NOTIFICATION

No. 192 /2023 Dated : 23/11/2023

Subject : Implementation of new syllabus of Semester I to IV of the Course M.E. Mechanical Engineering (AdvancedManufacturing & Mechanical Systems Design) (C.B.C.S. Pattern) from the academic Session 2023-2024 onwards.

It is notified for general information of all concerned that the authorities of the University have accepted to implement the new syllabus of Semester I to IV of the Course M.E. Mechanical Engineering (Advanced Manufacturing & Mechanical Systems Design) (C.B.C.S. Pattern) from the academic Session 2023-2024 onwards as mentioned below:

Sd/-
(Dr.T.R.Deshmukh)
Registrar
Sant Gadge Baba Amravati University

Syllabus Prescribed For
Two Year Post Graduate Course in Master of Engineering (Full Time)
Mechanical Engineering (Advanced Manufacturing & Mechanical Systems Design)
Choice Based Credit System

SEMESTER - I

1MMD1 ADVANCED MANUFACTURING PROCESSES

Course Objectives:

1. To impart the knowledge of basic methodology of metal cutting.
2. To understand the concepts of tool life, machinability, wear, influence of heat.
3. To know about the applications of advanced manufacturing processes
4. To make acquainted the various advanced welding and forming processes
5. To make acquainted the various unconventional manufacturing processes

Course Outcomes:

1. Understand the mechanics of metal machining processes.
2. Apply the concept of computer numerical control technology.
3. Understand various metal casting processes.
4. Distinguish the various welding processes.
5. Analyze various metal forming processes.
6. Apply various unconventional machining processes.

SECTION – A

Unit-I: Advance machining theory: mechanics of chip formation, shear angle relations, and theoretical determination of cutting force in orthogonal cutting, analysis of turning, drilling, and milling operations. Mechanics of grinding, dynamometry, thermal aspects of machining, tool life and tool wear, economics of machining.

Unit-II: NC/CNC: basic concept, NC control, special features of CNC machine: turret head, tool magazine, servomotors, ball lead screw, automatic tool changer (ATC), and classification of CNC machines, cutting tool and tool holders, point to point, straight cut and continues path, control codes, machine control units, closed system, NC, machine components, CNC, DNC, Manual part programming, formats, coding, programming languages. APT, ADAPR, EXAPT etc. sensors and adaptive control, Manual part programming for drilling, milling and lathe, examples in APT. applications and economics of CNC.

Unit-III: Metal casting: Metal casting processes, pattern and mould, moulding materials, elements of gating system design, riser design, solidification structure, solidification shrinkage structure, defects and properties of finished casting, heat treatment.

SECTION – B

Unit-IV: Welding process, heat flow in welding, metallurgy of fusion weld, welding stresses and distortions, preheat and post weld heat treatment weld ability tests, weld defects, weld inspection and quality control. Electron beam welding, ultrasonic welding, laser beam welding.

Unit-V: Metal forming: Nature of plastic deformation, fundamentals of plasticity, mechanics of metal forming processes like rolling, forging, drawing, extrusion etc. various forming operations, defects in metal forming, local instability and tearing, bending of sheets, hydro forming. Electromagnetic forming, explosive forming, electrohydraulic forming, stretch forming, contour roll forming.

Unit-VI: Unconventional machining process: parametric study, applications and fundamentals of Ultrasonic Machining USM, Abrasive Jet Machining AJM, Water Jet Machining WJM, Abrasive Water Jet Machining AWJM, Electro- chemical Machining ECM, Electro Discharge Machining EDM, Electron Beam Machining EBM, Laser Beam Machining LBM.

BOOKS RECOMMENDED:

Text Books:

1. Juneja, Fundamentals of metal cutting
2. A. Ghosh, and A. K. Mallik, East-West Press Pvt. Ltd. New Delhi "Manufacturing Science".

Reference Books:

1. Arshinov, Metal cutting theory & cutting tool design.
2. Mikhal Groover, CAD/CAM.
3. N. K. Mehta, Machine tool design4. E. P. DeGarmo, J. T Black, R. A. Kohser, Prentice Hall of India, NewDelhi (ISBN 0-02-5. 978760) "Materials and Processes in Manufacturing" (8th Edition)
4. G.F. Benedict, Marcel Dekker, Inc. New York (ISBN 0-8247-7352-7) "Nontraditional Manufacturing Processes"

1MMD2 COMPUTER AIDED DESIGN AND ENGINEERING

Course Objectives:

1. To understand the fundamentals of CAD
2. To understand the modeling approaches
3. To understand the concepts of finite element analysis
4. To apply FEA methods to solve problems in structural and thermal domain

Course Outcomes:

1. Illustrate concept of CAD/ CAM and CIM.
2. Apply knowledge using CAD modeling for component design.
3. Illustrate the fundamentals of finite element analysis
4. Apply FEA techniques to analyze problems in stress on beams, three dimensional frames, heat transfer and fluid flow.

SECTION – A

Unit-I: **CAD** – Introduction, typical Product Cycle, Implementation of a typical CAD process, Application of CAD and their Advantages **3D modeling and viewing:** Introduction, Modeling Approaches, Types of Geometric Models, Coordinate System, sketching and Sketch Planes, Parameters and Dimensions, Basic Features, Datum Features, Geometric Constraints, Modeling Operations and Strategies.

Unit-II: **Modeling Aids and Tools:** Introduction, Geometric Modifiers, Layers, Colors, Grids, Groups, Dragging and Rubbering, Clipping, Entity Selection methods, Geometric Arrays, Transformations, Editing. **Geometric Modeling:** Types of Curves and Curve Manipulations, Types of Surfaces and Surface Manipulations, Solids: Introduction, Geometry and Topology, Solid Entities, Fundamentals of Solid Modeling, Boundary Representation (B-rep), Constructive Solid Geometry (CSG) examples, Sweeps and Solid Manipulations, Feature based Modeling: Introduction, Feature Entities, Parametrics, Feature Manipulations.

Unit-III: **CAD/CAM Data exchange and data storage**: Introduction, graphics and computing standards, data exchange standards like IGES, STEP **Assembly Modeling:** Introduction, Assembly Modeling, Assembly Tree, Assembly Planning, Mating Conditions, Bottom – Up and Top – Down Assembly Approaches with examples, Tolerance Analysis and Mass Property calculations.

SECTION – B

Unit-IV: **Review of One Dimensional FEM:** FEM Methodology – Modeling and discretization Interpolation, elements, nodes and degrees-of-freedom applications of FEA. One-Dimensional Elements: Bar element – truss element – assembly of elements – properties of stiffness matrices boundary conditions-solution of equations-mechanical loads and stresses thermal loads and stresses-example problems.

Unit-V: **Review of Two and Three Dimensional FEM:** Interpolation and shape functions - element matrices-linear triangular elements (CST)-quadratic triangular elements – bilinear rectangular elements solid elements-higher order elements – stress calculations.

Unit-VI: **Applications to Field Problems:** Solution to problems in linear elasticity- plane problems in elasticity- plates and shells- solution of problems in heat-transfer and fluid mechanics- numerical examples discussion on error estimates

Books Recommended:

Text Books:

1. Ibrahim Zeid, Matering CAD/CAM, Tata McGraw Hill Publishing Co. Ltd., New Delhi.72 73
2. Chandrupatla & Belagundu, Finite Elements in Engineering, Prentice Hall of India Private Ltd., 1997.

Reference Books:

1. P. N. Rao, CAD/CAM, Prentice Hill, International .
2. Daryl L. Logan, A first course in the Finite Element Method, Fourth edition, Thomson
3. Ibrahim Zeid, CAD/CAM – Theory and Practice, MGH International
4. Mikell P Groover and Emory W Zimmers Jr., CAD/CAM –Computer Aided Design and Manufacturing, Prentice Hill, International
5. P. Radhakrishnan, S. Subramanayan and V.Raju, CAD/CAM/CIM, New Age International (P) Ltd., New Delhi.
6. Rogers, D.F. and Adams, A., Mathematical Elements for Computer Graphics, McGraw Hill Inc, NY, 1989
7. Cook, Robert Davis et al "Concepts and Applications of Finite Element Analysis ", Wiley, John & Sons, 1999.
8. Bathe, K.J., Finite Element Procedures in Engineering Analysis, 1990.
9. S. S. Rao, Finite Element Analysis, 2002 Edition.
10. David V Hutton, Fundamentals of Finite Element Analysis, McGraw-Hill International Edition, 2004

1MMD3 Programme Elective-I (i) ADVANCED MACHINE DESIGN

Course Objectives:

1. To study failure theories and fatigue of materials
2. To study Stress-Life, Strain-Life and LEFM Approach
4. To study Fatigue from Variable Amplitude Loading
5. To study statistical aspects of fatigue of materials
6. To study surface failure in materials

Course Outcomes:

1. Apply failure theories to ductile and brittle materials
2. Apply Stress-Life approach
3. Apply Strain-Life approach
4. Apply LEFM approach
5. Apply fatigue from variable amplitude loading and statistical aspects
6. Apply surface failure approach in mechanical design

SECTION-A

Unit-I: **Introduction:** Role of failure prevention analysis in mechanical design, Modes of mechanical failure, Review of failure theories for ductile and brittle materials including Mohr's theory and modified Mohr's theory, Numerical examples.
Fatigue of Materials: Introductory concepts, High cycle and low cycle fatigue, Fatigue design models, Fatigue design methods, Fatigue design criteria, Fatigue testing, Test methods and standard test specimens, Fatigue fracture surfaces and macroscopic features, Fatigue mechanisms and microscopic features.

Unit-II: **Stess-Life (S-N) Approach:** S- N curves, Statistical nature of fatigue test data, General S-N behavior, Mean stress effects, Different factors influencing S-N behaviour, S-N curve representation and approximations, Constant life diagrams, Fatigue life estimation using S-N approach.

Unit-III: Strain-Life(-N)approach: Monotonic stress-strain behavior ,Strain controlled test methods ,Cyclic stress-strain behavior, Strain based approach to life estimation, Determination of strain life fatigue properties, Mean stress effects, Effect of surface finish, Life estimation by N approach.

SECTION-B

Unit-IV: **LEFM Approach:** LEFM concepts, Crack tip plastic zone, Fracture toughness, Fatigue crack growth, Mean stress effects, Crack growth life estimation.

Unit-V: **Statistical Aspects of Fatigue:** Definitions and quantification of data scatter, Probability distributions, Tolerance limits, Regression analysis of fatigue data, Reliability analysis, Problems using the Weibull distribution.
Fatigue from Variable Amplitude Loading: Spectrum loads and cumulative damage, Damage quantification and concepts of damage fraction and accumulation, Cumulative damage theories, Load interaction and sequence effects, Cycle counting methods, Life estimation using stress life approach.

Unit-VI: **Surface Failure:** Introduction, Surface geometry, Mating surface, Friction, Adhesive wear, Abrasive wear, Corrosion wear, Surface fatigue spherical contact, Cylindrical contact, General contact, Dynamic contact stresses, Surface fatigue strength.

Books Recommended:

Text Books:
1. Robert L. Norton, Pearson: "Machine Design"
2. S. Suresh: "Fatigue of Materials" - Press, Cambridge, U.K.

Reference Books:
1. Jack. A. Collins, John Wiley, New York: "Failure of Materials in Mechanical Design"- 1992.
2. Julie. A. Benantine: "Fundamentals of Metal Fatigue Analysis"- Prentice Hall, 1990
3. ASM Hand Book: "Fatigue and Fracture"- Vol. 19, 2002.
4. Ralph I. Stephens, Ali Fatemi, Robert .R. Stephens, Henry Fuchs, John: "Metal Fatigue in Engineering"- Wiley New York, Second edition. 2001.

1MMD3 Programme Elective-I (ii) DESIGN FOR MANUFACTURING AND ASSEMBLY

Course Objectives:

1. To understand the concepts of design philosophy.
2. To understand the fundamentals of design for machining.
3. To study design factors in different joining operations.
4. To study manual and automated assembly methods

Course outcomes:

1. Explain the fundamentals of design philosophy
2. Illustrate various concepts in design for machining processes
3. Explain the factors in joining operations
4. Illustrate various techniques in design for assembly.

SECTION – A

Unit-I: **Introduction**: Design philosophy steps in Design process, General Design rules for manufacturability , basic principles of design Ling for economical production, creativity in design. Materials: Selection of Materials for design Developments in Material technology, criteria for material selection, Material selection interrelationship with process selection process selection charts.

Unit-II: **Machining process**: Overview of various machining processes, general design rules for machining - Dimensional tolerance and surface roughness , Design for machining , Ease ,Redesigning of components for machining ease with suitable examples. General design recommendations for machined parts.

Unit-III: **Metal casting**: Appraisal of various casting processes, selection of casting process, - general design considerations for casting , casting tolerances , use of solidification simulation in casting design, product design rules for sand casting.

