SGGS INSTITUTE OF ENGINEERING AND TECHNOLOGY NANDED

Department of Mechanical Engineering

B. Tech. (Mechanical) Curriculum Structure

Academic year 2021-22 onwards

Semester VII and VIII (Final Year)

Programme Educational Objectives (PEOs)

PEO 1 Provide knowledge and skills of broad spectrum in domain of Mechanical Engineering.

PEO 2 Cater the needs of Indian as well as multinational industries and other organizations.

PEO 3 Be competent with a strong technological background, to formulate, analyze the societal, industrial and environmental challenges to obtain the economically viable solutions.

PEO 4 Foundation for higher studies, research, entrepreneurship and administrative services.

PEO 5 Inculcate the attitude of self and lifelong learning, out of box thinking, ethics and integrity, professional and managerial competencies to work on the multidisciplinary projects.

Programme Outcomes (POs):

Engineering Graduates will be able to:

a. **Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

b. **Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

c. **Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

d. **Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

e. **Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

f. **The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

g. **Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

h. **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

i. **Individual and teamwork:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

j. **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

k. **Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

l. **Life-long learning:** Recognize the need for and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Programme Specific Outcomes (PSOs):

B. Tech Mechanical Engineering

PSO 1 Apply Principal of engineering, basic sciences and mathematics to model, analyze, design mechanical systems and processes.

PSO 2 Plan, operate, control, maintain & improve mechanical systems, components & processes.

Correlation Matrix (Correlation between the PEOs and the POs)

➡PO/PSO ⬇PEO	a	b	c	d	e	f	g	h	i	J	k	l	PSO1	PO2
PEO 1	√				√					√		√	√	√
PEO 2	√	√	√	√	√	√	√	√	√	√	√	√	√	√
PEO 3	√	√	√	√	√	√	√	√	√	√	√	√	√	√
PEO 4	√	√	√	√	√	√	√	√	√	√	√	√	√	√
PEO 5	√						√	√		√	√	√	√	√

Note: The cells filled in with ✓ indicate the fulfillment/correlation of the concerned PEO with the PO.

SGGS INSTITUTE OF ENGINEERING AND TECHNOLOGY, NANDED

Department of Mechanical Engineering

B. Tech. (Mechanical) Curriculum Structure

Academic year 2021-22 onwards

Semester VII (Final Year)

Course Code	Course Title	Hours/Week			Total contact Hours	Credits	
		(L)	(T)	(P)		Th.	Pr.
PCC-ME401	Tool Design	03	0	02	05	03	01
HMC-ME402	Operations Research	03	0	02	05	03	01
PEC-ME4**	Elective IV	03	0	02	05	03	01
PEC-ME4**	Elective V	03	0	02	05	03	01
PEC-ME4**	Elective VI	03	0	00	03	03	0
	Total	**15**	**0**	**08**	**23**	**15**	**04**
				Total Credits		**19**	

Semester VIII (Final Year)

Course Code	Course Title	Hours/Week			Total contact Hours	Credits	
		(L)	(T)	(P)		Th	Pr
SII-ME421	Internship#	0	0	--	--	0	02
PRJ-ME422	Mini Project	0	0	04	04	0	02
PRJ-ME423	Major Project (Industrial/In-house)	0	0	24	24	0	12
	Total	**00**	**00**	**28**	**28**	**0**	**16**
				Total Credits		**16**	
L-No of Lecture Hours/week, T- No. of Tutorials Hours/ week, P- Practical Hours/week							

B.Tech.(MECH)	**Contact Hours**	**Credits**
TOTAL	51	35

List of courses in Electives

Elective-IV and Elective-V

Course Code	Name of Subject
PEC-ME403	Finite Elements Analysis
PEC-ME404	Introduction to Industry 4.0
PEC-ME405	CAD / CAM Software Customization
PEC-ME406	Computational Fluid Dynamics
PEC-ME407	Elements of PLM
PEC-ME408	Composite Materials

Elective-VI

Course Code	Name of Subject
PEC-ME411	Industrial Fluid Power
PEC-ME412	Quality and Reliability Engineering
PEC-ME413	Fracture Mechanics
PEC-ME414	Renewable Energy
PEC-ME415	Heating, Ventilation and Air Conditioning (HVAC)

****** Student should register for any two courses from the elective list for Electives IV and V and one course from the list of Elective VI provided.

#: Internship to be completed during vacation after second year or third year and evaluation will be done at start of 8^{th} semester (duration of internship must be minimum of 5 weeks).

PCC-ME401 – TOOL DESIGN

(CREDITS THEORY: 03, PRACTICAL: 01)

Course code: PCC-ME401 (L- 03, T- 0, P-02)

Course Objectives:

1. To demonstrate Tool design methodologies for different elements of machines and Jig Fixtures.
2. To demonstrate the use of locating and clamping devices in industries.
3. To make aware of the designing principles in jig, fixture and die designing.
4. To apply the designing principles in designing of dies for different machining operations.

Course Outcomes: At the end of course, student will be able to;

CO 1 Draw and represent the design of mechanical components

CO 2 Selects proper Jig, fixture, positioning, and handling of component to provide ease in manufacture.

CO 3 Demonstrates the sheet metal operation and can explain phenomenon of metal flow during operation.

CO 4 Design and select proper die and tools required for manufacturing.

Articulation Matrix

➡ PO/PSO ⬇ CO	a	b	c	d	e	f	g	h	i	J	k	l	PSO1	PSO2
CO 1	3		2		1	1							1	
CO2	2	2	3	2	2								2	2
CO3	2	1		3									1	
CO4	2	2	3	2		1							3	2

Note: 1-Low, 2-Medium or 3- High

Evaluation Scheme:

Theory	**Practical**
Mid Term: 30 Marks	Continuous Evaluation: 50%
End Term: 50 Marks	Continuous Evaluation: 50%
In Semester Evaluation: 20 Marks	

Course Content:

Unit-I

Locating and Clamping Devices: Degrees of freedom, 3-2-1 method of location, choosing a locating surface, redundant locaters, fool proofing, locating methods and devices, clamping methods, power clamping: pneumatic, hydraulic, hydro–pneumatic, vacuum, magnetic and non-conventional clamps.

Unit-II

Jig / Fixture Design Considerations: Design principles of Jig/Fixture and their parts, fastening elements, construction elements, and process planning for Jig/Fixture manufacturing.

