



SATHYABAMA

INSTITUTE OF SCIENCE AND TECHNOLOGY
(DEEMED TO BE UNIVERSITY)

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School of Mechanical Engineering

Department of Mechanical Engineering

1.1.2 Revised and new Courses Introduced in 2023-2024

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1	SMEA3024	Lean Manufacturing	5
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Minutes of meeting of Board of Studies Virtual meet held on 7th June 2023
The following Members are participated in the meeting:

1. Dr.L. Vijayaraghavan, Professor- IIT Madras - External Member
2. Er. James Michael Amulu, Director- SAP Research- Walldorf, Baden-Württemberg, Germany - External Member
3. Dr.S. Ganesan, Professor and Head- Mechanical Engineering - Internal Member
4. Dr.G. Arunkumar, Professor – Mechanical Engineering- Internal Member
5. Dr.S.P. Venkatesan, Associate Professor- Mechanical Engineering - Internal Member
6. Dr.G. Senthilkumar, Associate Professor- Mechanical Engineering - Internal Member
7. Dr. J. Jayaprabhakar, Associate Professor- Mechanical Engineering- Internal Member
8. Ms. Sanjana Kallat, Alumni- External Member.

The Chair Person welcomed the members of BOS and placed the agenda for the thoughts of the members. The following deliberations were made as per the items of the circulated agenda.

1. Agenda item # 1 Addition of new Course for Bachelors of Engineering– Mechanical Engineering

The Head of the department highlighted the feedback received from the Alumni for the inclusion of new course to focus on emerging technologies and the suggestion from Dr.L. Vijayaraghavan and Er. James Michael Amulu suggested Lean Enterprises and Advanced Manufacturing Technology. Based on BOS members suggestion, Department proposed the following new elective courses for the incorporation from 2021 batch onwards.

Course 1: LEAN MANUFACTURING

Resolutions:

The BOS resolved to recommend for approval of the suggested courses for inclusion in B.E Programme of Mechanical Engineering.

Agenda item # 2 Modifications proposed for 2021 batch Bachelors of Engineering– Mechanical Engineering course syllabus:

Head of the department informed that the need of revising the syllabus of SMEA1501– CAD/CAM, as per the recent advancements in the field and the following modifications have been considered.

Inclusion of the following topics in Unit IV: NC, DNC and CNC machine tools. NC Programming: point to point and continuous path machining approaches, G Codes, M Codes, Canned cycles, Manual NC programming for turning and milling operations.

Use of computer applications in inspection, rapid prototyping, material handling and other manufacturing related tasks.

Inclusion of the following topics in Unit V: Computer Aided Process Planning (CAPP): Traditional process planning, Benefits of CAPP, Variant and Generative approaches. Computer integrated production system (CIPS): Traditional production planning, Benefits of CIPS, Master production Schedule, Material Requirement Planning, Inventory Management, Capacity planning, Shop floor control.

Resolutions: The External members considered the revision as necessary as it broadly involved in manufacturing sector. The changes mentioned under inclusion had been approved by all and modification in curriculum had been reflected. Also, it was decided to implement for 2021 batch onwards.

3. Agenda item #_3 Addition of Skill in the professional domains in order to promote industry ready competency among learners. Necessity of introduction of certification courses from competent Government authorities for improving the domain knowledge and thus improving core placement counts.

Head pointed out that the workshop offered by the Department such as trends in Mechanical Engineering and Computational Fluid Dynamics.

Resolutions: The BoS members appreciated the same and suggested to follow in future also for making the industry ready competency among the students.

4. Agenda item # 4 Any other points with the permission of Chair -Academic flexibilities with extra credits acquired through either advanced study of some courses or with accumulation of additional credits from additional courses as per students' choice.

Head asked for the suggestions from the External members for students pursuing different specialization.

Resolutions: The BoS recommended that NPTEL courses. It can be selected based on the student's specialization. Also recommend that the students can select the courses at the end of the fourth semester subject to the condition prescribed by the Board of Management time to time. With the above discussion, the Head expressed his deep sense of gratitude to all members for an academic vibrant discussion on various matters. Since there was no other agenda, the meeting ended with the Vote of thanks to the Chair.

Member	Designation	Signature
Dr.L.Vijayaraghavan	Professor, IIT Madras	
Er.James Michael Amulu	Director, SAP Research-Walldorf, Baden-Württemberg, Germany	
Dr.S.Ganesan	Professor and Head	
Dr.G.Arunkumar	Professor	
Dr.S.P.Venkatesan,	Associate Professor	
Dr.G.Senthilkumar	Associate Professor	
Dr. J.Jayaprabakar	Associate Professor	
Ms. Sanjana Kallat	External Member (Alumni)	

Addition of new Courses for Bachelors of Engineering– Mechanical Engineering

SMEA3024	LEAN MANUFACTURING	L	T	P	Credits	Total Marks
		3	0	0	3	100

Course Objectives:

- To introduce the students the lean manufacturing concepts
- To understand group technology and use of it for part identification
- To understand value stream mapping in lean manufacturing.
- To teach the tools and method used in lean manufacturing
- To introduce concept of Total Productive Maintenance and other system

UNIT I INTRODUCTION

14

Origins and objectives of lean manufacturing – lean process, 3M concept key principles and implications of lean manufacturing – traditional Vs lean manufacturing characteristics– roadmap for lean implementation and lean benefits - study of Ford and Toyota production systems - JIT manufacturing, Lean building blocks. Lean Manufacturing Concepts: Value creation and waste elimination – seven types of waste – pull production-different models of pull production -the Kanban system-continuous flow-the continuous improvement process / Kaizen- Worker involvement. Design of Kanban quantities – Leveled production - tools for continuous improvement.

UNIT II GROUP TECHNOLOGY AND CELLULAR LAYOUT

7

JIT with cell manufacturing – part families- production flow analysis – Composite part concept - machine cell design – quantitative analysis – case studies – single piece flow

UNIT III VALUE STREAM MAPPING

7

The value stream– benefits mapping process - the current state map–mapping icons - mapping steps. VSM exercises - Takt time calculations.

UNIT IV LEAN MANUFACTURING TOOLS AND METHODOLOGIES

9

Standardized work–standard work sequence timing and working progress. Quality at source-Automation / Jidoka, Visual management system, Mistake proofing / Poka-Yoke. 5S technique – Elements and waste elimination through 5S, advantages and benefits - 5S-audit - visual control aids for improvement, flexible work force

UNIT V TOTAL PRODUCTIVE MAINTENANCE

9

Goals and benefits – Hidden factory, the six big losses, types of maintenance. Overall equipment effectiveness - pillars of TPM and implementation. Change over and set up timer education techniques. Temple of quality, OEE calculations. Reconciling Lean with Other Systems: Study of lean Six-sigma and lean design – lean and ERP- lean with ISO9001:2000 - administrative lean.

TOTAL: 45 PERIODS

Course Outcomes:

CO1: Ability to implement lean manufacturing concepts in industries CO2: Ability to group the parts in manufacturing

CO3: Ability to apply value stream in mapping. CO4: Ability to use the lean manufacturing tools CO5: Ability to use the lean manufacturing methods

CO6: Ability to apply total productive maintenance concepts in industries.