SECTION – B

Unit-IV: **Metal joining**: Appraisal of various welding processes, Factors in design of elements, general design guidelines, pre and post treatment of welds, effects of thermal stresses in weld joints, design of brazed joints. Forging, Design factors for Forging, Closed die forging design, parting lines of die5 drop forging die design , general design recommendations. Extrusion & Sheet Metal Work: Design guidelines for extruded sections – design principles for Punching, Blanking, Bending, Deep Drawing, Keeler Goodman Forming Line Diagram, and Component Design for Blanking.

Unit-V: Assemble advantages: Development of the assemble process, choice of assemble method assemble advantages social effects of automation.
Automatic assembly transfer systems: Continuous transfer, intermittent transfer, indexing mechanisms, and operator - paced free – transfer machine.

Unit-VI: Design of manual assembly: Design for assembly fits in the design process, general design guidelines for manual assembly, development of the systematic DFA methodology, assembly efficiency, classification system for manual handling, classification system for manual insertion and fastening, effect of part symmetry on handling time, effect of part thickness and size on handling time, effect of weight on handling time, parts requiring two hands for manipulation, effects of combinations of factors, effect of symmetry effect of chamfer design on insertion operations, estimation of insertion time.

BOOKS RECOMMENDED:

Text Books:
1. Geoffrey Boothroyd, "Assembly Automation and Product Design", Marcel Dekker Inc., NY, 1992.
2. Geoffrey Boothroyd, "Hand Book of Product Design" Marcel and Dekken, N.Y. 1990.
3. Mickell Groover, "Automation, Production Systems, and Computer Integrated Manufacturing", Pearson, 1996.

Reference Books:

1. Engineering Design – Material & Processing Approach – George E. Deiter, McGraw Hill Intl. 2nd Ed.2000.
2. A Delbainbre "Computer Aided Assembly London, 1992.

1MMD3 Programme Elective-I (iii) ANALYSIS AND SYNTHESIS OF MECHANISMS

Course Objectives:

1. Graphical and analytical techniques commonly used in the synthesis of mechanisms.
2. Kinematic geometry to formulate and solve constraint equations to design linkages for specified tasks
3. Simplify the mechanism for analysis purposes.
4. Orient applications of analytical techniques by means of computer programs.

Course outcomes:

1. Apply the graphical and analytical techniques commonly used in the synthesis of mechanisms.
2. Formulate and solve problems of analysis and synthesis of mechanisms using modern IT tools.
3. Explain and discuss the theory and methodologies employed for design of mechanisms.
4. Synthesize mechanisms creatively; participate in design challenges, and present logical solutions.

SECTION – A

Unit-I: Basic Concepts: Definitions and assumptions; planar and spatial mechanisms; kinematic pairs; degree of freedom; equivalent mechanisms; Kinematic Analysis of Planar Mechanisms. Review of graphical and analytical methods of velocity and acceleration analysis of kinematically simple mechanisms, velocity-acceleration, analysis of complex mechanisms by the normal acceleration and auxiliary-point methods.

Unit-II: Curvature Theory: Fixed and moving centrodes, inflection circle, Euler-Savary equation, Bobillier constructions, cubic of stationary curvature, Ball's point, Applications in dwell mechanisms.

Unit-III: Kinematic Synthesis of planar mechanisms: accuracy (precision) points, Chebesychev spacing, types of errors, Graphical synthesis for function generation and rigid body guidance with two, three and four accuracy points using pole method, centre and circle point curves, Analytical synthesis of four-bar and slider crank mechanisms.

SECTION – B

Unit-IV: Synthesis of Four bar Mechanisms: Freudenstein's equation, synthesis for four and five accuracy points, compatibility condition, synthesis of four-bar for prescribed angular velocities and accelerations using complex numbers, three accuracy point synthesis using complex numbers.

Unit-V: Coupler Curves : Equation of coupler curve, Robert-Chebychev theorem, double points and symmetry.

Unit-VI: Kinematic Analysis of Spatial Mechanisms: Denavit-Hartenberg parameters, matrix method of analysis of spatial mechanisms

Books Recommended:

1. R.S. Hartenberg and J. Denavit, "Kinematic Synthesis of Linkages", McGraw-Hill, New York, 1980.
2. Robert L.Nortan ,"Design of Machinery',Tata McGraw Hill Edition
3. Hamilton H.Mabie,"Mechanisms and Dynamics of Machinery",John Wiley and sons New York
4. S.B.Tuttle,"Mechanisms for Engineering Design" John Wiley and sons New York
5. A. Ghosh and A.K. Mallik, "Theory of Machines and Mechanisms", Affiliated East-West Press, New Delhi, 1988.
6. A.G. Erdman and G.N. Sandor, "Mechanism Design – Analysis and Synthesis", (Vol. 1 and 2), Prentice Hall India, 1988.
7. A.S. Hall, "Kinematics and Linkage Design", Prentice Hall of India.
8. J.E. Shigley and J.J. Uicker, "Theory of Machines and Mechanisms", 2nd Edition, McGraw-Hill, 1995.

1MMD4 Programme Elective-II (i) FLEXIBLE MANUFACTURING SYSTEM

Course Objectives:

1. To acquire knowledge concept of flexible manufacturing system
2. To apply the knowledge of group technology and FMS for the automation of industrial processes.
3. To aware different FMS layouts
4. To learn about automated material handling system in industries
5. To design and analyze various FMS

Course outcomes (CO):

1. Apply the concepts of PPC and GT to the development of FMS.
2. Develop Plan for Implementation of FMS
3. Be able to discuss the planning and scheduling methods used in manufacturing systems.
4. Identify various workstations, system support equipment.
5. Be able to identify hardware and software components of FMS.
6. Summarize the concepts of modern manufacturing such as JIT, supply chain management and lean manufacturing etc.

SECTION – A

Unit I: FMS an overview: types and configuration, concept, types of flexibility and performance measures, functions of FMS,
FMS host and area controller function distribution.

Unit II: Development and implementation of FMS: Planning phases, integration, system configuration for FMS.

Unit III: FMS layout, FMS project, Steps in development of FMS.

SECTION – B

Unit IV: Automated material handling and storage: Functions- types- analysis of material handling equipments design on conveyors and AGV systems.

Unit V: Automated Storages: Storage system performance- AS/RS- carausal storage system- WIP storage system- interfacing handling, storage with manufacturing.

Unit VI: Modeling and Analysis of FMS: Analytical, heuristic, queuing, simulation and petrinet modeling techniques- scope, applicability and limitations

Books Recommended:
1) Groover M.P.- Automation, Production Systems and CIM.
2) Ranky P.G.- The Design and Operation of FMS.
3) Parrish D.J.- Flexible Manufacturing
4) Jha N.K "Handbook of Flexible Manufacturing Systems", Academic Press Inc., 2006.
5) Raouf A. and Ben-Daya M, Editors, "Flexible Manufacturing Systems: Recent Development", Elsevier Science, 2000.

1MMD4 Programme Elective-II (ii) INDUSTRIAL ROBOTICS

Course Objectives:
1. To understand the Robot's anatomy, Robot Configurations and End Effectors.
2. To understand various robot drives, robot motion control and its levels.
3. To study principle of working and applications of different types of robot sensors.
4. To study various methods of teaching and programming the robots.
5. To understand different applications of robots in manufacturing and to understand importance of robot features for a particular application.

Course outcomes:
1. Illustrate the concept of robotics, robot anatomy and various configurations for different industrial application
2. Illustrate drives, controls and sensors used in industrial applications.
3. Identify a particular type of robot depending on its application in manufacturing.
4. Illustrate programming methods for industrial robot.

SECTION – A

Unit I : Fundamentals of Robotics- Introduction, Automation & Robotics- robot applications robotic systems, robot anatomy and robot configurations, Joint types used in robots, robot wrists, joint notation schemes, work value for various robot anatomies, robot Specifications.

Unit II : Robots end-effectors-classification of end-effectors, mechanical grippers, hooking or Lifting grippers, grippers for molten metal , plastics, vacuum cups, magnetic grippers Electrostatic grippers, multiple grippers, internal & external grippers, drive systems for gripers, active & passive grippers. Design consideration in gripper, gripper analysis.

Unit III: Robot drives & Sensors - pneumatic power drives, hydraulic systems, electric drives, Contact type sensors:- wrist force sensor, binary & analog touch sensor, Artificial skins, force, torque, encoders, position, velocity sensors, Non contact type sensors;- vision sensor, proximity, range sensors, safety measures in robot.

SECTION – B

Unit IV: Manipulator Kinematics- Forward & reverse kinematics, forward and reverse transformation of two DOF & three DOF 2-D manipulator, homogeneous transformations, Deviations and problems. Robot dynamics.

Unit V: Robot Control Systems and Programming : Basics of control Systems – Open loop and Closed loop system – robot controllers-servo and non servo systems, motion control of robots, point to point and continuous path control, Process Control Systems, Discrete Control System, Continuous Versus Discrete Control. Linear and Non-linear controls. Teach pendant programming, Lead through programming, Robot programming languages, Robot programming as a path in space, Motion interpolation, Robot Languages: Textual robot Languages, Generation.

Unit VI: Applications of Robot: Robot Application – Implementation of robots in industries – Various steps, Machine loading/unloading. Processing operation, Assembly and Inspection, Feature Application. Types of locomotion, Hopping robots, Legged robots, Wheeled robots, Wall climbing robots, COBOTS, Sensors for mobile robots like global positioning system (GPS), Path planning algorithms, Stochastic dynamic programming (SDP).

Books Recommended:

1. Deb S.R, "Robotics Technology and flexible automation", Tata McGraw-Hill Education, 2nd Edition 2017.
2. Mikell P Groover& Nicholas G Odrey, Mitchel Weiss, Roger N Nagel, Ashish Dutta, Industrial Robotics, "Technology Programming and Applications", McGraw Hill, 2012.
3. Richard D. Klafter, Thomas A, Chri Elewski, Michael Negin, "Robotics Engineering an Integrated Approach", Phi Learning., 2009.
4. Saeed B Niku, "Introduction to Robotics Analysis, Control and Application" Wiley student 2nd Edition.

1MMD4 Programme Elective-II (iii) LEAN MANUFACTURING

Course Objectives:

1. To Know how the philosophy and core methods of Lean manufacturing
2. Identify waste and its root cause in the value stream
3. To understand different techniques of Lean implementation
4. To understand the concept of Cellular Manufacturing
5. To understand the concept TPM

Course outcomes (CO):

1. Explain the concept, history and applications of lean manufacturing
2. Interpret different elements of Toyota Production System,
3. Interpret different tools of lean production processes
4. Apply cellular systems for production.
5. Apply the concepts of TPM for quality improvement.
6. Apply the concepts of Lean Manufacturing for sustaining improvements.

SECTION – A

Unit I: Introduction: Introduction, background, and lean thinking. Importance of Lean philosophy, strategy, culture, alignment, focus and systems view.

Unit II: Toyota Production System: Discussion of Toyota Production System. Lean production preparation – System assessment, process and value stream mapping – Sources of waste.

Unit III: Lean production processes: Lean production processes, approaches and techniques.—Importance of focusing upon flow. Tools include: Workplace organization, Stability. Just-In-Time – One piece flow – Pull.

SECTION – B

Unit IV: Cellular systems: Cellular systems, Quick change and set-up reduction methods.

Unit V: Total productive maintenance: Total productive maintenance, Poka-Yoke – mistake proofing, quality improvement. Visual management. Startup of lean processes, examples and applications.

Unit VI: Sustaining improvement: Sustaining improvement and change, auditing, follow-up actions for improvement

BOOKS RECOMMENDED:

Text Books:

1. N. Gopalkrishnan, Simplified Lean Manufacture, PHI Learning Private Limited. New Delhi
2. B.S Nagendra Parashar, Cellular Manufacturing system: An integrated approach, PHI Learning Private Limited. New Delhi

References Books:

1. William M. Feld , Lean Manufacturing: Tools, Techniques, and How to Use Them ,The st Lucie Press.
2. Lonnie Wilson, How To Implement Lean Manufacturing: by McGraw Hill, August 2009.
3. Walter W Mc Intyre, Lean and Mean Process Improvement:
4. Dale H. Besterfield, Total Quality Management, Pearson Educations.

1MMD5 RESEARCH METHODOLOGY AND IPR

Course Objectives:

1. To familiarize students with the different aspects of research.
2. To provide an idea of good scientific writing and proper presentation skills.
3. To provide an understanding of philosophical questions behind scientific research.
4. To provide a brief background on the historical legacy of science.
5. To provide an insight of nature of Intellectual Property and new developments in IPR.

Course Outcomes:

1. Understand research problem formulation
2. Analyze research related information and follow research ethics
3. Understand that today's world is controlled by computer, information technology but Tomorrow's world will be ruled by ideas, concepts and creativity
4. Understand that IPR would take such important place in growth of individuals and nation, it is needless to emphasize the need of information about Intellectual Property Right to be promoted among students in general and Engineering
5. Understand the nature of Intellectual Property and IPR in International Scenario
6. Understand that IPR protection provides an incentive to inventors for further research work and investment in R &D, which leads to creation of new and better products, and in turn brings about, economic growth and social benefits.