JIG Design: Drill bush types, fixed, plain, headed renewable, slip, threaded and special, design principles for drill bush, drill bush materials, jig feet, Types of jigs, templates, plate, angle-plate, leaf, turnover, box, multi-station and indexing jigs.

Unit-III

Fixture Design: Cutter setting and mounting devices, milling fixture design, single piece, sting, progressive, index and rotary milling, design of lathe, boring and broaching fixtures.

Unit-IV

Blanking and Piercing Die Design: Introduction, Die cutting operations, Power press types, General press information, Cutting action in Punch and Die Operations, Die clearance, Types of Die construction, Die design fundamentals, Pilots, Strippers and Pressure pads, Press Work Material, Strip layout. Design problems.

Unit-V

Design of Bending, Forming and Drawing Dies: Introduction, bending dies, forming dies, Drawing Operations, variables that affect metal flow during Drawing, Determining Blank size, Drawing force, Single and Double action draw dies. Design problems.

Unit-VI

Forging Dies: Types of forging dies, advantages and limitations; forging equipment and machines, press forging, drop forging, open die forging, close forging, dogging defects. Forging design, factors-draft, fillet, corner radius, parting line, shrinkage, die wear, mismatch, and tolerances, forging operations stock size determination, forging die design.

Term Work:

It shall consist of **one full imperial sheet each** on:

1. Jig design and
2. Fixture design
3. Cutting die design
4. Shaping die design

Journal based on above syllabus for:

1. Jig design
2. Fixture design
3. Design of a cutting die (punching, blanking, compound, and progressive), bending die, and drawing die
4. Press tool Design and / or 3D Modeling, assembling and drawing assignment using computer.

Practical Examination:

The practical examination consists of an oral/practical exam based on the syllabus prescribed above.

Textbooks:

1. Donaldson, Lecain, Good "Tool Design Tata McGraw" Hill co. Ltd 3rd Edition 1976).

Reference Books:

1. Kempster "Introduction to Jig and Tool Design": M.H.A. English language book society.
2. Joshi P.H, "Jigs and Fixtures," Tata McGraw Hill, New Delhi.
3. Sharma P.C. "Production Engineering," S. Chand and co. Ltd. New Delhi 7th edition 1982.
4. Pollack Herman W "Tool Design" D.B. Tarapurwall son's and co. pvt. Ltd. Mumbai 1983.

HMC-ME402– OPERATIONS RESEARCH

(CREDITS THEORY: 03, PRACTICAL: 01)

Course code: PCC-ME402 (L- 03, T- 0, P- 02)

Course Objectives:

1. To impart the operation research techniques.
2. To familiarize with model formulation and applications, those used in solving business decision problems.
3. To motivate students for learning decision making techniques.

Course Outcomes: At the end of course, student will be able to;

CO 1 Apply various tools and techniques in finding optimal solutions to problems involving limited resources in the form of – Men, Materials and Machinery.

CO 2 Apply various scientific methods of – decision making, project management, inventory management and scheduling different shop-floor processes.

CO 3 Evaluate the effects of dynamic changes on optimized solutions.

CO 4 Formulate & Analyse the models for real life optimization problems.

Articulation Matrix

➡ PO/PSO ⬇ CO	a	b	c	d	e	f	g	h	i	J	k	l	PSO1	PSO2
CO 1	3	2		2	1						2	2	3	3
CO 2	3	2		2	1						3	2	3	3
CO 3	2	1		2									2	2
CO 4	3	3		2		1						2	3	1

Note: 1-Low, 2-Medium or 3- High

Evaluation Scheme:

Theory	**Practical**
Mid Term: 30 Marks	Continuous Evaluation: 50%
End Term: 50 Marks	Continuous Evaluation: 50%
In Semester Evaluation: 20 Marks	

Course Content:

Unit-I: Linear programming (08)

Definition of Operations Research, Scope & Objectives. Formulation of LP problem, Graphical Method, Simplex Methods, Degeneracy in LP, Duality in LP, Sensitivity analysis.

Unit-II: Transportation and Assignment Problems (08)

Structure, industrial and business applications of Transportation & Assignment Models.
Use of various methods for solving Transportation problems, Degeneracy and its solution, Trans-shipment problem. Assignment problem solutions of various types of problems, Travelling Salesman problem.

Unit-III: Decision Theory and Investments Analysis (08)

The theory of Games: Introduction, Two-Person Zero Sum Game, Minimax-Maximin Principle, Saddle Point, methods for solving game problems with Mixed Strategies, Graphical and Iterative methods. Methods of Investment Analysis, Break-Even Analysis.

Unit-IV: Sequencing & Scheduling, Queuing Theory and Inventory Control (08)

Sequencing & Scheduling – Introduction, Assumptions in Sequencing Problems, Solution of Sequencing Problems: Processing N jobs through - One, Two & Three machine/s.
Queuing Theory – Introduction, Basic Structure, Terminology (Kendal's Notations) and Applications, Single Channel Queuing Models.
Inventory Control – Necessity of Inventory, Inventory Control Problem, Deterministic Inventory Control Models.

Unit-V: Project Management & Network Analysis (08)

Project management: Planning, Scheduling & Controlling; Network Techniques in PM, Construction of Networks, Critical Path Method, Program Evaluation & Review Technique, Time estimates Floats and their significance, Probability of completing projects by given date, Crashing for optimum duration and the cost, Resource Smoothing and Levelling.

Term Work:

It shall consist of at least one assignment on each chapter based on above syllabus.

Practical Examination:

The practical examination consists of an oral/practical based on the syllabus prescribed above.

Textbooks:

1. P. K. Gupta and D. S. Hira, "Operations Research, 3rd Edition", S. Chand and Company Ltd.

Reference Books:

1. R. Paneerselvam, "Operations Research", Prentice Hall of India (2002)
2. Ravindran, Philips, Soldberb, "Operations Research: Principles and Practices", 2nd Edition, John Wiley and Sons (2000).
3. H. S. Kasana and K. D. Kumar, "Introductory Operations Research: Theory and Applications", Springer International Edition (2003).
4. H. A Taha., "Operations Research An introduction", Prentice Hall Pvt. Ltd., ISBN 81-203-1222-8.