TEXT BOOKS:

1. Michael Wader, “Lean Tools: A Pocket guide to Implementing Lean Practices”, Productivity and Quality Publishing, 2002.
2. William M Feld, “Lean Manufacturing: Tools, Techniques and How to use them”, APICS, 2001

3. Dennis P Hobbs, "Lean Manufacturing Implementation", Narosa Publications, 2004
4. Gopalakrishnan N, "Simplified Lean Manufacture", PHI Learning Pvt Ltd, 2010

REFERENCES:

1. Richard B Chase, "Production and Operations Management", McGraw Hill, 2003
 2. Taiichi Ohno, "Toyota Production Systems: Beyond Large Scale Production", Productivity Press, 1988.
 3. Askin R G and Goldberg J B, "Design and Analysis of Lean Production Systems", John Wiley and Sons, 2003.
 4. Mahadevan B, "Operations Management", Pearson, 2010
- Note: (Use of P S G Design Data Book is permitted in the University examination)

END SEMESTER EXAM QUESTION PAPER PATTERN

Max. Marks: 100

Exam Duration: 3 Hrs.

PART A: 10 Questions of 2 marks each-No choice

20 Marks

PART B: 2 Questions from each unit with internal choice, each carrying 16 marks

80 Marks



New Courses for 2021 batch Bachelors of Engineering– Mechanical Engineering course syllabus

Modifications proposed for 2021 batch Bachelors of Engineering– Mechanical

Engineering

SMEA1501	CAD/CAM	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVES

- To provide the fundamental information about computer graphics, elements of CAD/CAM and basic understanding about transformations, clipping, windowing and hidden line removal.
- To provide understanding of various wireframe, surface and solid modelling techniques used for generating computer models.
- To provide the details on how computer applications are used directly and indirectly for the manufacturing applications.

UNIT 1 FUNDAMENTALS OF CAD/CAM

9 Hrs.

Introduction: Elements of CAD, Elements of CAM, CAD/CAM integration, Advantages and applications. Computer graphics: Input and output devices, CAD/CAM databases, Requirements of Computer graphics packages. Transformations: Geometric transformation versus viewing transformation, Basic transformation matrices, such as translation, rotation and scaling.

UNIT 2 GEOMETRIC MODELLING - I

9 Hrs.

Wireframe modelling of analytical curves, such as line, circle and conics, and synthetic curves, such as Hermite cubic spline, Bezier curve and B-Spline curve. Surface modelling of analytical surfaces, such as plane surface, ruled surface, surface of revolution and tabulated cylinder, and synthetic surfaces, such as Hermite cubic surface, Bezier surface and B-Spline surface.

UNIT 3 GEOMETRIC MODELING - II

9 Hrs.

Solid modelling techniques: Constructive solid geometry (CSG) representation and Boundary representation. Assembly modelling: Assembly of part drawing, Approaches, Interferences of positions and orientation. Graphics standards: Product data exchange, File format of DXF, IGES and STEP files. Capabilities of modelling & analysis packages.

UNIT 4 COMPUTER AIDED MANUFACTURING - I

9 Hrs.

Manufacturing process data system integration of process data. Manufacturing Planning and Control - CAD/CAM Integration - Principles of Computer Integrated computer structures and networking Structure of manufacturing process control strategies. General configuration of an adaptive control system. NC, DNC and CNC machine tools. NC Programming: point to point and continuous path machining approaches, G Codes, M Codes, Canned cycles, Manual NC programming for turning and milling operations. Use of computer applications in inspection, rapid prototyping, material handling and other manufacturing related tasks.

UNIT 5 COMPUTER AIDED MANUFACTURING - II

9 Hrs.

Computer Aided Process Planning (CAPP): Traditional process planning, Benefits of CAPP, Computer Integrated Production Management System - Master Production Schedule - Material Requirement Planning - Inventory Management - Manufacturing and Design Data Base - Capacity Planning - Shop Floor Control - Functions - Order release - Order Scheduling - Order progress - Factory data collection. Variant and Generative approaches. Computer integrated production system (CIPS): Traditional production planning, Benefits of CIPS, Master production Schedule, Material Requirement Planning, Inventory Management, Capacity planning, Shop floor control.

Max. 45 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

- CO1 - Interpret how the basic transformation operations are applied for the geometric and viewing transformations in a CAD environment.
- CO2 - Interpret how the analytic and synthetic curves are generated using the parametric representations in a CAD environment.
- CO3 - Interpret how the analytic and synthetic surfaces are generated using the parametric representations in a CAD environment.
- CO4 - Sketch the 3D model of a given part drawing step by step using a 3D modeling representation technique.
- CO5 - Write the manual NC programming using the FANUC standard NC code library for the given part drawing.
- CO6 - Suggest the appropriate computer aids for the phases of manufacturing and control activities for the stated industrial application.

TEXT / REFERENCE BOOKS

1. Ibrahim Zeid and R. Sivasubramanian, "CAD/CAM: Theory and Practice: Special Indian Edition", 2nd Edition, McGraw Hill Education, 2009.
2. M. Groover and E. Zimmers, "CAD/CAM Computer-Aided Design and Manufacturing", 1st Edition, Pearson Education, 2003.

3. Donald D. Hearn and M. Pauline Baker, "Computer Graphics, C Version", 2nd Edition, Pearson Education, 2014.
4. John F. Hughes, Andries van Dam, Morgan McGuire, David F. Sklar, James D. Foley, Steven K. Feiner and Kurt Akeley, "Computer Graphics: Principles and Practice", 3rd Edition, Pearson Education India, 2013.
5. Mikell P Groover, "Automation, Production Systems, and Computer-Integrated Manufacturing", 4th Edition, Pearson Education, 2014.
6. Mike Mattson, "CNC Programming: Principles and Applications", 1st Edition, Delmar, 2013.
7. M. Adithan and B.S. Pable, "CNC Machines", 3rd Edition, New Age International Publishers, 2018.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100

Exam Duration: 3 Hrs.

PART A: 2 Questions each from CO1-CO4, 1 question each from CO5 and CO6 – No choice

20 Marks

PART B: 4 Questions each with internal choice from CO1-CO4, 1 question from CO5 and CO6
with internal choice, each carrying 16 marks

80 Marks



Modifications proposed for 2021 batch Bachelors of Engineering– Mechanical Engineering course syllabus



Portions deleted from 2015 regulation BE– Mechanical Engineering course syllabus

Modifications proposed for 2022 batch Bachelors of Engineering– Mechanical Engineering

SMEA1302	ENGINEERING THERMODYNAMICS	L	T	P	Credits	Total Marks
		3	*	0	3	100

COURSE OBJECTIVES

- Y To understand the basic concepts of thermodynamics.
- Y To comprehend laws of thermodynamics and apply it to the related processes.
- Y Perform thermal analysis on behavior and performance of systems.

UNIT 1 BASIC CONCEPTS AND FIRST LAW OF THERMODYNAMICS

9 Hrs.

Basic concepts - concept of continuum, microscopic and macroscopic approach. Thermodynamic systems - closed, open and isolated. Thermodynamic Equilibrium, Property, state, path and process, quasi-static process and irreversible processes, heat and work, modes of work. Zeroth law of thermodynamics- concept of temperature and thermal equilibrium. Concept of ideal and real gases. First law of thermodynamics - application to closed and open systems, internal energy, specific heat capacities, enthalpy, steady flow process with reference to various thermal equipments.