SECTION-A

Unit I: Meaning of research problem, Sources of research problem, Criteria Characteristics of a good research problem, Errors in selecting a research problem, Scope and objectives of research problem.
Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, Necessary instrumentations.

Unit II: Effective literature studies approaches, analysis Plagiarism, Research ethics,

Unit III: Effective technical writing, how to write report, Paper Developing a Research Proposal, Format of research proposal, a presentation and assessment by a review committee.

SECTION-B

Unit IV: Nature of Intellectual Property: Patents, Designs, Trade and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development.
International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, Patenting under PCT.

Unit V: Patent Rights: Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications.

Unit VI: New Developments in IPR: Administration of Patent System. New developments in IPR; IPR of Biological Systems, Computer Software etc. Traditional knowledge Case Studies, IPR and IITs.

Books Recommended:

1. Stuart Melville and Wayne Goddard, "Research methodology: an introduction forscience & engineering students'"
2. Wayne Goddard and Stuart Melville, "Research Methodology: An Introduction "Model Curriculum of Engineering & Technology PG Courses [Volume -II]
3. Ranjit Kumar, 2nd Edition, "Research Methodology: A Step by Step Guide for beginners"
4. Halbert, "Resisting Intellectual Property", Taylor & Francis Ltd ,2007.
5. Mayall , "Industrial Design", McGraw Hill, 1992.
6. Niebel , "Product Design", McGraw Hill, 1974.
7. Asimov , "Introduction to Design", Prentice Hall, 1962.
8. Robert P. Merges, Peter S. Menell, Mark A. Lemley, "Intellectual Property in New Technological Age", 2016.
9. T. Ramappa, "Intellectual Property Rights Under WTO", S. Chand, 2008
10. Ann M. Korner, Guide to Publishing a Scientific paper, Bioscript Press, 2004.
11. Ramappa T, "Intellectual Property Rights Under WTO", S. Chand, 2008.
12. Kothari C. R, "Research Methodology - Methods and Techniques", New Age International publishers, New Delhi, 2004.

1MMD6 ADVANCED MANUFACTURING PROCESSES- LAB

At least five practicals (study/trials) based on above syllabus, as given below shall be performed and a report there of submitted by the students

List of Practicals:-

1. Demonstration of job setting on CNC turning center and vertical machining center.
2. Preparation of program for plain turning of shaft.
3. Preparation of program for taper turning.
4. Preparation of program for grooving.
5. Preparation of program for threading.
6. Preparation of program for pocket milling.
7. Preparation of program for drilling.
8. Preparation of program for 2D profile cutting.
9. Preparation of program for boring and tapping.

Practical Examination:

Practical examination shall consist of viva voce/performance based on the above syllabus and practical work.

1MMD7 COMPUTER AIDED DESIGN AND ENGINEERING - LAB

At least five practicals (study/trials) based on above syllabus, as given below shall be performed and a report there of submitted by the students

List of Practicals:-

1. Study of at least one CAD software in each of the following category,
   a. High-End CAD like UG/NX, CATIA, Pro/E
   b. Middle-range CAD like Solid Edge, AIP, Solid Edge
   c. Low-end CAD like AutoCAD, Turbo CAD, AutoCAD LT
2. Assembly modeling (for any 2 assemblies or sub-assemblies) using top down and bottom-up approaches inclusive of sketching, parts modeling (using solid and surface modeling/styling toolboxes), drafting (parts and assemblies)
3. Part families and design table creation using spreadsheet interface
4. CAD File/data exchange amongst the various CAD software and software for CMM, CAE, CNC, CAM
5. Customization/Program development for parts modeling and drafting using API and other development tools
6. FEA: Using any FEA software packages solve 2 problems each on structural mechanics and heat transfer, Introduction to nonlinear analysis

Practical Examination:

Practical examination shall consist of viva voce/performance based on the above syllabus and practical work

1MMD8 / 2MMD8

AUDIT I and II: (i) ENGLISH FOR RESEARCH PAPER WRITING

Course Objectives: Students will be able to:

1. Demonstrate writing meaningful sentences and coherent paragraphs
2. Show conciseness, clarity and avoid redundancy in writing
3. Summarize, evaluate literature, and write methodology, results and conclusion
4. Describe how to develop title, write abstract and introduction
5. Apply correct style of referencing and use punctuation appropriately

Course Outcomes:

1. Explain planning and preparation required for research communication
2. Use appropriate word order and write short sentences, writing coherent paragraphs and sentences
3. Demonstrate conciseness, clarity and avoid redundancy
4. Write abstract, introduction, summarize, evaluate literature, methodology, discussions, results and conclusion
5. Use correct punctuation, correct style(s) of in-text citation and bibliography and avoid plagiarism

SECTION-A

Unit I: Planning and Preparation, Word Order, Breaking up long sentences, Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness.

Unit II: Clarifying Who Did What, Highlighting Your Findings, Hedging and Criticizing, Paraphrasing and Plagiarism, Sections of a Paper, Abstracts. Introduction.

Unit III: Review of the Literature, Methods, Results, Discussion, Conclusions, the Final Check.

SECTION-B

Unit IV: Key skills are needed when writing a Title, key skills are needed when writing an Abstract, key skills are needed when writing an Introduction, skills needed when writing a Review of the Literature,

Unit V: Skills are needed when writing the Methods, skills needed when writing the Results, skills are needed when writing the Discussion, skills are needed when writing the Conclusions.

Unit VI: Useful phrases, how to ensure paper is as good as it could possibly be the first- time submission.

Books Recommended:

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

AUDIT 1 and 2: (ii) DISASTER MANAGEMENT

Course Objectives:

1. Learn to demonstrate a critical understanding of key concepts in disaster risk reduction and humanitarian response.
2. Critically evaluate disaster risk reduction and humanitarian response policy and practice from multiple perspectives.
3. Develop an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.
4. Critically understand the strengths and weaknesses of disaster management approaches, planning and programming in different countries, particularly their home country or the countries they work in

Course Outcomes:

1. Knowledge of disaster and its types.
2. Knowledge of Repercussions of Disasters and Hazards.
3. Study of Seismic Zones and Disaster Prone Areas In India.
4. Study of Disaster Preparedness and Management.
5. Understanding Disaster Risk Situation, Risk Assessment and Disaster Mitigation in India.

SECTION-A

Unit I: **Introduction Disaster:** definition, factors and significance; difference between hazard and disaster; natural and manmade disasters: difference, nature, types and magnitude.

Unit II: **Repercussions Of Disasters And Hazards**: economic damage, loss of human and animal life, destruction of ecosystem. natural disasters: earthquakes, volcanisms, cyclones, tsunamis, floods, droughts and famines, landslides and avalanches, man-made disaster: nuclear reactor meltdown, industrial accidents, oil slicks and spills, outbreaks of disease and epidemics, war and conflicts.

Unit III: Disaster Prone Areas In India study of seismic zones; areas prone to floods and droughts, landslides and avalanches; areas prone to cyclonic and coastal hazards with special reference to tsunami; post-disaster diseases and epidemics.

SECTION-B

Unit IV: Disaster Preparedness and Management Preparedness: monitoring of phenomena triggering a disaster or hazard; evaluation of risk: application of remote sensing, data from meteorological and other agencies, media reports: governmental and community preparedness.

Unit V: Risk Assessment Disaster Risk: concept and elements, disaster risk reduction, global and national disaster risk situation. techniques of risk assessment, global co-operation in risk assessment and warning, people's participation in risk assessment. strategies for survival.

Unit VI: Disaster Mitigation: meaning, concept and strategies of disaster mitigation, emerging trends in mitigation. structural mitigation and non-structural mitigation, programs of disaster mitigation in India.

Books Recommended:

1. R. Nishith, Singh AK, "Disaster Management in India: Perspectives, issues and strategies "'New Royal book Company.
2. Sahni, PardeepEt.Al. (Eds.)," Disaster Mitigation Experiences And Reflections", Prentice Hall Of India, New Delhi.
3. Goel S. L.,Disaster Administration And Management Text And Case Studies" ,Deep &DeepPublication Pvt. Ltd., New Delhi.

AUDIT 1 and 2: (iii) CONSTITUTION OF INDIA

Course Objectives:

1. Understand the premises informing the twin themes of liberty and freedom from a civil rights perspective.
2. To address the growth of Indian opinion regarding modern Indian intellectuals' constitutional role and entitlement to civil and economic rights as well as the emergence of nationhood in the early years of Indian nationalism.
3. To address the role of socialism in India after the commencement of the Bolshevik Revolution in 1917 and its impact on the initial drafting of the Indian Constitution.

Course Outcomes:

1. Knowledge of History and Philosophy of the Indian Constitution.
2. Understanding the Contours of Constitutional Rights & Duties.
3. Study of Organs of Governance.
4. Understanding the Local Administration.
5. Study of Election Commission.

SECTION-A

Unit I: **History of Making of the Indian Constitution:** History Drafting Committee, (Composition & Working)

Unit II: **Philosophy of the Indian Constitution:** Preamble, Salient Features

Unit III: **Contours of Constitutional Rights and Duties:** Fundamental Rights, Right to Equality, Right to Freedom, Right against Exploitation, Right to Freedom of Religion, Cultural and Educational Rights, Right to Constitutional Remedies, Directive Principles of State Policy, Fundamental Duties.

SECTION-B

Unit IV: **Organs of Governance:** Parliament, Composition, Qualifications and Disqualifications, Powers and Functions, Executive, President, Governor, Council of Ministers, Judiciary, Appointment and Transfer of Judges, Qualifications, Powers and Functions.

Unit V: **Local Administration:** District's Administration head: Role and Importance, Municipalities: Introduction, Mayor and role of Elected Representative, CEO of Municipal Corporation. Pachayati raj: Introduction, PRI: Zila Pachayat. Elected officials and their roles, CEO Zila Pachayat: Position and role. Block level: Organizational Hierarchy (Different departments), Village level: Role of Elected and Appointed officials, Importance of grass root democracy.

Unit VI: **Election Commission:** Election Commission: Role and Functioning. Chief Election Commissioner and Election Commissioners. State Election Commission: Role and Functioning. Institute and Bodies for the welfare of SC/ST/OBC and women.

Books Recommended:

1. The Constitution of India, 1950 (Bare Act), Government Publication.
2. Dr. S. N. Busi, Dr. B. R. Ambedkar framing of Indian Constitution, 1st Edition, 2015.
3. M. P. Jain, Indian Constitution Law, 7th Edn., Lexis Nexis, 2014.
4. D.D. Basu, Introduction to the Constitution of India, Lexis Nexis, 2015.

AUDIT 1 and 2: (iv) STRESS MANAGEMENT BY YOGA

Course Objectives: Students will be able to:

1. To achieve overall health of body and mind
2. To overcome stress

Course Outcomes:

1. Knowledge of Eight parts of yog(Ashtanga).
2. Understanding the Do`s and Don't's in life.
3.Knowledge of Yam and Niyam, Asan and Pranayam.
5. Regularization of breathing techniques and its effects.
6. Develop healthy mind in a healthy body thus improving social health and efficiency

SECTION-A

Unit I: Definitions of Eight parts of yog. (Ashtanga)

Unit II: Do`s and Don't's in life.
Yam. Ahinsa, satya, astheya, bramhacharya and aparigraha.

Unit III: Niyam. Shaucha, santosh, tapa, swadhyay, ishwarpranidhan

SECTION-B

Unit IV: Asan and Pranayam

Unit V: Various yog poses and their benefits for mind &body

Unit VI: Regularization of breathing techniques and its effects-Types of pranayam .

Books Recommended:

1. 'Yogic Asanas for Group Tarining-Part-I" :Janardan Swami Yogabhyasi Mandal, Nagpur
2. "Rajayoga or conquering the Internal Nature" by Swami Vivekananda, AdvaitaAshrama (Publication Department), Kolkata.

AUDIT 1 and 2: (v) SANSKRIT FOR TECHNICAL KNOWLEDGE

Course Objectives: Students will be able to:

1. To get a working knowledge in illustrious Sanskrit, the scientific language in the world
2. Learning of Sanskrit to improve brain functioning
3. Learn Sanskrit to develop the logic in mathematics, science & other subjects enhancing the memory power
4. The engineering scholars equipped with Sanskrit will be able to explore huge knowledge from ancient literature

Course Outcomes:
1. Understanding basic Sanskrit language
2. Ancient Sanskrit literature about science and technology can be understood
3. Being a logical language will help to develop logic in students.

SECTION-A

Unit I: Alphabets in Sanskrit,
Unit I: Past/Present/Future Tense,
Unit III: Simple Sentences

SECTION-B

Unit IV: Concepts in Mathematics, Order, Introduction of roots,
Unit V: Technical information about Sanskrit Literature
Unit VI: Technical concepts of Engineering-Electrical, Mechanical, Architecture

Books Recommended:
1. "Abhyaspustakam" – Dr.Vishwas, Samskrita-Bharti Publication, New Delhi
2. "Teach Yourself Sanskrit" Prathama Deeksha-VempatiKutumbshastri, Rashtriya Sanskrit Sansthanam, New Delhi Publication
3. "India's Glorious Scientific Tradition" Suresh Soni, Ocean books (P) Ltd., New Delhi.