PEC-ME403– FINITE ELEMENTS ANALYSIS

(CREDITS THEORY: 03, PRACTICAL: 01)

Course code: PEC-ME403 (L- 03, T- 0, P- 02)

Course Objectives:

1. To impart basics of Finite Elements Analysis.
2. To demonstrate the detailed procedure involved in Finite element analysis.
3. To motivate the students for applying finite elements analysis methods to real life problems.
4. To demonstrate the idea about pre and post processing in Finite Element Analysis.
5. To inculcate knowledge of FEA and use the commercial finite element packages.

Course Outcomes: At the end of course, student will be able to;

CO 1 Analyze and design real world components
CO 2 Suggest whether the given solid is safe for the load applied.
CO 3 Select proper methodology for designing and solving a design problem.
CO 4 Work with different software skills sets required for practical problem.

Articulation Matrix

➡ PO/PSO ⬇ CO	a	b	c	d	e	f	g	h	i	J	k	l	PSO1	PSO2
CO 1	1	2	1	3	1							1	3	1
CO 2	3	3	2	2	3							1	2	3
CO 3	2	2	1	1	1							1	2	1
CO 4	2	1	2	1	3							3	3	1

Note: 1-Low, 2-Medium or 3- High

Evaluation Scheme:

Theory	**Practical**
Mid Term: 30 Marks	Continuous Evaluation: 50%
End Term: 50 Marks	Continuous Evaluation: 50%
In Semester Evaluation: 20 Marks	

Course Content:

Unit-I: Introductory Concepts

Historical Background, Introduction to FEM. General FEM procedure. Applications of FEM in various fields. Advantages and disadvantages of FEM. stresses & equilibrium boundary conditions, strain displacement relations, stress – strain relations, temperature, effects, variational approach solution techniques.

Unit-II: FEA Procedure

Step wise procedure of Finite element method, variational techniques for derivation of finite element equations, assembly procedure, solution methods

Unit-III: FEM of One-Dimensional Problem

Introduction, finite element modeling, shape functions, variational approach, weighted residual approach, Assembly of finite element equations, Higher order element, Boundary conditions, Temperature effects.

Unit-IV: FEA of Two-Dimensional Problems

Introduction, FE modeling, formulation of constant strain triangular element, problem modeling & boundary conditions.

Unit-V: Preprocessor and Post Processors

Introduction, Mesh Generation, post processing, requirements of a preprocessor and post processor, preprocessor and post processors in analysis software. Introduction to FEA Software.

Term Work: It shall consist of following practicals/Assignments

1. Any two problems using truss element.
2. Any two problems using bar element.
3. Modal analysis of mechanical component using FEA software.
4. Static stress, strain analysis for a plate with centre hole using FEA software.
5. Any one problem on steady state heat conduction
6. Validate results deflection of beam with analytical method and FEA software.
7. Solve Plane truss problems, using FEA software and manually.
8. Solve Beam problems with different boundary and loading conditions using FEA software
9. Solve axisymmetric problems using FEA Software.
10. Solve 1D – Structural, thermal and fluid problems using FEA software and manually.

Practical Examination:

The practical examination consists of an oral/practical based on the syllabus prescribed above

Textbooks:

1. S. S. Rao, "Introduction to Finite Element Method in Engineering", Butterworth Heinmann Publication.

Reference Books:

1. Nitin S. Gokhale, "Practical Finite Element Analysis" Finite to Infinite
2. Bathe K.J. "Finite Element Procedures by using ANSYS & other software manuals", Prentice Hall of India, New Delhi.
3. P. Seshu "Textbook of Finite Element Analysis" Prentice Hall of India, New Delhi
4. Reddy J. N. "Finite Element Method" Mc-GRAW-HILL

PEC-ME404– INTRODUCTION TO INDUSTRY 4.0

(CREDITS THEORY: 03, PRACTICAL: 01)

Course code: PEC-ME404 (L- 03, T- 0, P- 02)

Course Objectives:

1. To study the industry 4.0 and its applications in the business world.
2. To study the automation decision making and processes.
3. To analyze the data using new business models and intelligent algorithms.
4. To drive knowledge for operationalize use by cyber physical systems.
5. To understand the manufacturing systems and industry 4.0 technologies and applications.
6. To apply the industrial 4.0 applications and case studies in industries.

Course Outcomes: At the end of course, student will be able to;

CO1 Understand the drivers and enablers of Industry 4.0

CO2 Appreciate the smartness in Smart Factories, Smart cities, smart products, and smart services.

CO3 Identify the various systems used in a manufacturing plant and their role in an Industry 4.0 world.

CO4 Appreciate the power of Cloud Computing in a networked economy.

CO5 Understand the opportunities, challenges brought about by Industry 4.0 and how organizations and individuals should prepare to reap the benefits.

Articulation Matrix

➡PO/PSO ⬇ CO	a	b	c	d	e	f	g	h	i	J	k	l	PSO1	PSO2
CO 1		1	1								2		1	1
CO 2	1				2						3		1	3
CO 3	1	2		2									2	3
CO 4					3								2	2
CO 5									1			1	2	2

Note: 1-Low, 2-Medium or 3- High

Evaluation Scheme:

Theory	**Practical**
Mid Term: 30 Marks	Continuous Evaluation: 50%
End Term: 50 Marks	Continuous Evaluation: 50%
In Semester Evaluation: 20 Marks	

Course Content:

Unit-I: Introduction to Industry 4.0

The Various Industrial Revolutions, Digitalization and the Networked Economy, Drivers, Enablers, Compelling Forces and Challenges for Industry 4.0, The Journey so far: Developments in USA, Europe, China

and other countries, Comparison of Industry 4.0 Factory and Today's Factory, Trends of Industrial Big Data and Predictive Analytics for Smart Business Transformation.

Unit-II: Road to Industry 4.0
Internet of Things (IoT) & Industrial Internet of Things (IIoT) & Internet of Services, Smart Manufacturing, Smart Devices and Products, Smart Logistics, Smart Cities, Predictive Analytics.

Unit-III: Related Disciplines, System, Technologies for enabling Industry 4.0
Cyber physical Systems, Robotic Automation and Collaborative Robots, Support System for Industry 4.0, Mobile Computing, Related Disciplines, Cyber Security.

Unit-IV: Role of data, information, knowledge, and collaboration in future organizations
Resource-based view of a firm, Data as a new resource for organizations, Harnessing and sharing knowledge in organizations, Cloud Computing Basics, Cloud Computing and Industry 4.0.

Unit-V: Business issues in Industry 4.0
Opportunities and Challenges, Future of Works and Skills for Workers in the Industry 4.0 Era, Strategies for competing in an Industry 4.0 world.