UNIT 2 SECOND LAW OF THERMODYNAMICS AND ENTROPY

9 Hrs.

Second law of thermodynamics - Kelvin's and Clausius statements. Reversibility and irreversibility. Heat Engine, Refrigerator, Heat pump, Carnot theorem, Carnot cycle, reversed Carnot cycle, efficiency, COP. Thermodynamic temperature scale, Clausius inequality, concept of entropy, entropy of ideal gas, principle of increase of entropy. Available and Unavailable energy -Availability of non-flow and steady flow systems-Irreversibility and second law efficiency.

UNIT 3 PROPERTIES OF PURE SUBSTANCES

9 Hrs.

Properties of pure substances - Thermodynamic properties of pure substances in solid, liquid and vapour phases, phase rule, P-V, P-T, T-V, T-S, H-S diagrams, PVT surfaces. Thermodynamic properties of steam, Dryness fraction and its determination by separating and throttling calorimeter, Calculations of work done and heat transfer in non-flow and flow processes. **Ideal and actual Rankine cycles, Cycle Improvement Methods - Reheat and Regenerative cycles-Binary Vapour cycles.**

UNIT 4 IDEAL AND REAL GASES, GAS MIXTURES AND THERMODYNAMIC RELATIONS

9 Hrs.

Properties of ideal and real gases - Equations of state for ideal and real gases - compressibility factor - compressibility chart. Properties of gas mixture. Exact differentials - Maxwell's relations-T-ds relations - Difference and ratio of heat capacities-Clausius Clapeyron equations - Joule Thomson effect.

UNIT 5 FUELS AND COMBUSTION

9 Hrs.

Types of fuel, Combustion equations, Stoichiometric air, Excess air, Air-fuel ratio by volume & weight. Calorific value - HCV & LCV. Bomb and Boy's gas calorimeter, Proximate and ultimate analysis of fuel-mass basis and volume basis, analysis of exhaust and flue gases.

UNIT 5 PSYCHROMETRY

9 Hrs.

Psychrometric properties, Psychrometric charts. Property calculations of air vapour mixtures by using chart and expressions. Psychrometric process - adiabatic saturation, sensible heating and cooling, humidification, dehumidification, evaporative cooling and adiabatic mixing. Simple Calculations & Applications.

Max. 45 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

- CO1 - Apply the first law of thermodynamics for simple open and closed systems under steady and unsteady conditions.
- CO2 - Apply second law of thermodynamics to open and closed systems and calculate entropy and availability.
- CO3 - Summarize the thermodynamic properties of gases and steam and apply it to related system analysis.
- CO4 - Derive simple thermodynamic relations of ideal and real gases.
- CO5 - Calculate the properties of gas mixtures and apply it to related system analysis.
- CO6 - Calculate the properties of moist air and its use in psychrometric processes.

TEXT / REFERENCE BOOKS

1. Nag.P.K, Engineering Thermodynamics, 6th Edition, Tata McGraw-Hill, 2017.
2. R.K.Rajput, A Textbook of Engineering Thermodynamics, 5th Edition, Laxmi Publications, 2016.
3. Onkar Singh, Applied Thermodynamics, 4th Edition, New Age International Private Limited, 2018.
4. Chattopadhyay, P, "Engineering Thermodynamics", Oxford University Press, 2016.
5. Yunus A Cengel and Michael A Boles, Thermodynamics: An Engineering Approach, 8th Edition, McGraw Hill, 2017.
6. Claus Borgnakke, Richard E. Sonntag, Fundamentals of Thermodynamics, 8th Edition, Wiley, 2016.
7. Lynn D. Russell, George A. Adebisi, Engineering Thermodynamics, 6th Edition, Oxford University Press, New Delhi, 2008.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks : 100

PART A : 10 Questions of 2 marks each - No choice

PART B : 2 Questions from each unit with internal choice, each carrying 16 marks

Exam Duration : 3 Hrs.

20 Marks

80 Marks

 → Modifications proposed for 2022 batch Bachelors of Engineering– Mechanical Engineering course syllabus

 → Portions deleted from 2015 regulation BE– Mechanical Engineering course syllabus

Modifications proposed for 2022 batch Bachelors of Engineering– Mechanical Engineering.

SMEA1303	FLUID MECHANICS AND MACHINERY	L	T	P	Credits	Total Marks
		3	*	0	3	100

COURSE OBJECTIVES

- Y To understand the fluid properties, flow characteristics and hydrostatic force on surfaces.
- Y To study the equation of motions such as mass, momentum and energy equation and their practical applications.
- Y To understand the functioning and characteristic curves of hydraulic machines.

UNIT 1 FLUID PROPERTIES

9 Hrs.

Fluid Properties: Density-Specific Weight-Specific Gravity-viscosity-surface tension-capillarity-Vapour pressure-compressibility. Fluid Static: Hydrostatic Law-Pressure Variation in static fluid-Hydrostatic force on a submerged plane surfaces-Location of hydrostatic force. Manometers-Simple, U tube and differential Manometers. Buoyancy-Meta centric height-determination of stability of floating bodies and submerged bodies.

UNIT 2 EQUATIONS OF MOTION

9 Hrs.

Basic equations of motion: Types of fluid flow-Concept of Control Volume- Control Volume Analysis of mass, momentum and energy. Differential equation of continuity and momentum - Euler's and Bernoulli's Equation and its applications. Flow Measurement: Orifice meter, Venturi meter, Piezometer, Pitot tube.

UNIT 3 LAMINAR AND TURBULENT FLOW FLOW THROUGH ORIFICE, NOTCHES, WEIRS AND PIPES

9 Hrs.

Hydraulic co-efficient-Flow through orifice, Notches and weirs. Flow through rectangular orifice, Notches and weirs Laminar and Turbulent flow-Reynolds experiment-laminar flow through circular pipe (Hagen poiseuille's)-Major and minor losses in pipes-Darcy weisbach's equation, chezy's formula- friction factor- moody diagram-pipes in series and pipes in parallel-total energy line-hydraulic gradient line-Equivalent pipe. Concept of Boundary Layer-Types of boundary layer thickness-drag on flat plate.

UNIT 4 PUMPS

9 Hrs.

Impact of jets - Theory of roto-dynamic machines - various efficiencies-velocity components at entry and exit of the rotor- velocity triangles Centrifugal Pumps: Introduction-Definitions of heads and efficiencies-Operations-work done by the Impeller with Velocity triangles-Performance curves-Cavitations-Multi-staging: Pumps in Series and Parallel. Reciprocating Pumps: Operation- power required driving the pump-Slip- indicator Diagram-Separation-Air vessels.