AUDIT 1 and 2: (vi) VALUE EDUCATION

Course Objectives: Students will be able to:
1. Understand value of education and self- development
2. Imbibe good values in students
3. Let the should know about the importance of character

Course Outcomes:
1. Knowledge of self-development
2. Learn the importance of Human values
3. Developing the overall personality

SECTION-A

Unit I: Values and self-development, Social values and individual attitudes, Work ethics, Indian vision of humanism, Moral and non- moral valuation, Standards and principles, Value judgments

Unit II: Importance of cultivation of values, Sense of duty, Devotion, Self-reliance, Confidence, Concentration. Truthfulness, Cleanliness, Honesty, Humanity, Power of faith, National Unity, Patriotism, Love for nature, Discipline.

Unit III: Personality and Behavior Development, Soul and Scientific attitude, Positive Thinking, Integrity and discipline, Punctuality, Love and Kindness. Avoid fault Thinking, Free from anger, Dignity of labour.

SECTION-B

Unit IV: Universal brotherhood and religious tolerance, True friendship, Happiness Vs suffering, love for truth, Aware of self-destructive habits, Association and Cooperation, Doing best for saving nature.

Unit V: Character and Competence, Holy books vs Blind faith, Self-management and Good health, Science of reincarnation, Equality, Nonviolence, Humility, Role of Women.
Unit VI: All religions and same message. Mind your Mind, Self-control. Honesty, studying effectively

Book Recommended:
1. Chakroborty, S.K. "Values and Ethics for organizations Theory and practice", Oxford University Press, New Delhi

AUDIT 1 and 2: (vii) PEDAGOGY STUDIES

Course Objectives: Students will be able to:

1. Review existing evidence on the review topic to inform programme design and policy making undertaken by the DfID, other agencies and researchers.
2. Identify critical evidence gaps to guide the development.

Course Outcomes:
1. Knowledge of Theories of learning and Conceptual framework.
2. Understanding the Pedagogical practices.
3. Theory of change when pedagogical practices are done.
4. Understanding the Professional development and Barriers to learning.
5. Study of Research gaps and future directions.

SECTION-A

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

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

Unit III: Evidence on the effectiveness of pedagogical practices. Methodology for the in depth stage: qualityassessment of included studies. How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy?

SECTION-B

Unit IV: Theory of change. Strength and nature of the body of evidence for effective pedagogical practices. Pedagogic theory and pedagogical approaches. Teachers' attitudes and beliefs and Pedagogic strategies.

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

Unit VI: Research gaps and future directions, Research design, Contexts, Pedagogy, Teacher education, Curriculum and assessment, Dissemination, and research impact.

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

AUDIT 1 and 2: (viii) PERSONALITY DEVELOPMENT THROUGH LIFE ENLIGHTENMENT SKILLS

Course Objectives: Students will be able to:
1. To learn to achieve the highest goal happily
2. To become a person with stable mind, pleasing personality and determination
3. To awaken wisdom in students

Course Outcomes:
1. Knowledge of Holistic development of personality (Neetisatakam)
2. Approach to day to day work and duties.
3. Understanding the personality of role model will lead the nation and mankind to peace and prosperity
4. Study of Personality Development through life enlightenment skills and achieve the highest goal in life

SECTION-A

Unit I: Neetisatakam-Holistic development of personality
Verses- 19,20,21,22 (wisdom)
Verses- 29,31,32 (pride & heroism)

Unit II: Neetisatakam-Holistic development of personality
Verses- 26,28,63,65 (virtue)
Verses- 52,53,59 (dont's)
Verses- 71,73,75,78 (do's)

Unit III: Approach to day-to-day work and duties.
Shrimad BhagwadGeeta: Chapter 2-Verses 41, 47,48.

SECTION-B

Unit IV: Approach to day-to-day work and duties.
Chapter 3-Verses 13, 21, 27, 35, Chapter 6-Verses 5,13,17, 23, 35,
Chapter 18-Verses 45, 46, 48.

Unit V: Statements of basic knowledge.
Shrimad BhagwadGeeta: Chapter2-Verses 56, 62, 68
Chapter 12 -Verses 13, 14, 15, 16,17, 18

Unit VI: Personality of Role model. Shrimad BhagwadGeeta:
Chapter2-Verses 17, Chapter 3-Verses 36,37,42,
Chapter 4-Verses 18, 38,39
Chapter18 – Verses 37,38,63

Books Recommended:

1. "Srimad Bhagavad Gita" by Swami Swarupananda Advaita Ashram (Publication Department), Kolkata
2. Bhartrihari's Three Satakam (Niti-sringar-vairagya) by P.Gopinath, Rashtriya Sanskrit Sansthanam, New Delhi.

SEMESTER-II

2MMD1 MECHATRONICS IN SYSTEM DESIGN

Course Objectives:

1. Understand key elements of Mechatronics system, representation into block diagram
2. Understand concept of transfer function, reduction and analysis
3. Understand principles of sensors, its characteristics, interfacing with microcontroller
4. Understand concept of PLC system, its ladder programming, significance of PLC in industrial application
5. Understand the system modeling and analysis in time domain and frequency domain.
6. Understand control actions and study its significance in industrial applications

Course outcomes:

1. Understand scope and application of mechatronics with various electromechanical devices and components
2. Understand basics of electronic signals, working, applications of electronic devices like microcontroller, PLC etc.
3.Understand role, working of different control components of hydraulic, pneumatic systems and their Applications
4. Make pneumatic circuits commonly used in mechanical line automation and their industrial applications.
5. Make hydraulic circuits commonly used in mechanical line automation and their industrial applications.
6. Analyze and also make simple but complete mechatronics systems.

SECTION – A

Unit I: Fundamentals of Mechantronics: Evolution, Definition and concepts of Mechatronics, Conventional system vs. mechatronic system, Need and Role of Mechantronics in Design, Manufacturing and Factory Automation. Hardware components for Mechatronics. Transducer signal conditioning and Devices for Data conversion programmable controllers.

Unit II: Sensors and Actuators: Transducers and Sensors – Tactile sensor –Proximity and range sensors – Sensing joint forces –Position and velocitysensing devices – Design of drive systems – Hydraulic and Pneumaticdrives – Linear and rotary actuators and control valves – Electro hydraulicservo valves, electric drives – Motors – Robot End effectors– Vacuum,magnetic and air operated grippers, Micro sensors in Mechatronics.

Unit III: Pneumatic Systems: Physical concepts of pneumatics, electropneumatic components, operation and application, valves, auxiliarydevices, actuation, synchronizing, clamping, de-clamping etc. Design of pneumatic logic circuit.

SECTION – B

Unit IV: Hydraulic Systems: Study of different control components of HydraulicSystems, Valves and auxiliary devices, design and analysis of Hydraulic circuits sequencing Synchronizing, hydro-pneumatics, Design of electro-hydraulic circuits.

Unit V: Programmable Logic Controller: Comparison betweenmicroprocessor and microcontroller organization of microcontrollersystem Review of logic gates, basic structure, features, input/outputprocessing, programming, functional block diagram (FBD), ladder diagram,logic functions, latching, sequencing, jumps, internal relays, counters, shiftregisters, master and jump control, data handling, data movement, datacomparison, arithmetic operations, code conversion, analog input and output,applications of PLC

BOOKS RECOMMENDED:

Text Books:
1. C.W. De Silva, "Mechatronics: An Integrated Approach, Publisher: CRC.
2. Harry Stewart, "Pneumatics & Hydraulics", D. B. Taraporewala & Sons and Co.,
3. M.P. Groover, "Automation, Production Systems and CIM by PHI.

Reference Books:
1. M. B. Histand & D. G. Aiciatore, "Introduction to Mechatronics & Measurement Systems by Mc-Graw Hill.
2. Moh Mazidi and J. Mazidi, "The 8051 Microcontrollers and Embedded Systems", Prentice Hall
3. A. Malov, Y. Ivanov, "Principles of Automation" Automation by MIR Publication.

4. B.W. Anderson, "The Analysis and Design of Pneumatic Systems Wiley Eastern
5. D.V. Hall, "Microprocessor and It's Applications", Tata Mc-Graw Hill
6. Anthony Esposito, "Fluid Power with Applications Prentice Hallof India
7. Phillipe Collet, "Robotic Technology", Prentice Hall
8. Y. Koren, "Robotics for Engineers", McGraw H

2MMD2 EXPERIMENTAL STRESS ANALYSIS

Course Objectives:

1.To study role of photoelastic bench in photoelastic stress analysis
2.To study of three-dimensional photo elasticity
3.To study strain measurement methods
4.To study Moire Methods
5.To study brittle coating methods

Course outcomes:

1. Apply stress optic law using photoelastic bench
2. Use strain measurement methods
3. Use electrical resistance strain gauge
4. Apply Moire Methods
5. Apply brittle coating methods

SECTION-A

Unit I: Introduction to Photoelasticity: Photo elasticity, Light and Optics as Related to Photoelasticity Behavior of Light, Plane and circularly polarized light, Bright and dark field setups, Polariscope-Plane Polarizers, Wave Plates, Arrangement of Optical Elements in a Polariscope, Constructional Details of Diffused Light and Lens, Photo elastic materials.

Unit II: Theory of Photo-elasticity: Stress Optic Law in Two Dimensions at Normal Incidence, Effects of a Stressed Model in a Plane Polariscope, Effects of a Plane Model in a Circular Polariscope with Dark and Light Field Arrangements. **Analysis Techniques:** Isochromatic Fringe Patterns, Isoclinic Fringe Patterns, Compensation Techniques, separation Techniques, Sealing Model to Prototype Stresses.

Unit III: Three Dimensional Photoelasticity: Introduction, locking in model deformation, materials for three-dimensional photo elasticity, machining cementing and slicing three-dimensional models, slicing the model and interpretation of the resulting fringe patterns, effective stresses, the shear difference method in three dimensions, applications of the Frozen-stress method, the scattered light method.

SECTION-B

Unit IV: Strain Measurement Methods: Basic Characteristics of a Strain Gauge, Various types of strain gauges, Types of Shell Gauge, Moire Method ofStrain Analysis, Grid Method of Strain Analysis.

Electrical Resistance Strain Gauge: Factors Influencing Strain sensitivity in Metallic Alloys, Gauge Construction Temperature Compensation, Factors Influencing Gauge Section Gauge Sensitivity and Gauge Factor, Correction for transverse Strain Effects, Semiconductor Strain Gauges. Strain gauge circuits-Rosette Analysis - three element rectangular Rosette, the four Element Delta Rosettee, Stress Gauge, Strain Circuits, Potentiometer Circuits, Wheatstone Bridge.
Unit V: Moire Methods: Introduction, mechanism of formation of Moire fringes, the geometrical approach to Moire-Fringe analysis, the displacement fieldapproach to Moire-Fringe analysis, out of plane displacement measurements, out of plane slope measurements, sharpening and multiplication of Moire- Fringes, experimental procedure and techniques.

Unit VI: Brittle Coating Method: Introduction, Coating Stresses, Failure Theories, Brittle Coating Crack Patterns Produced by Direct Loading, Brittle Coating Crack Patterns Produced by refrigeration Techniques, Brittle Coating Crack, Pattern Produced by Releasing the Load, Double Crack Pattern, Crack Detection, Ceramic based brittle coatings, Resin based brittle coatings, Test procedures for brittle coatings analysis, Calibration procedures, analysis of brittle coating data. Load-Time Relation and Its influence onthe threshold Strain Effects of a Biaxial stress Field.

Bi-refringent Coatings: Introduction, Coating stresses and strains, coating sensitivity, coating materials, application of coatings, effects of coating thickness, Fringe order determinations in coatings, stress separation methods.

BOOKS RECOMMENDED:

Text Books:

1. J.W. Dally and W.F. Riley, Experimental Stress Analysis, 2nd Ed.MGH.
2. K. Ramesh, Published by IIT Madras, India, Experimental Stress Analysis, 2009.

Reference Books:

1. A Mubin, Khanna Publications, Experimental Stress Analysis, 2003.
2. Sadhu Singh, Khanna Publishers, Experimental Stress Analysis,1982
3. Mark B. Moore, Prentice-Hall ,Principles of experimental stress analysis, 1954
4. Dureli, An Introduction to Experimental Stress and Strain Analysis.
5. Srinath , An Introduction to Experimental Stress Analysis - MGH.
6. Experimental Stress Analysis - Dally and Riley, McGraw Hill.
7. Photoelasticity Vol I and Vol II - M.M.Frocht,. John Wiley and sons.