Term Work: It shall consist of
1. Assignments based on above syllabus.
2. At least one case study on application of industry 4.0
3. At least 2 assignments on industry 4.0 technologies and business models.

Practical Examination:
It shall consist of oral/practical examination based on the above syllabus and term work.

Reference Books:

1. Alp Ustundag and Emre Cevikcan,"Industry 4.0: Managing the Digital Transformation".
2. Bartodziej, Christoph Jan,"The Concept Industry 4.0".
3. Klaus Schwab,"The Fourth Industrial Revolution".
4. Christian Schröder ,"The Challenges of Industry 4.0 for Small and Medium-sized Enterprises"

PEC-ME405– CAD / CAM SOFTWARE CUSTOMIZATION

(CREDITS THEORY: 03, PRACTICAL: 01)

Course code: PEC-ME405 (L- 03, T- 0, P- 02)

Course Objectives:

1. Introduction to MCAD/PLM software customization for improving employability skills.
2. Awareness of UI customization.
3. Comprehend CAD/CAM/CAE/PLM customization techniques.
4. Impart knowledge of the VBA/GRIP/Python/C/C#/Java/JavaScript APIs in MCAD software

Course Outcomes: At the end of course, student will be able to;

CO 1 Create templates, part families, etc and record macros.
CO 2 Interactively customize menus, toolbars, etc.
CO 3 Identify and select appropriate API for various PLM software customization tasks.
CO 4 Design and develop UIs for custom applications.
CO 5 Design and develop algorithms and programs for back-end coding for custom applications.
CO 6 Identify custom software development requirements.
CO 7 Design and develop tiny custom software for CAD/CAM/CAE/PLM applications using APIs like VBA/GRIP/Python/C/C#/Java/JavaScript etc.

Articulation Matrix

➡ PO/PSO ⬇ CO	a	b	c	d	e	f	g	h	i	J	k	l	PSO1	PSO2
CO 1	1				3						1		3	2
CO 2	1				3						1		2	2
CO 3		3		2									1	1
CO 4	1		3		1								3	3
CO 5	1		3		1								3	3
CO 6		3		2									1	1
CO 7	1		3		1								3	2

Note: 1-Low, 2-Medium or 3- High

Evaluation Scheme:

Theory	**Practical**
Mid Term: 30 Marks	Continuous Evaluation: 50%
End Term: 50 Marks	Continuous Evaluation: 50%
In Semester Evaluation: 20 Marks	

Course Content:

Unit I – Introduction [6 Hrs]

Software Customization, Need, History, Part Library and Part Family in CAD, User Defined Functions

(UDFs), Creation of Custom Templates, Macros/Journals, Linetypes and Hatching Patterns, Script Programming, API, Software Ethics, Software Development Life Cycle (SDLC), Requirements Analysis

Unit II – User Interface (UI) Customization [3 Hrs]

Interactive Customization. E.g., NX UI Modifications, Roles in NX, CUI Editor in AutoCAD, DIESEL; Menus, Toolbars and Status line Customization, etc.

Unit III - Introduction to Programming [8 Hrs]

IDEs, APIs in CAD Software, General Purpose and System Dependent API, Projects - Sample Projects, Objects, Methods and Properties, Data types, Loops and Control Statements.

Unit IV - UI Design / Development [6 Hrs]

Forms Design, Events, User Interactions and Utility objects, Controlling Menus, Toolbars, Layers and Line types.

Unit V - Programming for Modeling (2D/3D) [10 Hrs]

Creating 2D and 3D entities through Programming; Editing 2D and 3D entities through Programming

Unit VI: Advanced Topics in Customization [8 Hrs]

Dimensions, Annotations, Layout, Creating Tables, File Operations, CAE/APDL Automation in ANSYS, PLM Software Customization – Codeless and Code-full, Knowledge Based Engineering (KBE) Applications.

Term Work:

At least 10 practical assignments on above syllabus.

Practical Examination:

The practical examination consists of an oral/practical exam based on the syllabus prescribed above.

Text Book/Documents

Developer Documentation/Help for the CAD/CAM/CAE/PLM software.

Reference Books:

1. Joe Sutphin, AutoCAD 2006 VBA: A Programmer's Reference, Apress; 2nd ed. edition (September 23, 2005).
2. Marion Cottingham, Mastering AutoCAD VBA, Sybex; 1 edition (March 16, 2001).
3. Lee Ambrosius, AutoCAD Platform Customization: User Interface, AutoLISP, VBA, and Beyond, Sybex; 1 edition (April 27, 2015).
4. Sham Tickoo, Customizing AutoCAD 2020, 13th Edition, CADCIM Technologies (September 11, 2019).
5. NX Open GRIP/User Function Programming manuals for Unigraphics (Vol. 1, 2, 3).
6. ANSYS APDL Programming manual.
7. Teamcenter/Windchill Customization manuals/guides.

PEC-ME406– COMPUTATIONAL FLUID DYNAMICS

(CREDITS THEORY: 03, PRACTICAL: 01)

Course code: PEC-ME406 (L- 03, T- 0, P- 02)

Course Objectives:

1. To introduce numerical modeling and its role in the field of heat transfer and fluid flow.
2. To enable the students to understand the various discretization methods and solving methodologies.
3. To impart skills to solve complex problems in the field of heat transfer and fluid dynamics by using high speed computers.

Course Outcomes: At the end of course, student will be able to;

CO 1 Express numerical modeling and its role in the field of fluid flow and heat transfer.

CO 2 Apply the various discretization methods, solution procedures and turbulence modeling to solve fluid flow and heat transfer problems.

CO 3 Interpret the knowledge, capability of analyzing and solving any concept or problem associated with heat energy & fluid dynamics.

CO 4 Use a CFD tool effectively for practical problems leading to enhance employability.

Articulation Matrix

➡ PO/PSO ⬇ CO	a	b	c	d	e	f	g	h	i	J	k	l	PSO1	PSO2
CO 1	3	3	2	2	2				1				3	2
CO2	2	3	2	2	2				1				2	2
CO3	2	2	3	2	2				1				2	2
CO4	1	2	2	2	3				3				2	1

Note: 1-Low, 2-Medium or 3- High

Evaluation Scheme:

Theory	**Practical**
Mid Term: 30 Marks	Continuous Evaluation: 50%
End Term: 50 Marks	Continuous Evaluation: 50%
In Semester Evaluation: 20 Marks	

Course Content:

Unit-I: Introduction to CFD

Computational approach to Fluid Dynamics and its comparison with experimental and analytical methods, Basics of PDE: Elliptic, Parabolic and Hyperbolic Equations. Review of Navier-Stokes Equation and simplified forms, Solution

Unit-II: Methodology

FDM and FVM with special emphasis on FVM, Stability, Convergence and Accuracy.