UNIT 5 TURBINES AND DIMENSIONAL ANALYSIS

9 Hrs.

Hydraulic Turbines: Classification of hydraulic turbines-Working principle of Pelton wheel, Francis and Kaplan turbines- velocity triangles-draft tube-hydraulic turbine characteristics. Governing of turbines. Dimensional Analysis: Needs and methods-Buckingham's π Theorem, Non-Dimensional Numbers, Similarities of flow. Model studies

Max. 45 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

- CO1 - Understand the properties of fluids and compute the fluid pressure in a pipe.
- CO2 - Analyze the Bernoulli's theorem and its engineering applications.
- CO3 - Evaluate and compare the hydraulic coefficients and energy losses in pipes.
- CO4 - Explain the working principle and operating characteristic curves of different types of pumps and estimate the power required.
- CO5 - Distinguish the working principle and operating characteristic curves of different types of turbines and compute the power developed.
- CO6 - Understand the methods of dimensional analysis and its application in model analysis.

TEXT / REFERENCE BOOKS

1. Bansal.R.K, Fluid Mechanics & Hydraulics Machines, 9th Edition, Laxmi Publications, 2015.
2. Modi P.N., Seth S.M., Hydraulics and Fluid Mechanics Including Hydraulic Machines, 21st Edition, Standard Book House, 2017.
3. Goyal, Manish Kumar, Fluid Mechanics and Hydraulic Machines, PHI Learning Pvt. Ltd., 2015.
4. Kumar K.L., Engineering Fluid Mechanics, 8th Edition, Eurasia Publication House (P) Ltd, 2014.
5. R. K. Rajput, Fluid Mechanics & Hydraulics Machines, 4th Edition, S. Chand Limited, 2008.
6. Yunus.A.Cengel, John.M.Cimbala, Fluid Mechanics Fundamentals and Application, 3rd Edition, Tata McGraw Hill, 2013.
7. Robert W. Fox, Alan T. McDonald, Philip J.Pritchard, John W.Mitchell, Fluid Mechanics, 9th Edition, Wiley India Edition, 2016.
8. Franck M.White, Fluid Mechanics, 8th Edition, Tata McGraw Hill Publication, 2015.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks : 100

Exam Duration : 3 Hrs.

PART A : 10 Questions of 2 marks each - No choice

20 Marks

PART B : 2 Questions from each unit of internal choice; each carrying 16 marks

80 Marks

 → Modifications proposed for 2022 batch Bachelors of Engineering– Mechanical Engineering course syllabus

 → Portions deleted from 2015 regulation BE– Mechanical Engineering course syllabus

Modifications proposed for 2021 batch Bachelors of Engineering– Mechanical Engineering

SMEA1502	DESIGN OF MACHINE ELEMENTS	L	T	P	Credits	Total Marks
	(FOR MECH AND MECHATRONICS)	3	*	0	3	100

COURSE OBJECTIVES

- To understand the various procedures involved in the design process based on strength requirements.
- To understand the design steps involved in evaluating the dimensions of a component to satisfy functional operation.
- To learn standard practices and standard data by using design data book and catalogues.
- To familiarize the use of data books and various codes for practice.

UNIT 1 STATIC STRESSES AND VARIABLE STRESSES IN MACHINE COMPONENTS

9 Hrs.

Introduction to the design process-factors influencing machine design, selection of materials based on mechanical properties - Preferred Numbers-Direct, Bending and torsional stress equations-Impact and shock loading- Principal stresses for various load -Factor of safety-Theories of failure- design based on strength and stiffness- stress concentration-Design for Variable loading –Gerber line, Goodman's line, and Soderberg's Line.

UNIT 2 DESIGN OF SHAFTS AND COUPLINGS

9 Hrs.

Design of solid and hollow shafts based on strength and rigidity, Keys- different types of keys- Design Keys, keyways, failures of keys-Couplings - Rigid coupling- flexible coupling

UNIT 3 TEMPORARY AND PERMANENT JOINTS

9 Hrs.

Threaded fasteners- stress in screwed threads, bolted joints including eccentric loading- Design of knuckle and cotter joints- Welded joints- merits and demerits of welded joints, Types of welded joints, weld symbols, Strength of parallel and fillet weld, strength of a welded joint, eccentrically loaded welded joints.

UNIT 4 DESIGN OF SPRINGS AND CONNECTING ROD

9 Hrs.

Functions of springs-applications- spring materials-Design of helical, Belleville springs (disc) and torsion spring–Design of Leaf Spring – Design of connecting rod.

UNIT 5 DESIGN OF BEARINGS FLYWHEELS

9 Hrs.

Introduction -Design of bearings - Sliding contact bearing – Cubic mean load - Design of journal bearings- McKees equation- Lubrication in journal bearings -Rolling contact bearing (antifriction bearing). Types of fly wheels- Design of flywheels involving stresses in rim and arm.

COURSE OUTCOMES

On completion of the course, student will be able to

- CO1 - Demonstrate and understand the various steps in design process.
- CO2 - Apply the design considerations on the basis of strength, rigidity and standardization.
- CO3 - Analyze and design bolted rivets, welded joints with respect to static and dynamic loads.
- CO4 - Apply the concept of energy absorbing members and connecting rod.
- CO5 - Analyze and apply the concept of bearings and flywheel.
- CO6 - Understand the various design process of machine parts.

TEXT / REFERENCE BOOKS

1. Juvinall R.C. and Marshek K.M., "Fundamentals of Machine Component Design", John Wiley & Sons, 2002.
2. Bhandari V.B., "Design of Machine Elements", Tata McGraw-Hill Book Co, 2003.
3. Norton R.L., "Design of Machinery", Tata McGraw-Hill Book Co., 2004.
4. Spotts M.F., Shoup T.E., "Design and Machine Elements", Pearson Education, 2004.
5. Kannaiah, P., Machine Design, 2nd Edition, SciTech Publication Pvt. Ltd., 2009.
6. Shigley, J.E and Mischke, C. R. Mechanical Engineering Design, 6th Edition, Tata McGraw Hill, 2005.
7. Sundararajamoorthy, T.V. and Shanmugam, N., Machine Design, Anuradha Agencies, 2015.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100

Exam Duration: 3 Hrs.

PART A: 10 Questions of 2 marks each - No choice

20 Marks

PART B: 2 Questions from each unit with internal choice, each carrying 16 marks

80 Marks

Modifications proposed for 2022 batch Bachelors of Engineering– Mechanical Engineering course syllabus

Portions deleted from 2015 regulation BE– Mechanical Engineering course syllabus

Modifications proposed for 2021 batch Bachelors of Engineering– Mechanical Engineering

SMEA1601	DESIGN OF TRANSMISSION SYSTEMS	L	T	P	Credits	Total Marks
		3	*	0	3	100

(Use of approved design data book is permitted)

COURSE OBJECTIVES

- Y To gain knowledge on the principles and procedure for the design of Mechanical power transmission components.
- Y To understand the standard procedures available for Design of Transmission Elements.
- Y To identify critical static and dynamic stresses in a mechanical component.
- Y To learn to use standard data from the design data book and catalogues.

UNIT 1 DESIGN OF FLEXIBLE DRIVES

9 Hrs.

Design of Flat belts and pulleys – Selection of V belts and pulleys – Selection of hoisting wire ropes and pulleys. Design of Transmission chains and Sprockets.

