Rapid Prototyping – Laser Based and Other Technologies,” Kluwer, 2004.

MEP532LAYERED MANUFACTURING LAB

1 credit (0-0-2)

Pre-requisites: Nil

Overlaps with:

Course Outcomes/ Objectives:

To Learn the fundamentals of layered manufacturing of polymers, metals, and ceramics, along with those for emerging materials and complex architectures.

To Understand the operating principles, capabilities, and limitations of state-of-the-art AM methods, including laser melting, fused deposition modeling, stereolithography, and jetting.

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.

Content:

Experiments using FDM

Experiments using 3D printer

Preparation of part for layered manufacturing

Text Books/ Reference Books:

MEL442COMPUTER & DATABASE MANAGEMENT

3 credits (3-0-0)

Pre-requisites: Nil

Overlaps with:

Course Outcomes/ Objectives:

To understand the different issues involved in the design and implementation of a database system.

To study the physical and logical database designs, database modelling, relational, hierarchical, and network models,

To understand and use data manipulation language to query, update, and manage a database,

To develop an understanding of essential DBMS concepts such as: database security, integrity, concurrency, distributed database, and intelligent database, client/server, data warehousing.

Content:

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 improves 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

Text Books/ Reference Books:

Panneerselvan R, " Database Management System", Prentice Hall of India Pvt. Ltd., 2002

Sinha P.K , "Computer Fundamental: Concept, Systems and Applications",

Kanter Jerome, "Managing with Information", Prentice Hall of India, 2nd Ed 1994

Elmarsi R., Navathe S.B., "Fundamental of database System", Pearson Education Asia

Devis Gordon B.,Olson M.H, "Management Information System," TMH, 2nd Ed.

Banerjee H.R., "A Profile of Information Technology-Computer Digest", Jaico Publication

MEP442COMPUTER & DATABASE MANAGEMENT

1 credit (0-0-2)

Pre-requisites: Nil

Overlaps with:

Course Outcomes/ Objectives:

To understand various tyeps of hardware and software used in IT

To learn data design and architecture

To prepares MIS

To learn different methods of data collections and management

Content:

Development of software for file handling system.

Development of programs using simple SQL commands.

Use of DDL commands on Computer (MS-SQL)

Use of DML commands

Development of database management system for any Industrial application

Specific application system progress for detail study.

Development of any practical oriented system as applicable in industry

Text Books/ Reference Books:

MEL555- PROJECT EVALUATION & MANAGEMENT

3 credits (3-0-0)

Pre-requisites: Nil

Overlaps with:

Course Outcomes/ Objectives:

Students will be able to use various tools and techniques for project management.

Students will be able to prepare feasibility report for a new project.

Mapping with POs:

POs → / COs ↓	a	b	c
CO1	H	H	H
CO2	H	H	H
Overall	H	H	H

Content:

Introduction:

Project Evaluation, Benefits of project evaluation, Limitation of project evaluation, Methods of project evaluation.

Project Management Concept:

Concept of project management, Establishing the project: scope, time, cost and performance, Goals, Organizing human resources and contracting.

Project Management techniques:

Organizing systems and Procedures for project implementation, project direction, coordination and control, project management & performance.

MIS: Management information system.

Text Books/ Reference Books:

Meredith jack R., Mantel S.J., Project Management, fifth edition, Wiley, 2005.

Choudhary S.; Project Management, 9th Ed.; Tata McGraw hill, Mew Delhi, 2003

Panneerselvam R., Senthilkumar P. , Project Management, PHI, 2009.

MEL* Design of Fixtures in Manufacturing**

3 credits (3-0-0)

Pre-requisites: Nil

Overlaps with: MEL310

Course Outcomes/Objectives: On completion of this course, students will be able to

To understand the importance of precision manufacturing and tool design.

To understand the principles and design techniques of jigs and fixtures.

To design and develop jigs and fixtures for a particular part.

To select the suitable materials for the jigs and fixture elements.

CO/ PO	a	b	c	d	e	f	g	h	i	j	k
CO1	L	L	M	-	-	-	M	-	L	M	L
CO2	M	M	H	-	-	-	M	-	-	M	H
CO3	H	H	H	M	M	H	M	-	M	H	M
CO4	H	L	M	L	-	-	L	-	M	M	M
Overall	H	M	H	L	L	M	M	-	M	H	M

Content:

Precision Manufacturing: Part Accuracy, Geometric Dimensioning and Tolerancing (GD&T), Static Stiffness & Accuracy, Supporting Elements for Work Setting, Concept of Tool Design, Overview of Tool Design. CO1

Introduction to Jigs & Fixtures: Elements and their Function, Classification and Types of Jigs &

Fixtures, Fundamental Principles of Jigs & Fixtures, Features: Locating/Datum Surface, Loading/Unloading and Clamping, Tolerancing on Fixtures. CO2

Supporting, Locating and Clamping Principles: Referencing, Basic Rules for Locating, Fool Proofing, Planes of Movement and Restriction, Stability of Work, Locating Principles and Types, Locating from an External Profile, Rules of Clamping, Cutting and Clamping Forces, Types of Clamps, Non-mechanical Clamping, Clamping Accessories. CO1, CO2

Design of Jigs & Fixtures: Design Economics, Tool Design Parameters, Developing the Initial Design, Initial Drawing and Dimensioning, Limits and Critical Dimensions, Design of Milling Fixtures, Turning and Welding Fixtures, Sheet Metal Forming Fixtures, Case Studies. CO2, CO3

Materials for Jigs & Fixture Elements: Basic Properties Required for Jigs & Fixtures, Ferrous, Non-ferrous and Non-metallic Tool Materials, Designing with Relation to Heat Treatment, Dimensional Stability. Safety and Maintenance. CO3, CO4

Text Books/ Reference Books:

1. Jig & Fixture Design, by Edward Hoffman
2. Metal Cutting and Design of Cutting Tools and Jigs & Fixtures, by N.K. Mehta
3. Jigs and Fixtures, by P. H. Joshi
4. Jigs and Fixtures: Non-standard Clamping Devices, by Hiram E Grant
5. Tool Design, by Cyril Donaldson