Unit-III: Finite Volume Method

Domain discretization, types of mesh and quality of mesh, SIMPLE, pressure velocity coupling, Checkerboard pressure field and staggered grid approach

Unit-IV: Geometry Modeling and Grid Generation

Practical aspects of computational modeling of flow domains, Grid Generation, Types of mesh and selection criteria, Mesh quality, Key parameters and their importance

Unit-V: Methodology of CFDHT

Objectives and importance of CFDHT, CFDHT for Diffusion Equation, Convection Equation and Convection-Diffusion Equation.

Unit-VI: Solution of N-S Equations for Incompressible Flows

Semi-Explicit and Semi-Implicit Algorithms for Staggered Grid System and Non-Staggered Grid System of N-S Equations for Incompressible Flows

Term Work: It shall consist of following practicals/Assignments

1. CFD Analysis of external flow: Circular Cylinder
2. CFD analysis of heat transfer in pin fin.
3. Mini project on any practical application. Students should take a problem of their choice and verify the CFD solution with experimental data / research paper.

Practical Examination:

The practical examination consists of an oral/practical based on the syllabus prescribed above

Textbooks:

1. John D. Anderson Jr, Computational Fluid Dynamics, McGraw Hill Book Company.

Reference Books:

1. S. V. Patankar, Numerical Heat Transfer and Fluid Flow, McGraw-Hill.
2. H. K. Versteeg & W. Malalasekera, An Introduction to Computational Fluid Dynamics, Longman Scientific & Technical.
3. T. J. Chung, Computational Fluid Dynamics, Cambridge University Press.
4. J. H. Ferziger and M. Peric, Computational Methods for Fluid Dynamics, Springer.
5. John C. Tannehill, Dale A. Anderson and Richard H. Pletcher, Computational Fluid Mechanics and Heat Transfer, Taylor &Francis.
6. J. Blazek, Computational Fluid Dynamics: Principles and Applications, Elsevier.

PEC-ME407– ELEMENTS OF PLM

(CREDITS THEORY: 03, PRACTICAL:01)

Course code: PEC-ME407 (L- 03, T- 0, P- 02)

Course Objectives:

1. Establishing industry partnerships that guide, support, and validate PLM research and education activities.
2. Assisting with the integration of PLM into College curricula.
3. Facilitating the pursuit of PLM career opportunities by SGGS graduates.
4. Serving as a knowledge base for the PLM discipline.

Course Outcomes: At the end of course, student will be able to;

CO 1 Evaluate the difference between the terms PDM and PLM.

CO 2 Demonstrate the basic components and functionality of a PLM system.

CO 3 Analyze PLM tools and techniques for application in a range of practical situations.

CO 4 Integrate, install, model, maintain the PLM system.

CO 5 Solve the Industrial problem in the area of PLM

Articulation Matrix

➡ PO/PSO ⬇ CO	a	b	c	d	e	f	g	h	i	J	k	l	PSO1	PSO2
CO 1	2				3				1	1	2	2	2	3
CO2	2				3							3	2	3
CO3	3	2			2								2	3
CO4		2	3		3							3	2	3
CO5			2		3				1				2	3

Note: 1-Low, 2-Medium or 3- High

Evaluation Scheme:

Theory	**Practical**
Mid Term: 30 Marks	Continuous Evaluation: 50%
End Term: 50 Marks	Continuous Evaluation: 50%
In Semester Evaluation: 20 Marks	

Course Content:

Unit-I:

Introduction: Background, Overview, Need, Benefits, and Concept of Product Life Cycle, Product lifecycle management systems, Components / Elements of PLM, Emergence of PLM, Significance of PLM.

Unit-II:

Product Data, Product and Product Data, Product Data Examples, Product Data Issues, Metadata, Product Data Models.

Unit-III:
Product organizational structure, Human resources in product lifecycle, Information, Standards, Vendors of PLM Systems and Components, Integration of the PLM system with other applications, Examples of PLM in use. The PLM Strategy,

Unit-IV:
Product Structure, EBOM, MBOM, Workflow, Terminologies in workflow, The Link between Product Data and Product Workflow, PLM applications, PDM applications

Unit-V:
Problems in deployment. Stages of deployment, company's vision. PLM software and tools. Product Data security.

Reference Books:

1. Grieves, Michael, Product Lifecycle Management, McGraw-Hill, 2006. ISBN 0071452303
2. Antti Saaksvuori, Anselmi Immonen, Product Life Cycle Management - Springer, 1st Edition (Nov.5, 2003)
3. Stark, John. Product Lifecycle Management: Paradigm for 21st Century Product Realization, Springer-Verlag, 2004. ISBN 1852338105
4. Relevant recent technical articles, research papers, keynote addresses, etc

PEC-ME408– COMPOSITE MATERIALS

(CREDITS THEORY: 03, PRACTICAL:01)

Course code: PEC-ME408 (L- 03, T- 0, P- 02)

Course Objectives:

1. To impart sound knowledge on importance of composites, their – types, manufacturing aspects, properties and applications.
2. To gain an understanding and in-depth knowledge of the various Reinforcements and Matrix Materials.
3. To familiarize the students with modern composites, design attributes & strengthening mechanisms in composite materials.

Course Outcomes: At the end of course, student will be able to;

1. Understand the importance, types, manufacturing processes, applications & future aspects of composite materials.
2. Evaluate & analyze the mechanical properties of composite laminates.
3. Analyze toughening mechanisms in composites.
4. Fabricate PMC, MMC and CMC by selecting an appropriate processing method to use them in variety of extreme environment applications.