UNIT 2 SPUR GEARS AND PARALLEL AXIS HELICAL GEARS

9 Hrs.

Speed ratios and number of Teeth-Force analysis- Tooth stresses –Dynamic Effects-Fatigue Strength-Factor of Safety-Gear Materials-Design of Straight tooth spur and helical gears based on strength and wear considerations- Pressure angle in the normal and transverse plane –Equivalent number of teeth - Parallel axis Helical Gears - Forces for helical gears.

UNIT 3 BEVEL AND WORM GEARS

9 Hrs.

Straight bevel gear: Tooth terminology- Design of pair of straight bevel gears - Tooth forces and stresses Worm Gear: Merits and demerits- Terminology. Design of the worm and gear - Forces and stresses, efficiency.

UNIT 4 GEAR BOXES

9 Hrs.

Geometric progression - Standard step ratio - Ray diagram, kinematics layout -Design of sliding mesh gear box -Constant mesh gear box. - Design of multi speed gear box.

UNIT 5 INTRODUCTION TO FINITE ELEMENT METHOD

9 Hrs.

Basic concept of FEM- steps involved in FEM, shape function, mathematical modeling of one dimensional element- stepped bar, tapered bar-simple problems. Variational formulation and approximation- the Rayleigh-Ritz method, method of weighted residuals- simple problems

UNIT 5 CLUTCHES AND BRAKES

9 Hrs.

Design of plate clutches –Cone clutches – Centrifugal clutches- Electromagnetic clutches. Band and Block brakes- External shoe brakes – Internal expanding shoe brake.

Max. 45 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

- CO1 - Recognize the need for friction drives and positive drives.
- CO2 - Design of spur and helical gears.
- CO3 - Design Bevel and worm gears based on strength and wear consideration.
- CO4 - Design various types of gear boxes
- CO5 - Understand the Mechanical Design procedure of clutches and brakes
- CO6 - Design transmission components used in engine and machines

TEXT / REFERENCE BOOKS

- Bhandari V, "Design of machine elements", 4th Edition, Tata McGraw Hill Book Company, 2017.
- Joseph Shigley, Charles Mischke, Richard Budynas and Keith Nisbett – Mechanical.
- Engineering Design, 8th Edition, Tata McGraw-Hill, 2008.
- Prabhu. T.J., –Design of Transmission Elements, Mani Offset, Chennai, 2000.
- Sundararajamoorthy T. V, Shanmugam. N, –Machine Design, Anuradha Publications, Chennai, 2003.
- GitinMaitra, L. Prasad –Hand book of Mechanical Design, 2nd Edition, Tata McGraw-Hill, 2001.
- C.S. Sharma, Kamlesh Purohit, –Design of Machine Elements, Prentice Hall of India, Pvt. Ltd., 2003.
- Bernard Hamrock, Steven Schmid, Bo Jacobson, –Fundamentals of Machine Elements, 2nd Edition, Tata McGraw-Hill Book Co., 2006.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100

Exam Duration: 3 Hrs.

PART A: 10 Questions of 2 marks each – No choice

20 Marks

PART B: 2 Questions from each unit with internal choice, each carrying 16 marks

80 Marks

Modifications proposed for 2021 batch Bachelors of Engineering– Mechanical Engineering course syllabus

Portions deleted from 2015 regulation BE– Mechanical Engineering course syllabus



SATHYABAMA

INSTITUTE OF SCIENCE AND TECHNOLOGY

(DEEMED TO BE UNIVERSITY)

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School of Mechanical Engineering Department of Mechanical Engineering

Minutes of meeting of Board of Studies Virtual meet held on 15th November 2023.

The following Members are participated in the meeting:

1. Dr.L. Vijayaraghavan, Professor- IIT Madras - External Member
2. Er. James Michael Amulu, Director- SAP Research- Walldorf, Baden-Württemberg, Germany - External Member
3. Dr.S. Ganesan, Professor and Head- Mechanical Engineering - Internal Member
4. Dr.G. Arunkumar, Professor – Mechanical Engineering- Internal Member
5. Dr.S.P. Venkatesan, Associate Professor- Mechanical Engineering - Internal Member
6. Dr.G. Senthilkumar, Associate Professor- Mechanical Engineering - Internal Member
7. Dr. J. Jayaprabhakar, Associate Professor- Mechanical Engineering- Internal Member
8. Ms. Sanjana Kallat, Alumni- External Member.

The Chair Person welcomed the members of BoS and placed the agenda for the thoughts of the members. The following deliberations were made as per the items of the circulated agenda.

1. Agenda item # 1 Addition of new Course for Bachelors of Engineering– Mechanical Engineering

The Head of the department highlighted the feedback received from the Alumni for the inclusion of new course to focus on emerging technologies and the suggestion from Dr.L. Vijayaraghavan and Er. James Michael Amulu suggested Lean Enterprises and Advanced Manufacturing Technology. Based on BOS members suggestion, Department proposed the following new elective courses for the incorporation from 2021 batch onwards.

Course 1: LEAN MANUFACTURING

Resolutions:

The BOS resolved to recommend for approval of the suggested courses for inclusion in B.E Programme of Mechanical Engineering.

2. Agenda item # 2 Modifications proposed for 2021 batch Bachelors of Engineering– Mechanical Engineering course syllabus:

Head of the department informed that the need of revising the syllabus of SMEA1403– Power Plant Engineering, as per the recent advancements in the field and the following modifications have been considered.

Inclusion of the following topics in Unit I: Feed water heaters and evaporators – Steam turbines, Binary cycles. Draught System, cooling pond and cooling towers, Feed Water Treatment.

Inclusion of the following topics in Unit II: Layout and Components of Diesel - Gas Turbine and Hydro Electric Power Plants- site selection, operations, Advantages - Disadvantages - Applications.

Resolutions: The External members considered the revision as necessary as it broadly involved in manufacturing sector. The changes mentioned under inclusion had been approved by all and modification in curriculum had been reflected. Also, it was decided to implement for 2021 batch onwards.

3. Agenda item #_3 Addition of Skill in the professional domains in order to promote industry ready competency among learners. Necessity of introduction of certification courses from competent Government authorities for improving the domain knowledge and thus improving core placement counts.

Head pointed out that the workshop offered by the Department such as trends in Mechanical Engineering and Computational Fluid Dynamics.

Resolutions: The BoS members appreciated the same and suggested to follow in future also for making the industry ready competency among the students.

4. Agenda item # 4 Any other points with the permission of Chair -Academic flexibilities with extra credits acquired through either advanced study of some courses or with accumulation of additional credits from additional courses as per students' choice.

Head asked for the suggestions from the External members for students pursuing different specialization.

Resolutions: The BoS recommended that NPTEL courses. It can be selected based on the student's specialization. Also recommend that the students can select the courses at the end of the fourth semester subject to the condition prescribed by the Board of Management time to time. With the above discussion, the Head expressed his deep sense of gratitude to all members for an academic vibrant discussion on various matters. Since there was no other agenda, the meeting ended with the Vote of thanks to the Chair.