8. Strain Gauge Primer - Perry and Lissner.
9. Photo elastic Stress analysis - Kuske, Albrecht and Robertson JohnWiley & Sons.
10. Motion Measurement and Stress Analysis - Dave and Adams,
11. Hand Book of Experimental Stress Analysis AS. Kobayassin (Ed),SEMNCH, II edition

2MMD3 Programme Elective-III (i) OPTIMIZATION METHODS IN ENGINEERING DESIGN

Course Objectives:

1. To introduce mathematical theory behind optimization
2. To introduce exact methods for optimizing unconstrained functions
3. To introduce exact methods for optimizing constrained functions
4. To learn basics of different evolutionary algorithms.
5. Techniques to solve various models arising from engineering areas.

Course outcomes:

1. Explain the engineering applications of optimization
2. Use exact methods for optimizing unconstrained functions
3. Use exact methods for optimizing constrained functions
4. Use different novel methods for optimization and algorithms
5. Solve various optimization problems arising from engineering areas.

SECTION – A

Unit I: Introduction: Historical Developments, Engineering applications of Optimization.
Classical Optimization Techniques: Introduction, Review of single and multivariable optimization methods with and without constraints, Non-linear one-dimensional minimization problems, Examples.

Unit II: Constrained Optimization Techniques: Introduction, Direct methods - Cutting plane method and Method of Feasible directions, Indirect methods - Convex programming problems, Exterior penalty function method, Examples and problems.

Unit III: Unconstrained Optimization Techniques: Introduction, Direct search method - Random, Univariate and Pattern search methods, Rosenbrock's method of rotating co-ordinates, Descent methods - Steepest Decent methods-Quasi-Newton's and Variable metric method, Examples.

SECTION – B

Unit IV: Geometric Programming: Introduction, Unconstrained minimization problems, solution of unconstrained problem from arithmetic-geometric inequality point of view, constrained minimization problems, generalized polynomial optimization, Applications of geometric problems.

Unit V: Novel methods for Optimization: Introduction to simulated annealing, selection of simulated annealing parameters, simulated annealing algorithm; Genetic Algorithm (GA), Design of GA, Key concepts of GA, Neural Networks, A frame work for Neural Network models, Construction of Neural Network algorithm, Examples of simulated algorithm, genetic annealing and Neural Network method, Fuzzy optimization techniques.

Unit VI: Special topics in Optimization: Integrating simulation in optimization models, Multidisciplinary optimization, FEA optimization, Stochastic optimization, Robustness and tolerance optimization. Use Matlab to solve optimization problems.

BOOKS RECOMMENDED:

Text Books:

1. Engineering Optimization, S. S. Rao New Age International.
2. Optimization for Engineering Design, Kalyanmoy Deb Prentice Hall of India.
3. Ashok D. Belegundu, Tirupathi R. Chandrupatla, Optimization Concepts and Applications in Engineering, Pearson Education, 1998.

Reference Books:

1. Applied Optimal Design, E. J. Haug and J.S. Arora Wiley, New York
2. Optimization, G.V. Reklaites, A. Ravindran and K.M. RogsdethWiley, New York
3. Ignizio, J. P., 1982, Linear Programming in Single and Multi-Objective Systems, Prentice-Hall, Englewood Cliffs, New Jersey.
4. Luenberger, D. G., 1984, Linear and Nonlinear Programming, Addison-Wesley Publishing Company, Inc., Reading, Massachusetts.

2MMD3 Programme Elective-III (ii) ADVANCED MATERIALS TECHNOLOGY

Course Objectives:

1. To learn the various advanced materials used for engineering applications.
2. To learn the effect of strengthening on structure and mechanical properties of materials.
3. To learn behavior of advanced materials under various manufacturing processes.
4. To learn the various modern metals and non metals and their applications.

Course outcomes:

1. Comprehensive understanding of various advanced materials.
2. Understanding the principles and concepts of internal structure of materials.
3. Applying the knowledge of material properties for various applications.
4. Exploring the advanced manufacturing techniques of various metals and non metals.

SECTION – A

Unit I: Materials and Classification: Solid materials- Classification, Ceramics, composites and metal glasses, selection and application of tool steel, Magnetic alloys, Copper, aluminum and magnesium alloys, Bearing alloys, Super hard materials, Plastics, Alloying techniques, Thermal, mechanical and chemical methods, Power metallurgy techniques.

Unit II: Mechanical Properties: Strengthening mechanism of materials, elements of dislocation theories, Strain hardening, Grain size control, Single crystal growth, Reinforcing fibres for polymers, Composite structure, determination of mechanical properties of materials, Dynamic tests, Fracture and toughness tests, Low temperature and high temperature tests, Creep characteristics, Hot hardness tests.

Unit III: Processing of Materials for Casting and Joining: Plastic working ofmaterials, Strain hardening, Recovery and recrystallisation, Formability, Forgibility and drawability of materials, Powder processing of materials,Ceramic processing, Composite processing, Features controllingmachinability of materials, thermal treatment for better mach inabilityof metals, Universal mach inability index.

SECTION – B

Unit IV: Modern Materials and Alloys: Super alloys-refractory materials,Ceramic and their applications, Low melting alloys, Shape memoryalloys, Advanced Composites-Particulate and dispersioned composites, Metal matrix and ceramic matrix composites, Carbon-Carboncomposites, Ti and Ni based alloys for gas turbine applications, Managingand cryogenic steels, smart and nano materials.

Unit V: Non metallic materials: Polymeric materials - Formation of polymerstructure - Production techniques of fibres, foams, adhesives and coatings- Structure, properties and applications of engineering polymers -Advanced structural ceramics, WC, TiC, TaC, AI2O3, SiC, Si3N4, CBNand diamond – properties and applications.

Unit VI: Composite Materials: Fiber reinforced, laminated and dispersed materials with metallic matrix of aluminium, copper and Titanium alloys and with non-metallic matrix of unsaturated polyesters and epoxy resins. Development, Important properties and applications of these materials.**Smart Materials:**Varistors and Intelligent materials for bio-medical applications. Nanomaterials: Definition, Types of nanomaterials including carbon nanotubes and nanocomposites, Physical and mechanical properties, Applications of nanomaterials.

BOOKS RECOMMENDED:

Text Books:

1. Engineering Materials and Applications P. Flinn and P.K.Trojan MIR Publications
2. Engineering Materials: Polymers, Ceramics and CompositesA.K Bhargava Prentice Hall of India

Reference Books:

1. Manufacturing processes for Engineering Materials SeropeKalpakjian Wesley Publishing Co.
2. An introduction to Physical Metallurgy S.H. Avner McGraw Hill
3. Advances in Materials and Their Applications P. Rama Rao Wiley Eastern
4. Mechanical Metallurgy Dieter McGraw Hill:
5. P.C.Shrma, Production technology
6. Thomas H.Courtney, " Mechanical Behaviour of Materials ", (2nd Edition), McGraw-Hill,
7. Charles J.A., Crane, F.A.A and Furness, J.A.G., " Selection anduse of Engineering Materials ",(3rd Edition), Butterworth-Heiremann, 1977.
8. Flinn, R.A. and Trojan, P.K., " Engineering Materials and theirApplications ", (4th Edition), Jaico, 1999.
9. George E.Dieter, " Mechanical Metallurgy ", McGraw Hill, 1988.
10. Engineering Material Technology James A. Jacobs & Thomas F. Kilduff Prentice Hall
11. Materials Science and Engineering WD. Callister Jr. Wiley India Pvt. Ltd 2010
12. Engineering Design: A Materials and Processing Approach G.E. Dieter McGraw Hill 1991
13. Materials Selection in Mechanical Design M.F. Ashby Pergamon Press 1992
14. Introduction to Engineering Materials & Manufacturing Processes NIIT Prentice Hall of India
15. Engineering Materials Properties and Selection Kenneth G. Budinski Prentice Hall of India
16. Selection of Engineering Materials Gladius Lewis Prentice-Hall, New Jersey

2MMD3 Programme Elective-III (iii) ADVANCED MECHANICAL VIBRATIONS

Course Objectives:

1. Understand mathematical techniques necessary for describing and analyzing mechanical vibration
2. To impart the ability to model, analyze and solve vibration problems.
3. To impart the knowledge of vibration control techniques and the ability to apply these techniques.
4. Understand vibration measurement techniques and ability to choose the correct technique in a given situation.
6. To introduce modern vibration data acquisition software and hardware

Course outcomes:

1. Ability to approach real-world vibration problem and describing and analyzing vibrations
2. Make use of analytical and experimental dynamic models of a given situation.
3. Ability to acquire and interpret Frequency Response Functions
4. Ability to describe basic vibration data acquisition hardware and excitation techniques
5. Proficiency in data acquisition and analysis software and new functionality and capabilities as needed.

SECTION – A

Unit-I: Introduction: Free and forced vibrations with and without damping, transient vibrations, Laplace transform formulation.

Unit-II: Isolation and Stability Criterion: Vibration isolation and transmissibility, undamped vibration absorbers, self-exited vibrations, criterion of stability, effect of friction on stability.

Unit-III: Nonlinear Vibration: Free vibration with nonlinear spring force or nonlinear damping, phase plane, energy curves,Lienard's graphical construction, methods of isoclines, random vibration, power spectraldensity, bandwidth in vibration, numerical methods for vibration analysis, vibration of continuous systems, Euler equation for beams, effect of rotary inertia and shear deformation.

SECTION – B

Unit-IV: Vibration Analysis of Rotors : Transverse vibrations single, two and three rotor systems, critical speeds of shafts, torsional vibrations of rotors: one, two and three disc rotor system, frequency of torsional vibration systems, coupling of torsional and bending vibrations due to pretwist and eccentricity, rotor faults, forward and backward rotor whirl model, variable elasticity effects in rotating systems, flow induced vibration in rotating systems, Newkirk effect, stresses in rotating disc and blade, disc of uniform strength, thermal stresses.

Unit-V:Diagnostic Techniques : Introduction to diagnostic maintenance and instrumentation in machinery vibration, amplitude, frequency and phase characteristics, signature analysis-trend plot, time domain plot, frequency domain plot, FFT, spectrum plot, fault detection transducers, artificial intelligence techniques applied to vibration analysis.

Books Recommended:

1. S. S. Rao. Mechanical Vibrations, 4th Edition, Pearson Education, 2007.
2. L. Meirovitch. Fundamentals of Vibrations, McGraw Hill, 1st edition, 2001.
3. E. Krämer. Dynamics of Rotors and Foundations, Springer-Verlag, New York, 1993.
4. R. Subbiah and J. E. Littleton. Rotor and Structural Dynamics of Turbo-machinery – A Practical, 1st edition, 2018.
5. P. Luciano Gatti. Advanced Mechanical Vibrations: Physics, Mathematics and Applications. CRC Press; 1st edition 2020.

2MMD4 Programme Elective-IV (I) INDUSTRIAL TRIBOLOGY

Course Objectives:

1. To introduce and expose students to the field and fundamentals in tribology
2. To learn principles of lubrication, regimes, theories of hydrodynamic and the advanced lubrication techniques.
3. To understand the behavior of Tribological components.
4. To study solution oriented approach by in depth knowledge of Industrial Tribology.
5. To address the underlying concepts, methods and application of Industrial Tribology.

Course Outcomes:

1. Understand fundamentals of tribology and identify different areas of industrial tribology.
2. Can find the applications of all the areas in day to day life.
3. Ability to design friction, wear and Lubrication
4. Ability to identify different types of sliding , rolling friction, wear related theories
5. Ability to distinguish among the different Lubricant regime.
6. Select proper bearing materials and lubricants for a given tribological application.

SECTION – A

Unit-I: Introduction: Tribology in design, tribology in industry Viscosity, flow of fluids, viscosity and its variation absolute and kinematic viscosity, temperature variation, viscosity index determination of viscosity, different viscometers, Tribological considerations Nature of surfaces and their contact; Physic-mechanical properties of surface layer, Geometrical properties of surfaces, methods of studying surfaces; Study of contact of smoothly and rough surfaces.

Unit-II: Friction and wear: Role of friction and laws of static friction, causes of friction, theories of friction, Laws of rollingfriction; Friction of metals and non-metals; Friction measurements. Definition of wear, mechanism ofwear, types and measurement of wear, friction affecting wear, Theories of wear; Wear of metals and non-metals.

Unit-III: . Hydrostatic lubrication: Principle of hydrostatic lubrication, General requirements of bearing materials, types of bearing materials., Hydrostatic step bearing, application to pivoted pad thrust bearing and other applications, Hydrostatic lifts, hydrostatic squeeze films and its application to journal bearing, optimum design of hydrostatic step bearing.

SECTION – B

Unit-IV: Hydrodynamic theory of lubrication: Principle of hydrodynamic lubrication, Various theories of lubrication, Petroff's equation, Reynold's equation in two dimensions -Effects of side leakage - Reynolds equation in three dimensions, Frictionin sliding bearing, hydro dynamic theory applied to journal bearing, minimum oil film thickness, oilwhip and whirl, anti –friction bearing, hydrodynamic thrust bearing.