Articulation Matrix

➡ PO/PSO ⬇ CO	a	b	c	d	e	f	g	h	i	J	k	l	PSO1	PSO2
CO 1	3	1	2	2	2	2	2					2	2	3
CO2	3	1	1	2								1	3	2
CO3	3	1	1	2	1							1	2	2
CO4	3	1	3	2	2	3	2					2	3	3

Note: 1-Low, 2-Medium or 3- High

Evaluation Scheme:

Theory	**Practical**
Mid Term: 30 Marks	Continuous Evaluation: 50%
End Term: 50 Marks	Continuous Evaluation: 50%
In Semester Evaluation: 20 Marks	

Course Content:

Introduction to Composites: History of composite materials, Classification of composite materials, Properties of composites compared to other materials, Principles of composite reinforcement, Effect of fibrous reinforcement on composite strength, Application of Composites. (03 Hrs)

Reinforcements and Matrix Materials: Glass, Boron, Carbon, Organic, Ceramic and Metallic fibers, Manufacturing processes of fibers, Characteristic features of fibers, Surface treatment for glass fibers, Coupling agents, Particulate and flake reinforcement. Matrix Materials – Polymers, Metals and Ceramics, Composition manufacture. (06 Hrs)

Processing of Polymer Matrix Composites: Processing of thermoplastic PMCs – Injection moulding, Compression moulding, Glassmat-Thermoplastic. Processing of thermosetting PMCs – Filament winding, Pultrusion, Unidirectional Prepreg autoclave processing, Resin transfer moulding, Sheet moulding Compound. (06 Hrs)

Processing of Metal Matrix Composite: Solid State Fabrication Techniques – Diffusion Bonding, Powder Metallurgy Techniques. Plasma Spray, Chemical and Physical Vapor Deposition of Matrix on fibers. Liquid State Fabrication Methods – Infiltration, Squeeze Casting, Rheo-Casting, Compo casting. (06 Hrs)

Processing of Ceramic Matrix Composites: Processing of CMCs – Cold Compaction, Slurry Impregnation, Sol-Gel Processing, Polymer Infiltration & Pyrolysis, Vapor Deposition. Failure Behaviour in CMCs. (05 Hrs)

Toughening Mechanisms in Composite Materials: Crack Bowing, Crack Deflection, Debonding, Pull-Out, Wake Toughening, Microcrack Toughening, Transformation Toughening. (04 Hrs)

Mechanical Properties and Mechanical Testing of Composites: Rule of mixtures, Responses of polymer composites to different mechanical loading conditions, Principles and features of different mechanical test methods. (06 Hrs)

Carbon-Carbon Composites and Nanocomposites: Carbon-Carbon Composites – Processing, Interfaces, Structure, Properties and Applications. Nano-Composites – Introduction, Mechanical properties & Synthesis Methods. (04 Hrs)

Term work and Practical Evaluation: It shall consist of lab-work on problem-based learning of the topics mentioned in the above syllabus, where students will have to work on couple of open-ended problems such as:

Preparing a layout of Environmental friendly Green/Bio composite materials & suggesting its suitable applications; Selecting the materials required to design advanced composites based on the properties requirements & justifying the selection; Comparing the set of technological properties of the advanced composite materials with the conventional materials; Micro-mechanical analysis of composite lamina; Using/preparing a computer program for composite lamination theory; Selecting an appropriate processing method & Fabricating PMC/MMC/CMCs; Explaining the need of the research in the composite materials to fulfil the demand of the hi-tech applications.

Reference Books:

1. "Composite Materials: Engineering & Science", Matthews & Rawlings, CRC Press.
2. "Composite Manufacturing – Materials, Product and Processing Engineering", Mazumdar S. K., CRC Press, Boca Raton, 2002.
3. "Fiber reinforced plastics", P. K. Mallick, Marckel Dekkar Inc, 1998.
4. "Composite Material: Science and Engineering", Krishan K. Chawla, Springer.
5. "Mechanics of composite materials", Autar K. Kaw CRC Press New York.

PEC-ME411– INDUSTRIAL FLUID POWER

(CREDITS THEORY: 03)

Course code: PEC-ME411 (L- 03, T- 0, P- 0)

Course Objectives:

1. To impart knowledge of the fluid power and its various applications.
2. To familiarize physical laws and principles that governs the behavior of fluid power systems.
3. To acquaint components utilized in industrial fluid power systems.
4. To demonstrate the control systems designed for fluid power.

Course Outcomes: At the end of course, student will be able to;

CO 1 Demonstrates knowledge of basic fluid power systems.
CO 2 Formulate and analyse mathematical models of hydraulic and pneumatic circuits.
CO 3 Design & implement simple fluid power systems common in industrial applications.

Articulation Matrix

➡ PO/PSO ⬇ CO	a	b	c	d	e	f	g	h	i	J	k	l	PSO1	PSO2
CO 1	3	2	3	1	2	1					1		2	2
CO 2	2	3	2	2	2								3	2
CO 3	2	3	3	1	2				2				3	3

Note: 1-Low, 2-Medium or 3- High

Evaluation Scheme:

Component	In-Sem Evaluation	Mid term Examination	End term Examination
Theory	20 Marks	30 Marks	50 Marks

Course Content:

Unit-I: **Introduction to Fluid Power**

Fluid power system: Components, advantages and applications. Transmission of power at static and dynamic states. Pascal's law and its applications such as hydraulic press/Jack (Numerical treatment). Fluids for hydraulic system: Types, properties, selection. Additives, effect of temperature and Pressure on hydraulic fluid. Types of pipes, hoses, material, quick acting couplings. Pressure drop in hoses/pipes.

Unit-II:

Pumps: Types, classification, principle of working and constructional details of Vane pumps, gear pumps, radial and axial plunger pumps, screw pumps, power and efficiency calculations, characteristics curves, selection of pumps for hydraulic Power transmission.

Power units and accessories: Types of power units, reservoir assembly, constructional details, pressure switches, temperature switches. Accumulators: Types, selection, applications of accumulators.

Unit-III: Fluid Power Control

Symbols for hydraulic and pneumatic circuits. Control of fluid power through different valves such as pressure control valves, directional control valves, and flow control valves (Principle, classification, constructional details, symbols, advantages, disadvantages and applications).Flow rate, working pressure, differential pressure Check valve, Servo valves, Proportional valves and Cartridge valves, cut off Valves.

Unit-IV: Hydraulics

Actuators: Linear and Rotary, Hydraulic motors- Types- Vane, gear, Piston types, radial piston. Methods of control of acceleration, deceleration. Types of cylinders and mountings. Calculation of piston velocity, thrust under static and dynamic applications, considering friction, inertia loads. Design considerations for cylinders. Cushioning of cylinders. (Numerical treatment)

Industrial circuits – Simple reciprocating, Regenerative, Speed control (Meter in, Meter out and bleed off), Sequencing, Synchronization, transverse and feed, circuit for riveting machine, automatic reciprocating, fail safe circuit, counter balance circuit, actuator locking, circuit for hydraulic press, unloading circuit (Numerical treatment), motor breaking circuit.