Member	Designation	Signature
Dr.L.Vijayaraghavan	Professor, IIT Madras	
Er.James Michael Amulu	Director, SAP Research- Walldorf, Baden-Württemberg, Germany	
Dr.S.Ganesan	Professor and Head	
Dr.G.Arunkumar	Professor and Head	
Dr.S.P.Venkatesan,	Associate Professor	
Dr.G.Senthilkumar	Associate Professor	
Dr. J.Jayaprabakar	Associate Professor	
Ms. Sanjana Kallat	External Member (Alumni)	

Modifications proposed for 2021 batch Bachelors of Engineering– Mechanical Engineering

SMEA1504	HEAT AND MASS TRANSFER	L	T	P	Credits	Total Marks
		3	*	0	3	100

COURSE OBJECTIVES

- Y To learn the various modes of heat transfer and understand the basic concepts of mass transfer.
- Y To understand the applications of various experimental heat transfer correlations in engineering applications.
- Y To discuss the thermal analysis and sizing of heat exchangers.

UNIT 1 CONDUCTION

9 Hrs.

General Heat Conduction Equation- Cartesian, Polar and Spherical Co-ordinate Systems – One dimensional steady state heat conduction in simple geometries – Plane wall – Cylinder and sphere – Composite walls – Composite cylinders and spheres – Critical thickness of insulation – heat generation in plane wall, cylinder and sphere – extended surfaces - unsteady state heat conduction-Lumped Analysis – Semi Infinite and Infinite Solids –Use of Heisler's charts.

UNIT 2 CONVECTION

9 Hrs.

Free and Forced Convection – Hydrodynamic and Thermal Boundary Layer – Free and Forced Convection during external flow over Plates and Cylinders – Internal flow through tubes, Internal Flow - Laminar and Turbulent Flow Solutions -Analogies between momentum and heat Transfer-Reynolds Analogy-Chilton colburn analogy (Modified Reynolds analogy)-Free Convection – Flow over Vertical Plate - Vertical Tubes - Horizontal Plate, Inclined Plate, Cylinders and Spheres.

UNIT 3 RADIATION

9 Hrs.

Laws of radiation - Wien's, Rayleigh-Jeans' and Planck's laws, Hemispherical Emissive Power, Stefan-Boltzmann law for the total emissive power of a black body, Emissivity and Kirchhoff's Laws – Concept of Gray, White, Opaque, Transparent and Black body radiation – shape factor - radiation exchange between surfaces -Radiations resistance network - Radiation shields.

UNIT 4 PHASE CHANGE HEAT TRANSFER AND HEAT EXCHANGER

9 Hrs.

Boiling and condensation – pool boiling regimes and correlations – critical heat flux - flow boiling correlations - Nusselt's theory – film wise and dropwise condensation - Condensation over surfaces. Heat Exchanger Types – Overall Heat Transfer Coefficient – Fouling Factors – Analysis – LMTD method – NTU method.

UNIT 5 MASS TRANSFER

9 Hrs.

Basic Concepts – Diffusion Mass Transfer – Fick's Law of Diffusion – Steady state Molecular Diffusion – Convective Mass Transfer – Momentum, Heat and Mass Transfer Analogy –Convective Mass Transfer Correlations.

Max. 45 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

- CO1 - Understand the basic modes of heat transfer and Compute temperature distribution in steady-state and unsteady-state heat conduction.
- CO2 - Understand and analyze heat transfer through extended surfaces.
- CO3 - Interpret and analyses forced and free convection heat transfer.
- CO4 - Explore the real time applications of radiation mode of heat transfer.
- CO5 - Design heat exchangers using LMTD and NTU methods.
- CO6 - Relate the mass transfer concepts for various industrial applications.

TEXT / REFERENCE BOOKS

1. Incropera, F.P. and Dewitt, D.P., Fundamentals of Heat and Mass Transfer, 7th Edition, John Wiley, 2011.
2. Holman, J.P., Heat Transfer, 10th Edition, Tata McGraw-Hill, 2010.
3. Ozisik, M.N., Heat Transfer - A Basic Approach, McGraw-Hill, 1985.
4. Cengel, Y.A., Heat Transfer - A Practical Approach, 2nd Edition, McGraw-Hill, 2002.
5. Sachedva, R.C., Fundamentals of Heat and Mass Transfer, 4th Edition, New Age International, 2012.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100

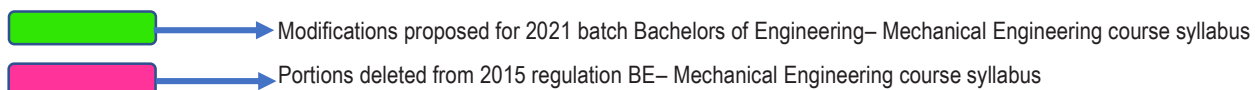
Exam Duration: 3 Hrs.

PART A: 10 Questions of 2 marks each - No choice

20 Marks

PART B: 2 Questions from each unit of internal choice; each carrying 16 marks

80 Marks



Modifications proposed for 2021 batch Bachelors of Engineering– Mechanical Engineering

SMEA1403	POWER PLANT ENGINEERING	L	T	P	Credits	Total Marks
		3	*	0	3	100

COURSE OBJECTIVES

- Y To provide essential knowledge of construction and working of various types of power plants.
- Y To detail the role of Mechanical Engineers in their operation and maintenance.

UNIT 1 STEAM POWER PLANT

9 Hrs.

Layout of Thermal Power Plant, Fuel and Ash Handling, Dust collection, Super Critical & FBC Boilers, Super heaters, Air pre heaters, Economizer, Condensers, Feed water heaters and evaporators – Steam turbines, Binary cycles, Draught System, cooling pond and cooling towers, Feed Water Treatment.

UNIT 2 POWER PLANT EQUIPMENTS AND INSTRUMENTATION 9 Hrs.

Subcritical and supercritical boilers, boiler calculations - boiler efficiencies, equivalent evaporation, boiler power. Condensers types - Calculation of vacuum efficiency, Feed Heaters. cooling towers - tower characteristics. Classification of plant instruments-Pressure gauges and types, Thermo-meters and types, Liquid level, gauges and types, Flow meter, pH measurement instruments, Gas Analysis, Impurity measurement instruments, Speed measuring instruments. Major Electrical Equipment in Power Plant-Layout of Electrical Equipment, Generator and Excites, Switch gear installations, Circuit breakers, Power transformers, Methods of Earthing a power system, Protective devices and control system used in power plant, Types of relays and voltage regulation.

UNIT 2 DIESEL, GAS, HYDRO ELECTRIC POWER PLANT

9 Hrs.

Layout and Components of Diesel - Gas Turbine and Hydro Electric Power Plants- site selection, operations, Advantages - Disadvantages - Applications.

UNIT 3 NUCLEAR & COMBINED POWER PLANT

9 Hrs.

Nuclear Engineering, Layout and components of Nuclear Power Plants, Working of Nuclear Reactors: BWR, PWR, CANDU, Fast Breeder, Gas Cooled and Liquid Metal Cooled Reactors, Combined and Binary Cycle Power Plants, Integrated Gasifier Combined Cycle power plants.

UNIT 4 ECONOMIC AND ENVIRONMENTAL ISSUES

9 Hrs.

Load Distribution Parameters, Load Curve, Capital and Operating Cost of Different Power Plants - Power Tariff Types - Pollution Control Technologies Including Waste Disposal Options for Thermal and Nuclear Power Plants.