Unit-V:Air/gas lubricated bearing: Advantages and disadvantages application to Hydrodynamic journal bearings, hydro-dynamic thrust bearings. Hydrostatic thrust bearings. Hydrostatic bearing Analysis including compressibility effect. **Lubrication and lubricants:** Introduction, dry friction; Boundary lubrication; classic hydrodynamics, hydrostatic and elasto hydrodynamic

lubrication, Functions of lubricants, Types of lubricants and their industrial uses; SAE classification, recycling, disposal of oils, properties of liquid and grease lubricants; lubricant additives, general properties and selection.

Unit-VI: Special Topics: Selection of bearing and lubricant; bearing maintenance, diagnostic maintenance of Tribological components and considerations in IC engines and automobile parts, roller chains and wire rope, lubrication systems; Filters and filtration

Text Books:

1. Fundamentals of Tribology, Basu, Sen Gupta and Ahuja /PHI.
2. Introduction to Tribology", B. Bhushan, John Wiley & Sons, Inc., New York, 2002
3. A. Harnoy. "Bearing Design in Machinery "Marcel Dekker Inc, New York, 2003.
4. Engineering Tribology, Prasanta Sahoo, PHI Learning Private Ltd, New Delhi, 2011.
5. Engineering Tribology, J. A. Williams, Oxford Univ. Press, 2005.

Reference Books :

1. M. M. Khonsari & E. R. Booser, "Applied Tribology", John Willey &Sons, New York, 2001.
2. E. P. Bowden and Tabor.D., "Friction and Lubrication ", Heinemann Educational Books Ltd., 1974.
3. A. Cameron, "Basic Lubrication theory", Longman, U.K.., 1981.
4. M. J. Neale (Editor), "Tribology Handbook", Newnes. Butterworth-Heinemann, U.K., 1995.
5. Tribology in Industry : Sushil Kumar Srivatsava, S. Chand &Co.
6. Tribology H.G.Phakatkar and R.R.Ghorpade Nirali Publications
7. Tribology – B.C. Majumdar, McGraw Hill Co Ltd.
8. Standard Hand Book of Lubrication Engineering, O'Conner and Royle, McGraw Hills C
9. Lubrication, Raymono O. Gunther; Bailey Bros & Swinfan Ltd.
10. Bearing Systems, Principles and Practice, PT Barwll.
11. Tribology Hand Book, Michel Ncole

2MMD4 Programme Elective-IV (ii) ADVANCED MACHINE TOOL DESIGN

Course Objectives:

1. To make aware about the various aspects of the machine tools in detail.
2. To provide the knowledge and practice regarding different machine tool drive mechanisms, hands on practice regarding mechanisms, regulation and design of machine tool drives & components;
3. To make familiar with the concepts of speed and feed regulation.
4. To aware about various machine drives, controls and power transmission systems in machine tool.
5. Insight about design of multi speed gear box, machine tool structure and all major elements along with their procedure of assessing dynamic stability

Course Outcomes:

1. Understand the various machine drives, controls and power transmission systems in machine tool.
2. Apply the speed and feed rate regulation concepts in various operating conditions.
3. Analyze the machine tool structure for the stability of the machine tool.
4. Understand the design of spindle, guide ways and the power screws of the machine tool.
5. Understand the dynamics of machine tool.

SECTION – A

Machine Tool Drive: working and auxiliary motion in machine, Machine tool drives, Hydraulic transmission, Mechanical transmission, General requirements of machine tool design, Layout of machine tools.
Regulation of Speed and Feed Rates: Aim of speed feed regulation, stepped regulation of speed, design of speed box, Design of feed box, Special cases of gear box design, Set stopped regulation of speed and feed rates.
Design of Machine Tool Structure: Fundamentals of machine tool structures and their requirements, Design criteria of machine tool structure, Static and dynamic stiffness, Design of beds and columns, Design of housing models, Techniques in design of machine tool structure.

SECTION – B

Design of Guide-ways and power Screws: Function and type of guideways, design of slide-ways, Protecting devices for slide-ways, Design of power screws.
Design of Spindles and Spindle Supports: Materials for spindles, Design of spindles, Antifriction bearings, Sliding bearings.
Dynamics of Machines Tools: General procedure of assessing dynamic stability of EES, Cutting processing, Closed loop system, Dynamic characteristics of cutting process, Stability analysis.

BOOKS RECOMMENDED:

Text Books:

1. N.K. Mehta Tata McGraw Hill “Machine Tool Design”
2. Acherkan, N., “Machine Tool Design”, Vol. 3 & 4, MIR Publishers, Moscow, 1968

Reference Books:

1. CMTI Banglore “Machine Tool design Handbook”
2. Koenisberger, F., “Design Principles of Metal cutting Machine Tools”, Pergamon Press, 1964.
3. Sen. G. and Bhattacharya, A., “Principles of Machine Tools”, Vol.2, NCB.Calcutta, 1973.

2MMD4Programme Elective-IV (iii) RAPID PROTOTYPING AND TOOLING

Course Objectives:

1. Understand the various steps in product design and development
2. To aware about various methods of Rapid Prototyping processes
3. Understand the various parameters in Rapid Prototyping processes
4. Know the need of Tooling in Rapid Prototyping processes
5. Aware the concept of Reverse Engineering

Course outcomes :

1. Aware of role of rapid prototyping in product development process
2. To identify various Rapid Prototyping Processes
3. Analyze the principles of Stereo lithography and Laser sintering process
4. Understand various types of Pre-processing, processing, post-processing errors in Rapid prototyping.
5. To Identify the various types of data formats and software’s used in Rapid prototyping
6. To Understand the concept of Reverse engineering

SECTION – A

Unit I: Introduction: Need for time compression in product development, Product development conceptual design, Development, Detail design, Prototype, Tooling Applications of RP.

Unit II: Stereo lithography systems: Principle, Process parameters, Process details, Machine details, Applications.

Unit III: Laser sintering systems: Principle, Process parameters, Process details, Machine details, Applications. Fusion deposition modeling: Principle, Process parameters, Process details, Machine details, Applications.

SECTION – B

Unit IV: Laminated object manufacturing: Principle, Process parameters, process details, Machine details, Applications.

Unit V: Laser engineering net shaping (lens): Ballistic Particle Manufacturing (BPM), 3D printing. Principle, Introduction to rapid tooling, Direct and indirect method, Commercial software for RP, STL file generation.

Unit VI: Rapid tooling techniques- vacuum casting, DMLS, etc. Introduction to reverse engineering.

Books Recommended:

1. Pham, D.T. &Dimov.S.S., "Rapid manufacturing", Springer -Verlag, London, 2001.
2. Terry wohlers, "Wohlers Report 2007", Wohlers Associates, USA, 2007.
3. Ghosh A., "Rapid Protopyping: A Brief Introduction", Affiliated East West,
4. Kenneth G. Cooper, "Rapid Prototyping Technology: Selection and Application", CRC Press, 2001.
5. Chua Chee Kai, Leong Kah Fai, Lim Chu -Sing, "Rapid Prototyping: Principles and Applications", World Scientific, 2003.

2MMD5 MECHATRONICS IN SYSTEM DESIGN - LAB

At least four practicals (study/trials) based on above syllabus, as given below shall be performed and a report there of submitted by the students

List of Practicals:-

1. Sensors applications in Mechanical System
2. Design and testing of sequencing circuits.
3. Design and testing of Different types of Speed control Circuits.
4. Design and testing of Continuous reciprocation of Double acting Cylinder.
5. Study of different components of a CNC Machine-tool
6. Application of Microcontroller in a Mechatronics system

Practical Examination:

Practical examination shall consist of viva voce/performance based on the above syllabus and practical work

2MMD6 EXPERIMENTAL STRESS ANALYSIS - LAB

At least five practicals (study/trials) based on above syllabus, as given below shall be performed and a report there of submitted by the students.

List of Practicals: -

1. Determination of Fringe constant of photo elastic material using.
2. Circular disc subjected to diametric compression.
3. Pure bending specimen (four-point bending)
4. Determination of 3- dimensional experimental stress analysis using polariscope.
5. Determine slopes of plates by experimental technique.
6. Determination of Principal stresses 1 and 2 in magnitude and direction
7. Study of effect of pressure on principal stresses.
8. Determination of stress concentration using photo elasticity for simple components like plate with a hole under tension. 2D crane hook.
9. Determination of stress frozen and a slice of cross section are taken to analyze stress & no separate loading frame required.
10. Experiments using strain gauges.
11. Measurement of strain, temperature effects.
12. Fixing of gauges on surfaces.
13. Experiments using photo elastic bench.
14. Setting of polariscope and calibration of disc, beam, and tension model.

Practical Examination:

Practical examination shall consist of viva voce/performance based on the above syllabus and practical work.

2MMD7 SEMINAR

Course Objectives:
1. Identify and compare technical and practical issues related to the area of course specialization.
2. Outline annotated bibliography of research demonstrating scholarly skills.
3. Prepare a well-organized report employing elements of technical writing and critical thinking.
4. Demonstrate the ability to describe, interpret and analyze technical issues and develop competence in presenting.

Course Outcomes:
1. Review, prepare and present on recent technological developments
2. Organize a detailed literature survey and build a document with respect to technical publications.
3. Make use of new and recent technology (e.g. Latex) for to prepare technical report
4. Establish motivation for any topic of interest and develop a thought process for technical presentation.
5. Analysis and comprehension of proof-of-concept and related data.
6. Effective presentation and improve soft skills.

Method of Evaluation:
During the seminar session each student is expected to prepare and present a topic on recent technological developments with respect to technical publications, for duration of about 15 to 20 minutes.
In a session of a period per week, students are expected to present the seminar.
Each student is expected to present at least once during the semester and the student is evaluated based on their performance.
At the end of the semester, He / She will submit a report on His / Her topic of seminar and are awarded based on the report presentation.
Evaluation is 100% Internal.

SEMESTER-III

3MMD1 Programme Elective-V (i) DESIGN OF MATERIAL HANDLING EQUIPMENTS

Course Objectives:
1. To learn the various types of material handling systems and its uses.
2. To learn the various aspects in designing of Hoist and Elevators.
3. To learn the selection processes of conveyors used for in industry.
4. To learn the various concepts in designing the lifting mechanisms.

Course outcomes:
1. Understand the different material handling systems and their criteria of selection.
2. Understand the factors for designing of hoists, conveyors and Elevators.
3. To apply the knowledge of handling system for selection of various drives of material handling systems
4. To apply designing criteria for materials handling systems used in industries.

SECTION-A

Unit-I: **Introduction**: Transmission and its requirements. Matching of load and prime mover. Types of material equipment's – Characteristics applications selection of the system.

Unit-II: **Design of Hoists**: Design of hosting elements – ropes, chains, pulleys, sheaves, hoists of different types.

Unit-III: **Design of Elevators**: Types – Design of chair and bucket elevators – belt and bucket elevators - discharges.

SECTION-B

Unit-IV: **Design of Conveyors**: Types of conveyors – design of belt, pneumatic, hydraulic, screw and vibratory conveyors – selection of the conveyors.

Unit-V: **Selection of Drives**: Types of drives – rails traveling mechanism – slewing with rotary pillar, fixed pillar and turn tablets – traveling gear.

Unit-VI: **Selection of Grabbing Attachments:** Cranes grabs – grabbing attachments for loose pieces – lifting magnets grab buckets and liquid handling buckets. **Design of Arresting Mechanism:** Brakes – Shoes, Band, cone disc and Centrifugal types.

BOOKS RECOMMENDED:
Text Books:
1. Spivakovsky, A. & Dychnov, V.K., "Conveying Machines Volumes I & II", MIR Publishers Moscow.

2. Rudenko, N., "Material Handling Equipments", MIR Publishers, Moscow

Reference Books:

1. Boltz, Hord, A., "Material Handling Handbook ", The Ronald Press CO.
2. V. Dobrovolsky et. al, "Design of Machine Elements", MIR Publishers
3. Spivakovsky, F. and Dyachkov, V.,"Conveyours and Related Equipments". MIR Publishers, Moscow.
4. Duglas, R WOODLEY, "Encyclopedia of Materials Handling – Vol. 1 Pregmen.
5. Hudson Wilbur, G., "Conveyors and Related Equipments ", Join Wiley and Sons.
6. M. F. Spotts and T. E. Shoup, "Design of Machine Elements", PHI
7. J.E.Shiegley, "Mechanical Engg Design", Mc-Graw Hill Book Co
8. D.N. Reshetov, "Machine Design", MIR Publishers.

3MMD1 Programme Elective-V (ii) INDUSTRY 4.0 AND INDUSTRIAL IOT

Course Objectives:

1. To walk though technology timeline (brief history) and evolution of IoT
2. Gain knowledge about IoT applications across various segments
3. Understand IoT architecture and its building blocks
4. Introduction to various IoT platforms
5. Understand the technology and skills required in building and IoT product

Course outcomes:

1. Describe to an overview and architecture of IIoT.
2. Identify suitable IoT technique for different industrial applications.
3. Perform the optimization of industrial processes using IoT technique.
4. Select the application of IoT for safety and service providers.
5.Identify, formulate and solve engineering problems by using Industrial IoT.
6. Implement real field problem by gained knowledge of Industrial applications with IoT capability.