Unit-V: Pneumatics

Principle of Pneumatics, Comparison of Pneumatics with Hydraulic power transmissions, Types of filters, regulators, lubricators, mufflers, dryers, Pressure regulating valves, Solenoid operated valves, push button, lever control valves, Speed regulating - Methods used in Pneumatics, Pneumatic actuators-rotary, reciprocating, Air motors- radial piston, vane, axial piston, Basic pneumatic circuit, selection of components, Application of pneumatics

Unit-VI: System Design

Design of hydraulic/pneumatic circuit for practical application, Selection of different components such as reservoir, various valves, actuators, filters, pumps based on design. (Students are advised to refer manufacturer's catalogues)

Reference Books:

1. Pinches, Industrial Fluid Power, Prentice hall
2. D. A. Pease, Basic Fluid Power, Prentice hall
3. J. J. Pipenger, Industrial Hydraulics, McGraw Hill
2. Andrew A. Parr, Hydraulics and Pneumatics, Elsevier Science and Technology Books.
3. Majumdar, Pneumatic Systems, Tata McGraw Hill
4. Majumdar, Oil Hydraulics- Principle and Maintenance, Tata McGraw Hill.
5. Product Manuals and books from Vickers/ Eaton, FESTO, SMC pneumatics can be referred

PEC-ME412– QUALITY AND RELIABILITY ENGINEERING

(CREDITS THEORY: 03)

Course code: PEC-ME412 (L- 03, T- 0, P- 0)

Course Objectives:

1. To understand fundamental concepts of quality Control. Objectives.
2. To study various quality control tools and techniques. Objectives
3. To study the quality control charts, process capability analysis and its applications. Objectives
4. To study the fundamentals of Acceptance Sampling, its use and economics.
5. Introduction to the Reliability Engineering.

Course Outcomes: At the end of course, student will be able to;

CO 1 Interpret the basic principles of probability theory, standard distributions.
CO 2 Understand and solve numerical on confidence interval, test of hypothesis.
CO 3 Solve numerical examples on statistical process control, rules for out of control, average run length, warning limits, probability of false alarm, etc.
CO 4 Solve numerical examples on variable and attribute control charts, process capability analysis.
CO 5 Design a single/double sampling plan, construct its OC curve, and estimate ATI, AOQ and other indices, evaluate economics of sampling.
CO 6 Solve numerical on system reliability estimation.

Articulation Matrix

➡ PO/PSO ⬇ CO	a	b	c	d	e	f	g	h	i	J	k	l	PSO1	PSO2
CO 1	2												2	2
CO2		2	2										2	1
CO3		1	3										2	2
CO4		2	3	3									2	2
CO5		2	3	3									2	2
CO6		1	3										2	2

Note: 1-Low, 2-Medium or 3- High

Evaluation Scheme:

Component	In-Sem Evaluation	Mid term Examination	End term Examination
Theory	20 Marks	30 Marks	50 Marks

Course Content:

Unit-I: Introduction (05)

Quality, components of quality control viz; quality of design, quality of conformance, quality assurance, statistical process control, role of Q. C. in industries

Basic Probability Concepts: The histogram, numerical indices for summarizing data (mean, median, standard deviation, etc) probability distribution (Normal, Exponential, Poisson, Binomial) concept, nature and applicability.

Unit-II: Statistical Estimation (05)

Sampling Distribution, Centre Limit Theorem, Confidence Interval, Accuracy of estimates, Hypothesis Testing, Type of Tests.

Unit-III: Fundamentals of Statistical Process Control (06)

Causes of variation, Statistical basis for control limits, Selection of control limits, Warning limits, Effect of sample size, Effect of choice of control limits, Interpretation of Lack of Statistical Control, Rules for out of control process, Estimation of Probability of false alarm, Average Run Length.

Unit-IV: Control Charts (10)

Control Charts for Variables: X & R, σ Charts, Estimation of Control Limits, Effect of shift in mean of the process, O. C. curve for control charts, Interpretation of Patterns of Variation on variable control Charts.

Control Charts for Attributes: Advantages and disadvantages, Estimation of control limits for p, c, np, u-Charts.

Process Capability Analysis: Objectives of Analysis, Estimation of Process Capability, Process Capability Indices, Viz: Cp, Cpk, Cpm, and their Interpretation, Estimation of rework and scrap.

Unit-V: Acceptance Sampling (08)

Concepts and importance of sampling, economics of sampling inspection cost of inspection, break even quality. Symbols and terms used in relation to sampling plans. Lot-by-lot acceptance using single sampling plan, OC curves, sampling risk, AQL, LTPD, alpha and beta risk, construction of OC curve for given sampling plan, estimating alpha and beta risks for a given plan. Effect of; lot size, sample size, acceptance number, on producer's and customer's risk. Design of sampling plans for given sampling risks. Estimation of performance indices such as; Average outgoing Quality, the the AOQL, and Average total inspection etc. Double sampling plans, Grubb's tables for selection of plans, analysis of double sampling plans, Estimation of performance indices, minimizing average total inspection. Use of ANSI/ASQC Z 1. 4 standards, for attribute sampling plans switching procedure, for normal and tightened inspections. Use of Dodge - Romig sampling plans. Construction of OC curves. Estimation of average inspection, average sample number, sampling risks, etc. for single and double sampling plans selected for the standard plan. AOQL, and Average total inspection etc.

Unit-VI: Reliability Engineering (05)

Introduction, Bathtub curve, causes of failure, concepts/definitions of reliability availability, maintainability. Computation of component reliability: failure rate, hazard rate, MTBF, MTTF etc. Reliability of series, parallel and standby systems configuration, redundancy. Product/component design analysis using FMECA and fault tree analysis

Textbooks:

1. Quality Planning and Analysis - J. M. Juran, Frank M. Gryna - Tata McGraw Hill.
2. Fundamentals of Quality Control and Improvement – Amitava Mitra Pearson Education Inc.

Reference Books:

1. Quality control handbook by J. M. Juran, Frank M. Gryna - Tata McGraw Hill.
2. Statistical Quality Control - E. L. Grant, R. S. Leavenwort --- Tata McGraw Hill
3. Mechanical Reliability – L. S. Srinath.