UNIT 5 NON-CONVENTIONAL POWER GENERATION

9 Hrs.

Principle, Construction and Working of Wind, Tidal, Solar Thermal, Solar Electrical, Geothermal, Biogas and Fuel Cell Power Systems, Different Direct Energy conversion systems.

Max. 45
Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

- CO1 - Understand the different power generation methods.
- CO2 - Apply the basic thermodynamic principles to different power generation methods. CO3 - Understand construction of steam power plant, its working and significance.
- CO4 - Analyze thermodynamic cycles of Diesel, gas turbine & nuclear power plant.
- CO5 - Study the power generation, Distribution cost and impact of pollution from power plants. CO6 - Understand basic concepts of Non-Conventional Power Generation & its importance.

TEXT / REFERENCE BOOKS

- Nag. P.K., "Power Plant Engineering", 4th Edition, Tata McGraw – Hill Publishing Company Ltd., 2012
- Domkundwar, Power Plant Engineering - Dhanpat Rai & Sons, Delhi, 2016.
- Vopal and Stortzki, "Power Plant Engineering", PHI, 2007.
- Rajput.R. K, "Power Plant Engineering", 5th Edition, Laxmi Publications, 2016.
- Nagpal.G. R, Sharma.S.C, "Power Plant Engineering", 16th Edition, Khanna Publishers, 2012.
- Joel Weisomon and Roy Eckart, "Modern Power Plant Engineering", PHI, 1985.
- Rai G.D, Non-Conventional Energy Sources, Khanna Publishers, New Delhi, 2011.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100
Hrs.

Exam Duration: 3

PART A: 10 Questions of 2 marks each - No choice

20 Marks

PART B: 2 Questions from each unit of internal choice each carrying 16 marks

80 Marks

-  → Modifications proposed for 2021 batch Bachelors of Engineering– Mechanical Engineering course syllabus
-  → Portions deleted from 2015 regulation BE– Mechanical Engineering course syllabus

Modifications proposed for 2022 batch Bachelors of Engineering– Mechanical Engineering

SMEA1404	THERMAL ENGINEERING	L	T	P	Credits	Total Marks
		3	*	0	3	100

COURSE OBJECTIVES

- Y To incorporate the laws, processes and cycles from the basics of thermodynamics to the different gas power cycles.
- Y To evaluate the Internal combustion engine performance with the application of thermodynamic concepts.
- Y To examine the significance of Steam nozzles, Turbines, Compressors, Refrigeration and Air conditioning systems in the field of Thermal Engineering.

UNIT 1 GAS AND VAPOUR POWER CYCLES

9 Hrs.

Air Standard Cycle analysis - Otto, Diesel, Dual, Brayton cycle, Simple Rankine, Reheat and Regeneration cycles performance. Calculation of air standard efficiency and mean effective pressure

UNIT 2 INTERNAL COMBUSTION ENGINE PERFORMANCE AND SYSTEMS

9 Hrs.

I.C engine classification, components and functions Working of S.I. and C.I. engines, two stroke and four stroke engines – Valve timing, port timing and PV diagrams of S.I and C.I engines - Estimation of brake power indicated power, thermal efficiency, Heat balance sheet. Electronic and Common Rail Direct injection systems. Magneto and Battery coil ignition systems. Lubrication and Cooling systems. Supercharging and turbocharging systems. Deviation of engine indicator diagram from air standard cycles. Combustion in SI & CI engines - abnormal combustion - phenomenon and control.

UNIT 3 AIR COMPRESSORS

9 Hrs.

Classification and working of air compressors - Classification of compressors and their comparison - Reciprocating air compressor-principle of operation, work requirement, isothermal efficiency, volumetric efficiency and effect of clearance, Multi stage compression with inter cooling, saving work, Working of Rotary Compressors and comparison with reciprocating air compressors, Axial Flow Compressor-Roots Blower, Vane Blower

UNIT 4 STEAM NOZZLES AND STEAM TURBINES

9 Hrs.

Flow of steam through nozzles, Isentropic flow, ideal and actual expansion in nozzle, condition for maximum discharge, critical pressure ratio, Meta stable flow. Steam turbines, impulse and Reaction principles, Compounding, Velocity diagrams for impulse and reaction blades, Work done on turbine blades, optimization and efficiency.

UNIT 5 REFRIGERATION AND AIR CONDITIONING SYSTEMS

9 Hrs.

Bell Coleman and vapour compression refrigeration systems, Performance calculations, vapour absorption refrigeration system, Air conditioning systems and types, working principle-Estimation of cooling load. Psychrometry and psychrometric properties, Concept of RSHF, GSHF and ESHF, Air conditioning systems- winter and summer.

COURSE OUTCOMES

Max. 45 Hrs.

On completion of the course, students will be able to

- CO1 - Demonstrate the different gas and vapour power cycles.
- CO2 - Evaluate the thermal performance and heat balance sheet of I.C. Engines
- CO3 - Identify the type of compressors based on different classifications.
- CO4 - Apply the steam tables with mollier chart to different conditions of steam
- CO5 - Calculate the minimum work requirement of reciprocating compressors.
- CO6 - Estimation of refrigeration system performance and cooling load for air conditioning systems.

TEXT / REFERENCE BOOKS

1. Rajput, R.K, Thermal Engineering, 10th Edition, Laxmi Publications, 2017.
2. Ajoy kumar, G.N. Sah, Thermal Engineering, 2nd Edition, Narosa Publications, 2010.
3. Ballaney, P.L., Thermal Engineering, 24th Edition, khanna Publishers, 2003.
4. Kothandaraman C.P., Khajuria P.R and Domkundwar.S., 4th Edition, A Course in Thermal Engineering. Dhanpat Raj & Sons, 2004.
5. Sarkar B.K, Thermal Engineering, McGraw Hill, 2004.
6. Sarao. A.S, Thermal Engineering, Satya Prakashan, New Delhi. 2004.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks : 100

Exam Duration: 3 Hrs.

PART A: 10 Questions of 2 marks each - No choice

20 Marks

PART B: 2 Questions from each unit of internal choice each carrying 16 marks

80 Marks

Modifications proposed for 2021 batch Bachelors of Engineering– Mechanical Engineering course syllabus

Portions deleted from 2015 regulation BE– Mechanical Engineering course syllabus

Modifications proposed for 2021 batch Bachelors of Engineering– Mechanical Engineering

SMEA1602	GAS DYNAMICS AND JET PROPULSION (Use of approved gas tables is permitted)	L	T	P	Credits	Total Marks
		3	*	0	3	100

COURSE OBJECTIVES

- Y To discuss the concepts of compressible and incompressible fluids.
- Y To understand Mach number variation on area ratio.
- Y To impart in depth knowledge on the flow characteristics through constant area duct.

UNIT 1 FUNDAMENTALS OF COMPRESSIBLE FLUID FLOW

9 Hrs.

Concept of compressible flow, Energy and momentum equations for compressible fluid flows, various regions of flow, fluid velocity, stagnation state, velocity of sound, critical states, Mach number, critical mach number, Crocco number, types of waves, mach cone, mach angle, effect of mach number on compressibility.