SECTION-A

UNIT I: Introduction and Industry 4.0: : Sensing & actuation, Communication-Part I, Part II, Networking-Part I, Part II, Globalization and Emerging Issues, The Fourth Revolution, LEAN Production Systems, Smart and Connected Business Perspective, Smart Factories Concepts of IoT and IIoT- Evolution of IoT, IoT architecture- Elements of IoT: Embedded systems,Micro controllers, operating system, Networking. Networking- Communication between IoT devices, Cloud based servers, Internet protocols, mobile Adhoc network ,MANET,WAN structure,Internet structure, TCP/IP application layer.

UNIT II: Industrial IOT in Manufacturing Processes : Dimensions of IIoT : Production flow monitoring , Remote equipment management, Condition based maintenance alerts. Manufacturing operations- asset management, intelligent manufacturing. Condition-based alerts.

UNIT III: Industrial IOT in Performance Optimization & Monitoring: Cyber Physical Systems and Next Generation Sensors, Collaborative Platform and Product Lifecycle Management, Augmented Reality and Virtual Reality, Artifical Intelligence, Big Data and Advanced Analysis, Performance optimization and monitoring, planning, human machine interaction, end-to-end operational visibility and these cyber-physical systems. IoT- enabled manufacturing ecosystem, tools to plan, schedule and pro-actively service, are important differentiators.

SECTION-B

UNIT IV: Industrial IOT for Safety and Service Providers: Staff safety applications, health monitoring (real-time), smart ventilation and air quality management, smart environmental measurement, access control (security). Supplier management Vehicle and asset tracking, connected factory applications- Cyber-attacks. Cyber security in Industry 4.0, Basics of Industrial IoT: Industrial Processes-Part I, Part II, Industrial Sensing & Actuation, Industrial Internet Systems.

UNIT V:Industrial IoT- Applications: Healthcare, Power Plants, Inventory Management & Quality Control, Plant Safety and Security (Including AR and VR safety applications), Facility Management.

UNIT VI: Case Studies of IIoT Systems: IIoT application development with Embedded PC based development boards, Development of mini Project on new version of Operating systems and Edge development board. That project should also address to the current societal needs. Real case studies: Oil, chemical and pharmaceutical industry, Milk Processing and Packaging Industries, Manufacturing Industries

Books Recommended:

1. Bruce Sinclair, IoT Inc: How Your Company Can Use the Internet of Things to Win in the Outcome Economy Hardcover – May 29, 2017
2. Maciej Kranz, Building the Internet of Things: Implement New Business Models, Disrupt Competitors, Transform Your Industry (Old Edition) Hardcover – 30 Dec 2016.
3. Cuno Pfister, Getting Started with the Internet of Things: Connecting Sensors and Microcontrollers to the Cloud (Make: Projects) 1st Edition, Kindle Edition
4. Robert Stackowiak , Art Licht , Venu Mantha, Louis Nagode, Big Data and The Internet ofThings: Enterprise Information Architecture for A New Age 1st ed. Edition

5. Dirk Slama , Frank Puhlmann, Jim Morrish, Rishi M Bhatnagar , Enterprise IoT: Strategies and Best Practices for Connected Products and Services 1st Edition.
6. Industry 4.0: The Industrial Internet of Things, by Alasdair Gilchrist (Apress)
7. Industrial Internet of Things: Cyber manufacturing Systems by Sabina Jeschke, Christian Brecher, Houbing Song, Danda B. Rawat (Springer)
8. Dr. OvidiuVermesan, Dr. Peter Friess, "Internet of Things: Converging Technologies for Smart Environments and Integrated Ecosystems", River Publishers.

9. Dr. OvidiuVermesan, Dr. Peter Friess, "Internet of Things: Converging Technologies for Smart Environments and Integrated Ecosystems", River Publishers.

3MMD1 Programme Elective-V (iii) MANUFACTURING MANAGEMENT

Course Objectives:
1. Understand the fundamentals of manufacturing systems and management of integrated manufacturing systems.
2. Understand product and process design and optimization of single stage and multistage manufacturing systems.
3. Learn production planning, operation scheduling and project scheduling.
4. To impart basic knowledge on planning, designing, and production systems and subsystems.
5. To improve, manage, and regulate all aspects of a successful manufacturing operations infrastructure.

Course outcomes:
1. Differentiate among general management decisions that are beyond strictly manufacturing, and includes skills to manage projects, energy, costs and budgets.
2. Generate written, oral, and graphic communications, including the use of current technology, persuasively and accurately in a professional manner.
3. Formulate the principles and practice of team-building in an interdisciplinary setting, and integrate negotiation and problem-solving skills.
4. Develop integrated manufacturing system models for industrial products with adequate managerial information.
5. Design and Plan product and production including operation scheduling, layout planning and project planning.

SECTION-A

Unit I: Strategy Planning: Nature of production-inventory management systems. Strategic, Tactical and Operational decisions. general discrete location-allocation problems - features and formulations. Facility location models - median model - distribution model - brown and gibson model.

Unit II: Tactical Planning: Aggregate production planning - ways to absorb demand fluctuations - costs relevant to aggregate production planning - aggregate production planning models - Inventory management - EOQ decision rules - costs in an inventory system - simple lot size model.

Unit III: Scheduling: Operations scheduling - Flow shop - n jobs – 2 machine Johnson's rule, 2 Jobs –M machine, N-Jobs M machine Sequencing Job on parallel machine - Assembly Line Balancing- Project Scheduling-crashing of project network with cost trade off.

SECTION-B

UNIT IV: MRP &MRP-II: Material Requirement Planning (MRP) - working of MRP - Use of MRP system - evolution from MRP to MRP II - master production scheduling - rough cut capacity planning - capacity requirement planning - Lot sizing in MRP II system.

UNIT V: SCM & Quality Management:
Concept of supply management and SCM, Flow in supply chains, Key issues in supply chain management, Decision phases in supply chain, concept of quality management - standards for quality management - statistical process control - Taguchi method of quality control.

References:
1. H.G. Menon,, "TQM in New Product Manufacturing", Mc Graw Hill, 1992.
2. Hax and Candea., "Production and Inventory Management", Prentice Hall, 1984.
3. Buffa., "Modern Production Management", John Welley, 1983.

3MMD2 OPEN ELECTIVE (i) BUSINESS ANALYTICS

Course Objectives:
1. Understand the role of business analytics within an organization.
2. Analyze data using statistical and data mining techniques and understand relationships between the underlying business processes of an organization.
3. To gain an understanding of how managers use business analytics to formulate and solve businessproblems and to support managerial decision making.
4. To become familiar with processes needed to develop, report, and analyze business data.
5. Use decision-making tools/Operations research techniques.
6. Mange business process using analytical and management tools.
7. Analyze and solve problems from different industries such as manufacturing, service, retail,software, banking and finance, sports, pharmaceutical, aerospace etc.

Course Outcomes:
1. Demonstrate knowledge of data analytics.
2. Demonstrate ability of think critically in making decisions based on data and deep analytics
3. Demonstrate ability to use technical skills in predicative and prescriptive modelingto business decision-making.
4. Demonstrate the ability to translate data into clear, actionable insights.

SECTION-A

Unit-I: Business analytics: Overview of Business analytics, Scope of Business analytics, Business Analytics Process, Relationship of Business Analytics Process and organisation, competitive advantages of Business Analytics. Statistical Tools: Statistical Notation, Descriptive Statistical methods, Review of probability distribution and data modelling, sampling and estimation methods overview.

Unit-II: Trendiness and Regression Analysis: Modelling Relationships and Trends in Data, simple Linear Regression. Important Resources, Business Analytics Personnel, Data and models for Business analytics, problem solving, Visualizing and Exploring Data, Business Analytics Technology.

Unit-III: Organization Structures of Business analytics, Team management, Management Issues, Designing Information Policy, Outsourcing, Ensuring Data Quality, Measuring contribution of Business analytics, Managing Changes. Descriptive Analytics, predictive analytics, predicative Modelling, Predictive analytics analysis, Data Mining, Data Mining Methodologies, Prescriptive analytics and its step in the business analytics Process, Prescriptive Modelling, nonlinear Optimization.

SECTION-B

Unit IV: Forecasting Techniques: Qualitative and Judgmental Forecasting, Statistical Forecasting Models, Forecasting Models for Stationary Time Series, Forecasting Models for Time Series with a Linear Trend, Forecasting Time Series with Seasonality, Regression. Forecasting with Casual Variables, Selecting Appropriate Forecasting Models. Monte Carlo Simulation and Risk Analysis: Monte Carle Simulation Using Analytic Solver Platform, New-Product Development Model, Newsvendor Model, Overbooking Model, Cash Budget Model.

Unit V: Decision Analysis: Formulating Decision Problems, Decision Strategies with the without Outcome Probabilities, Decision Trees, The Value of Information, Utility and Decision Making.

Unit VI: Recent Trends in : Embedded and collaborative business intelligence, Visual data recovery, Data Storytelling and Data journalism.

Books Recommended:
1. Business analytics Principles, Concepts, and Applications by Marc J. Schniederjans, Dara G. Schniederjans, Christopher M. Starkey, Pearson FT Press.
2. Business Analytics by James Evans, persons Education

3MMD2 OPEN ELECTIVE (ii) INDUSTRIAL SAFETY

Course Objectives:
1. To impart knowledge on safety engineering fundamentals and safety management practices.
2. To provide information regarding different elements of industrial water pollution and methods of treatment.
3. To understand about mechanical, electrical and chemical safety
4.To understand controlling of fire by various means
5. To expose to the various industrial applications, maintenance, preventive measures taken

Course Outcomes:
1. Know how to take safety measures in executing works
2. Identify the need for maintenance (or) replacement of equipment
3. Understand the need for periodic and preventive maintenance
4. Identify and prevent chemical, environmental mechanical, fire hazard through analysis
5. Apply proper safety techniques on safety engineering and management.

SECTION-A

Unit-I: Industrial safety: Accident, causes, types, results and control, mechanical and electrical hazards, types, causes and preventive steps/procedure, describe salient points of factories act 1948 for health and safety, wash rooms, drinking water layouts, light, cleanliness, fire, guarding, pressure vessels, etc, Safety color codes. Fire prevention and fire fighting, equipment and methods.

Unit-II: Fundamentals of maintenance engineering: Definition and aim of maintenance engineering, Primary and secondary functions and responsibility of maintenance department, Types of maintenance, Types and applications of tools used for maintenance, Maintenance cost & its relation with replacement economy, Service life of equipment.

Unit-III: Wear and Corrosion and their prevention: Wear- types, causes, effects, wear reduction methods, lubricants-types and applications, Lubrication methods, general sketch, working and applications, i. Screw down grease cup, ii. Pressure grease gun, iii. Splash lubrication, iv. Gravity lubrication, v. Wick feed lubrication vi. Side feed lubrication, vii. Ring lubrication, Definition, principle and factors affecting the corrosion. Types of corrosion, corrosion prevention methods.

SECTION-B

Unit-IV: Fault tracing: Fault tracing-concept and importance, decision tree concept, need and applications, sequence of fault finding activities, show as decision tree, draw decision tree for problems in machine tools, hydraulic, pneumatic, automotive, thermal and electrical equipment's like, I. Any one machine tool, ii. Pump iii. Air compressor, iv. Internal combustion engine, v. Boiler, vi. Electrical motors, Types of faults in machine tools and their general causes.

Unit-V: Periodic and preventive maintenance: Periodic inspection-concept and need, degreasing, cleaning and repairing schemes, overhauling of mechanical components, overhauling of electrical motor, common troubles and remedies of electric motor, repair complexities and its use, definition, need, steps and advantages of preventive maintenance. Steps/procedure for periodic and preventive maintenance of: (i). Machine tools, (ii). Pumps, (iii). Air compressors, iv. Diesel generating (DG) sets, Program and schedule of preventive maintenance of mechanical and electrical equipment, advantages of preventive maintenance. Repair cycle concept and importance.

Books Recommended:

1. Maintenance Engineering Handbook, Higgins & Morrow, Da Information Services.
2. Maintenance Engineering, H. P. Garg, S. Chand and Company.
3. Pump-hydraulic Compressors, Audels, Mc-graw Hill Publication.
4. Foundation Engineering Handbook, Winterkorn, Hans, Chapman & Hall London

3MMD2 OPEN ELECTIVE (iii) OPERATIONS RESEARCH

Course Objectives:

1. Understand the methodology, model formulation of OR problem solving
2. Formulate linear programming problem and finding solutions
3. Understand Non-linear programming problem and CPM/PERT
4. Understand project management techniques help in planning and scheduling a project
5. Understand basics of dynamic programming and simulation

Course Outcomes:

1. Apply the optimization techniques to solve problems of variables
2. Apply the concept of non-linear programming
3. Carry out sensitivity analysis
4. Apply project management techniques help in planning and scheduling a project
5. Apply sequencing and inventory control models models.
6. Model the real world problem and simulate it.