UNIT 2 FLOW THROUGH VARIABLE AREA DUCTS

9 Hrs.

Isentropic flow through variable area duct, T-S and h-s diagrams for nozzle and diffuser flows, area ratio as a function of Mach number, Mass flow rate through nozzles and diffusers, effect of friction in flow through nozzles.

UNIT 3 FLOW THROUGH CONSTANT AREA DUCTS FANNO FLOW AND RAYLEIGH FLOW

9 Hrs.

Flow in constant area duct with friction - Fanno curves, and Fanno Flow equations, variation of flow properties, variation of Mach number with duct length. Flow in constant area duct with heat transfer, Rayleigh line and Rayleigh flow equations, variation of flow properties, maximum heat transfer.

UNIT 4 NORMAL SHOCK AND OBLIQUE SHOCKS

9 Hrs.

Governing equations, variation of flow parameters, static pressure, static temperature, density, stagnation pressure, entropy across normal shock and oblique shocks. Normal shocks - stationary and moving, applications. Prandtl Meyer equation, impossibility of shock in sub-sonic flows, flow in convergent and divergent nozzles with shock, Flows with oblique shock.

UNIT 5 PROPULSION JET AND SPACE PROPULSION

9 Hrs.

Aircraft propulsion, types and working of jet engines - energy transfer in jet engines, study of turbo jet engine components thrust, thrust power, propulsive and overall efficiencies, thrust augmentations in turbo jet engines, ram jet and pulse jet engines. Rocket propulsion, types of rocket engines, Liquid and solid fuel rocket engines, Introduction to Electrical and Nuclear rockets -Space Flights, Orbital and escape velocity.

COURSE OUTCOMES

On completion of the course, student will be able to

- CO1 - Recall the fundamental concepts of compressible fluid flow.
- CO2 - Demonstrate the significance of mach number on compressibility
- CO3 - Differentiate isothermal flow and isentropic flow.
- CO4 - Apply the concept of normal shocks to different turbo machines.
- CO5 - Estimate the heat transfer in flow through constant area ducts.
- CO6 - Calculate the propulsive power in jet engines.

TEXT / REFERENCE BOOKS

1. Yahya S.M., "Fundamental of Compressible flow", New Age International (P) Ltd., New Delhi, 2003.
2. Cohen H., Rogers R.E.C. and Sravanamuttoo, "Gas Turbine Theory", Addison Wesley Ltd., 2001.
3. Hill D. and Peterson C., "Mechanics & Thermodynamics of Propulsion", Addison Wesley, 1992.
4. Ganesan V., "Gas Turbines", Tata McGraw Hill Publishing Company, New Delhi. 1999.
5. Sutton G.P., "Rocket Propulsion Elements", John Wiley, New York, 1975.
6. J.D. Anderson, Modern compressible flow, McGraw-Hill Education; 3rd Edition, 2002.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks 100

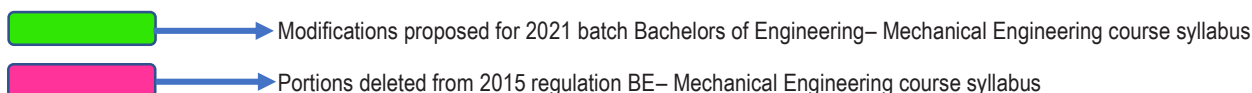
Exam Duration: 3 Hrs.

PART A: 10 Questions of 2 marks each - No choice

20 Marks

PART B: 2 Questions from each unit of internal choice each carrying 16 marks

80 Marks



Modifications proposed for 2021 batch Bachelors of Engineering– Mechanical Engineering

SMEA1503	FINITE ELEMENT ANALYSIS	L	T	P	Credits	Total Marks
		3	*	0	3	100

COURSE OBJECTIVES

- To understand the concepts of Mathematical Modeling of Engineering Problems.
- To apply the use of FEM in various engineering problems.
- To learn the efficient implementation of finite element method in solving of simple problems.
- To solve simple and complicated 2D structural problems for stress analysis under impact loads from general engineering aspects.

UNIT 1 INTRODUCTION

9 Hrs.

Historical Background– Basic Concepts of FEM – Mathematical Modeling of field problems in Engineering – Governing Equations – Discrete and continuous models – Boundary, Initial and Eigen Value problems–Residual Methods- Variational Formulation of Boundary Value Problems – Ritz Method, Finite Element Modeling - Element Equations - Shape functions -Bar, Beam Elements - stepped bar, tapered bar-simple problems

UNIT 2 ONE-DIMENSIONAL PROBLEMS

9 Hrs.

One Dimensional Second Order Equations – Discretization – Element types- Linear and Higher order Elements – Derivation of Shape functions and Stiffness matrices and force vectors- Assembly of Matrices- Solution of problems from solid mechanics and heat transfer-Bar, Beam Elements – Applications to Heat Transfer.

UNIT 3 TWO DIMENSIONAL PROBLEMS

9 Hrs.

Basic Boundary Value Problems in Two Dimensions – Triangular, quadrilateral, higher order elements – Triangular elements – Shape functions and element matrices and vectors. Application to Field Problems - Thermal problems – Torsion of Non circular shafts –Quadrilateral elements – Higher Order Elements.

UNIT 4 SOLUTION TO PLANE ELASTICITY PROBLEMS

9 Hrs.

Introduction to Theory of Elasticity – Plane Stress – Plane Strain and Axisymmetric Formulation – Principle of virtual work - Element matrices using energy approach. Body forces and temperature effects – Stress calculations - Plate and shell elements.

UNIT 5 ISO PARAMETRIC FORMULATION

9 Hrs.

Natural Co-ordinate System – Lagrangian Interpolation Polynomials – Iso-parametric Elements – Formulation –Numerical Integration – 1D -2D Triangular elements – rectangular elements – Introduction to Analysis Software— h & p Elements-Errors and Types

Max.45 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

- CO1 - Understand the basics of matrix manipulations required for Finite Element Analysis.
- CO2 - Apply finite element formulations to solve one dimensional Problems.
- CO3 - Apply finite element formulations to solve two dimensional scalar Problems.
- CO4 - Apply finite element method to solve two dimensional Vector problems.
- CO5 - Apply finite element method to solve problems on iso parametric element.
- CO6 - Analyze the importance of ethical issues pertaining to the effective utilization of FEA in Mechanical engineering.

TEXT / REFERENCE BOOKS

1. Reddy. J.N., "An Introduction to the Finite Element Method", 3rd Edition, Tata McGraw-Hill, 2010.
2. Seshu, P, "Text Book of Finite Element Analysis", Prentice-Hall of India Pvt. Ltd., New Delhi, 2007.
3. Chandrupatla & Belagundu, "Introduction to Finite Elements in Engineering", 4th Edition, Prentice Hall College Div, 1997.
4. Rao, S.S., "The Finite Element Method in Engineering", 4th Edition, Butterworth Heinemann, 2005.
5. Robert D. Cook, David S. Malkus, Michael E. Plesha, Robert J. Witt, "Concepts and Applications of Finite Element Analysis", 4th Edition, Wiley Student Edition, 2002.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100

Exam Duration: 3 Hrs.

PART A: 10 Questions of 2 marks each - No choice

20 Marks

PART B: 2 Questions from each unit of internal choice; each carrying 16 marks

80 Marks