SECTION-A

Unit I: Optimization Techniques, Model Formulation, models, General L.R Formulation, Simplex Techniques, Sensitivity Analysis, Inventory Control Models.

Unit II: Formulation of a LPP - Graphical solution revised simplex method - duality theory - dual simplex method - sensitivity analysis - parametric programming.

Unit III:Nonlinear programming problem - Kuhn-Tucker conditions min cost flow problem - max flow problem - CPM/PERT

SECTION-B

Unit IV: Scheduling and sequencing - single server and multiple server models - deterministic inventory models - Probabilistic inventory control models - Geometric Programming.

Unit V: Competitive Models, Single and Multi-channel Problems, Sequencing Models, Dynamic Programming, Flow in Networks, Elementary Graph Theory, Game Theory Simulation.

Books Recommended:

1. H.A. Taha, Operations Research, An Introduction, PHI, 2008
2. H.M. Wagner, Principles of Operations Research, PHI, Delhi, 1982.
3. J.C. Pant, Introduction to Optimisation: Operations Research, Jain Brothers, Delhi, 2008
4. Hitler Libermann Operations Research: McGraw Hill Pub. 2009
5. Pannerselvam, Operations Research: Prentice Hall of India 2010
6. Harvey M Wagner, Principles of Operations Research: Prentice Hall of India 2010.

3MMD2 OPEN ELECTIVE (iv) COST MANAGEMENT OF ENGINEERING PROJECTS

Course Objectives:
1. To attain knowledge in Cost Management process and Costing System.
2. Ability to understand the basic concepts of Project planning, execution, and cost control
3. Discuss about Various types of costs and its behaviour along with Quality Management
4. Identify various types of Budgets involved in Cost Management process
5. Broaden the career potential of available techniques and problems available in Cost Management.

Course Outcomes:
1. Discuss various construction costs to manage a construction project.
2. Summarize different construction activities and its application related to cost based on the fieldrequirements.
3. Identify Cost Behavior of various types of cost and Quality Management
4. Identifying various construction Budgets involved Cost Management process.
5. Discussing various types of Techniques and Problem-solving techniques involved in Construction

SECTION-A

Unit-I: Introduction and Overview of the Strategic Cost Management Process Cost concepts in decision-making; Relevant cost, Differential cost, Incremental cost and Opportunity cost. Objectives of a Costing System; Inventory valuation; Creation of a Database for operational control; Provision of data for Decision-Making.

Unit-II: Project: meaning, Different types, why to manage, cost overruns centres, various stages of project execution: conception to commissioning. Project execution as conglomeration of technical and nontechnical activities. Detailed Engineering activities. Pre project execution main clearances and documents Project team: Role of each member. Importance Project site: Data required

with significance. Project contracts. Types and contents. Project execution Project cost control. Bar charts and Network diagram. Project commissioning: mechanical and process.

Unit-III: Cost Behavior and Profit Planning Marginal Costing; Distinction between Marginal Costing and Absorption Costing; Break-even Analysis, Cost-Volume-Profit Analysis. Various decision-making problems. Standard Costing and Variance Analysis.

SECTION-B

Unit-IV: Pricing strategies: Pareto Analysis. Target costing, Life Cycle Costing. Costing of service sector. Just-in-time approach, Material Requirement Planning, Enterprise Resource Planning, Total Quality Management and Theory of constraints. Activity-Based Cost Management, Bench Marking; Balanced Score Card and Value-Chain Analysis.

Unit-V: Budgetary Control; Flexible Budgets; Performance budgets; Zero-based budgets. Measurement of Divisional profitability pricing decisions including transfer pricing.

Unit-VI: Quantitative techniques for cost management, Linear Programming, PERT/CPM, Transportation problems, Assignment problems, Simulation, Learning Curve Theory.

Books Recommended:
1. Cost Accounting A Managerial Emphasis, Prentice Hall of India, New Delhi
2. Charles T. Horngren and George Foster, Advanced Management Accounting
3. Robert S Kaplan Anthony A. Alkinson, Management & Cost Accounting
4. Ashish K. Bhattacharya, Principles & Practices of Cost Accounting A. H. Wheeler publisher
5. N.D. Vohra, Quantitative Techniques in Management, Tata McGraw Hill Book Co. Ltd.

3MMD2 OPEN ELECTIVE (v) COMPOSITE MATERIALS

Course Objectives:
1. Introduce modern composite materials and their applications and classification.
2. Equip with knowledge on composite strengthening addition of components and their production routes.
3. Train to be able to design composite structures, select composite materials.
4. Understand process of development of different composite materials with advances manufacturing techniques
5. Develop an understanding of the linear elastic analysis of composite materials.
6. Familiarize about the properties and response of composite structures subjected to mechanical loading.

Course Outcomes:
1. Explain the advantages and applications of composite materials.
2. Describe the properties of various reinforcements of composite materials.
3. Summarize the manufacture of metal matrix, ceramic matrix and C-C composites.
4. Describe the manufacture of polymer matrix composites.
5. Formulate the failure theories of composite materials.

SECTION-A

UNIT I: **Introduction**: Definition – Classification and characteristics of Composite materials. Advantages and application of composites. Functional requirements of reinforcement and matrix. Effect of reinforcement (size, shape, distribution, volume fraction) on overall composite performance.

UNIT II: REINFORCEMENTS: Preparation-layup, curing, properties and applications of glass fibers, carbon fibers, Kevlar fibers and Boron fibers. Properties and applications of whiskers, particle reinforcements. Mechanical Behavior of composites: Rule of mixtures, Inverse rule of mixtures. Iso-strain and Iso-stress conditions.

UNIT III: Manufacturing of Metal Matrix Composites: Casting – Solid State diffusion technique, Cladding – Hot isostatic pressing. Properties and applications. Manufacturing of Ceramic Matrix Composites: Liquid Metal Infiltration – Liquid phase sintering. Manufacturing of Carbon – Carbon composites: Knitting, Braiding, Weaving. Properties and applications.

SECTION-B

UNIT–IV: Manufacturing of Polymer Matrix Composites: Preparation of Moulding compounds and prepregs – hand layup method – Autoclave method – Filament winding method – Compression moulding – Reaction injection moulding. Properties and applications.

UNIT–V: Strength: Laminar Failure Criteria-strength ratio, maximum stress criteria, maximum strain criteria, interacting failure criteria, hygrothermal failure. Laminate first play failure-insight strength; Laminate strength-ply discount truncated maximum strain criterion; strength design using caplet plots; stress concentrations.

Books Recommended:

1. Material Science and Technology – Vol 13 – Composites by R.W.Cahn – VCH, West Germany.
2. Materials Science and Engineering, An introduction. WD Callister, Jr., Adapted by R. Balasubramaniam, John Wiley & Sons, NY, Indian edition, 2007.
3. Hand Book of Composite Materials-ed-Lubin.
4. Composite Materials – K.K.Chawla.
5. Composite Materials Science and Applications – Deborah D.L. Chung.
6. Composite Materials Design and Applications – Danial Gay, Suong V. Hoa, and Stephen W. Tasi.

3MMD2 OPEN ELECTIVE (vi) WASTE TO ENERGY

Course Objectives:

1. To enable students to understand of the concept of waste to energy.
2. To link legal, technical and management principles for production of energy form waste.
3. To learn about the best available technologies for waste to energy.
4. To analyze of case studies for understanding success and failures.

Course Outcomes:

1. Apply the knowledge about the operations of waste to energy plants.
2. Analyse the various aspects of waste to energy management systems.
3. Carry out Techno-economic feasibility for waste to energy plants.
4. Apply the knowledge in planning and operations of waste to energy plants.

SECTION-A

Unit-I: Introduction to Energy from Waste: Classification of waste as fuel – Agro based, Forest residue, Industrial waste - MSW – Conversion devices – Incinerators, gasifiers, digestors.

Unit-II: Biomass Pyrolysis: Pyrolysis – Types, slow fast – Manufacture of charcoal – Methods - Yields and application – Manufacture of pyrolytic oils and gases, yields and applications.

Unit-III: Biomass Gasification: Gasifiers – Fixed bed system – Downdraft and updraft gasifiers – Fluidized bed gasifiers – Design, construction and operation – Gasifier burner arrangement for thermal heating – Gasifier engine arrangement and electrical power – Equilibrium and kinetic consideration in gasifier operation.

SECTION-B

Unit-IV: Biomass Combustion: Biomass stoves – Improved chullahs, types, some exotic designs, Fixed bed combustors, Types, inclined grate combustors, Fluidized bed combustors, Design, construction and operation - Operation of all the above biomass combustors.

Unit-V: Biogas: Properties of biogas (Calorific value and composition) - Biogas plant technology and status - Bio energy system - Design and constructional features - Biomass resources and their classification - Biomass conversion processes - Thermo chemical conversion - Direct combustion - biomass gasification - pyrolysis and liquefaction - biochemical conversion - anaerobic digestion - Types of biogas Plants – Applications - Alcohol production from biomass - Bio diesel production - Urban waste to energy conversion - Biomass energy programme in India.

Books Recommended:

1. Non Conventional Energy, Desai, Ashok V., Wiley Eastern Ltd., 1990.
2. Biogas Technology - A Practical Hand Book - Khandelwal, K. C. and Mahdi, S. S., Vol. I & II, Tata McGraw Hill Publishing Co. Ltd., 1983.
3. Food, Feed and Fuel from Biomass, Challal, D. S., IBH Publishing Co. Pvt. Ltd., 1991.
4. Biomass Conversion and Technology, C. Y. WereKo-Brobby and E. B. Hagan, John Wiley & Sons, 1996

3MMD3 Dissertation Phase-I (SEMESTER-III) and 4MMD1Dissertation Phase-II (SEMESTER-IV)

Course Objectives:

1. Ability to synthesize knowledge and skills previously gained and applied to an in-depth studyand execution of new technical problem.
2. Capable to select from different methodologies, methods and forms of analysis to produce asuitable research design, and justify their design.
3. Ability to present the findings of their technical solution in a written report.
4. Presenting the work in International/ National conference or reputed journals.

Course Outcomes:

1. Design a research investigation that incorporates appropriate theoretical approaches, conceptual models, and a review of the existing literature.
2. Structure a discussion in a coherent and convincing way by summarizing the key arguments and providing suitable and coherent findings.
3. Draw valid conclusions, relating them to the research topic.
4. Write a comprehensive review of the literature, including a review of other dissertation research related to their study.
5. Develop a design of their study with a discussion of the methodology to be used. Students describe how their data will be treated and analyzed of their study.

Syllabus Contents:

The dissertation / project topic should be selected / chosen to ensure the satisfaction of the urgentneed to establish a direct link between education, national development and productivity and thusreduce the gap between the world of work and the world of study. The dissertation should have thefollowing:

- Relevance to social needs of society
- Relevance to value addition to existing facilities in the institute
- Relevance to industry need
- Problems of national importance
- Research and development in various domains.

The student should complete the following:

- Literature survey Problem Definition
- Motivation for study and Objectives
- Preliminary design / feasibility / modular approaches
- Implementation and Verification
- Report and presentation

The dissertation stage II is based on a report prepared by the students on dissertation allotted to them.

It may be based on:

- Experimental verification / Proof of concept.
- Design, fabrication, testing of Communication System.
- The viva-voce examination will be based on the above report and work.

Guidelines for Dissertation Phase- I and II

• As per the AICTE directives, the dissertation is a yearlong activity, to be carried out andevaluated in two phases i.e. Phase – I: July to December and Phase – II: January to June.

• The dissertation may be carried out preferably in-house i.e. department's laboratories andcenters OR in industry allotted through department's T & P coordinator.

• After multiple interactions with guide and based on comprehensive literature survey, thestudent shall identify the domain and define dissertation objectives. The referred literature shouldpreferably include Springer/Science Direct. In case of Industry sponsored projects, the relevantapplication notes, while papers, product catalogues should be referred and reported.

• Student is expected to detail out specifications, methodology, resources required, criticalissues involved in design and implementation and phase wise work distribution, and submit theproposal within a month from the date of registration.

• Phase-I deliverables: A document report comprising of summary of literature survey,detailed objectives, project specifications, paper and/or computer aided design, proof ofconcept/functionality, part results, A record of continuous progress.

• Phase-I evaluation: A committee comprising of guides of respective specialization shallassess the progress/performance of the student based on report, presentation and Q & A. In case ofunsatisfactory performance, committee may recommend repeating the phase-I work.

• During Phase-II, student is expected to exert on design, development and testing of theproposed work as per the schedule. Accomplished results/contributions/innovations should bepublished in terms of research papers in reputed journals and reviewed focused conferences ORIP/Patents.

• Phase-II deliverables: A dissertation report as per the specified format, developed system inthe form of hardware and/or software, A record of continuous progress.

• Phase-II evaluation: Guide along with appointed external examiner shall assess the progress / performance of the student based on report, presentation and Q & A. In case of unsatisfactory performance, committee may recommend for extension or repeating the work.

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