PEC-ME413– FRACTURE MECHANICS

(CREDITS THEORY: 03)

Course code: PEC-ME413 (L- 03, T- 0, P- 0)

Course Objectives:

1. To pass on knowledge of fracture mechanics
2. To percolate knowledge of using fracture mechanics in the actual design
3. To pass on knowledge of using materials with existing cracks and know the behavior of existing cracks.

Course Outcomes: At the end of course, student will be able to;

CO 1 Present basic knowledge about fracture mechanics.

CO 2 Predict the life of the components under fatigue loading.

CO 3 Identify/ suggest the phenomenon of crack propagation leading to failure of components

Articulation Matrix

➡ PO/PSO ⬇ CO	a	b	c	d	e	f	g	h	i	J	k	l	PSO1	PSO2
CO 1	3	2											2	3
CO2		2	3	3	2								2	3
CO3		2	3	3									2	3

Note: 1-Low, 2-Medium or 3- High

Evaluation Scheme:

Component	In-Sem Evaluation	Mid term Examination	End term Examination
Theory	20 Marks	30 Marks	50 Marks

Course Content:

Unit-I: Introduction (05)

Kinds of Failure, Historical Aspects, Brittle and Ductile Fracture, Modes of Fracture Failure, How Potent is a Crack? Point of View, Damage Tolerance.

Unit-II: Energy Release Rate (05)

Introduction, Griffith's Dilemma, Surface Energy, Griffith's Realization, Griffith's Analysis, Energy Release Rate, Definition, Mathematical Formulation, Change in Compliance Approach , Change in the Strain Energy Approach, Energy Release Rate of DCB Specimen , Anelastic Deformation at Crack-tip, Crack Resistance, Stable and Unstable Crack Growth, R-curve for Brittle Cracks, Thin Plate vs Thick Plate, Critical Energy Release Rate.

Unit-III: Crack tip plasticity (10)

Irwin plastic zone size - Dugdale approach - shape of plastic zone - state of stress in the crack tip region - influence of stress state on fracture behavior- LEFM testing: Plane strain and plane stress fracture toughness testing -determination of R-curves.

Unit-IV: Elastic plastic fracture mechanics (EPFM) (12)

Development of EPFM - J-integral – Definition-Path Independence-Application to engineering problems-crack opening displacement (COD) approach - COD design curve - relation between J and COD - tearing modulus concept - standard JIc test and COD test 26.

Unit-V: Fatigue crack growth: Mechanisms of fracture and crack growth (12)

Description of fatigue crack growth using stress intensity factor - effects of stress ratio - crack closure - prediction of fatigue crack growth under constant amplitude and variable amplitude loading - Fatigue Crack Initiation- Time-to-failure (TTF) tests - crack growth rate testing - practical significance of sustained load fracture testing- Basic aspects of Dynamic Crack Growth-Basic Principles of Crack Arrest -Fracture Mechanics Analysis of fast fracture and Crack Arrest.

Textbooks:

1. Prashant Kumar, Elements of Fracture Mechanics, Wheeler Publishing.

Reference Books:

1. M. Janssen, J. Zuidema and R. J. H. Wanhill., Fracture Mechanics, Taylor & Francis.
2. Broek D., Elementary Engineering Fracture Mechanics, Sijthoff & Noordhoff International Publishers.
3. T.L. Anderson, Fracture Mechanics Fundamentals and Applications, CRC PRESS.

PEC-ME414– RENEWABLE ENERGY

(CREDITS THEORY: 03)

Course code: PEC-ME414 (L- 03, T- 0, P- 0)

Course Objectives:

1. To study energy generation, different energy sources and their utilization and impact on environment
2. To gain knowledge of solar radiation and its applications
3. To understand the wind energy and its nature
4. To analyze the performance of solar collectors and wind turbines
5. To learn fuel cell and its efficiency

Course Outcomes: At the end of course, student will be able to;

CO 1 Interpret energy reserves of India and potential of different energy sources.
CO 2 Measure the solar radiation parameters and performance of different solar collectors.
CO 3 Calculate different parameters of wind turbine rotor.
CO 4 Appraise the importance and applications of geothermal and ocean energy.
CO 5 Demonstrate knowledge in field of fuel cell and potential for power generation

Articulation Matrix

➡ PO/PSO ⬇ CO	a	b	c	d	e	f	g	h	i	J	k	l	PSO1	PSO2
CO 1	1	2	2	2		2	1		1				1	2
CO2	2	1	2	3	1		2		1				2	2
CO3	2	1	2	3	1								2	1
CO4	1	2	2	2	1								1	2
CO5	1	2	3	2	1								1	1

Note: 1-Low, 2-Medium or 3- High

Evaluation Scheme:

Component	In-Sem Evaluation	Mid term Examination	End term Examination
Theory	20 Marks	30 Marks	50 Marks

Course Content:

Unit-I: Introduction (06)

Conservation and forms of energy, energy reserves in India, India's power scene, renewable energy sources, energy efficiency and conservation, Environmental aspects of electric energy generation

Unit-II: Solar radiation and measurement (04)

Solar constant, spectral distribution of extraterrestrial radiation, terrestrial solar radiation, solar radiation geometry, computation of COSθ, sunrise, sunset, day length, solar radiation measurement and Solar radiation data for India.

Unit-III:

Solar collector and applications (6)

Solar Thermal energy collectors, design parameters, analysis, performance, laws of thermal radiation, radiation heat transfer between real bodies, radiation optics, transmittivity, heat losses and coefficient, Solar Thermal energy storage. Solar thermal energy conservation systems – Solar water heating, solar distillation, thermodynamic cycles and power plants, solar ponds, solar pumping system, solar cooker, solar passive technologies, solar furnace, solar green house.

Solar photovoltaic systems (4)

Photovoltaic effect, solar photovoltaic system, materials for solar cells, characteristics, efficiency, applications PV system, plastic solar cell with nanotechnology, peltier cooling, solar photovoltaic in India.

Unit-IV:

Wind energy (6)

Classification, types of rotors, terminology, operation of wind turbines, wind energy extraction, wind characteristics, wind speed, energy estimation, power density duration curve, density function, direction and wind speed, energy pattern factor in wind power studies, wind power generation curve, horizontal axis wind turbine generator, advantages and disadvantages.

Unit-VI:

Fuel Cells (6)

Principle of operation of an acidic Fuel Cell, Technical parameter, Fuel Processor, methanol fuel cell, fuel cell types, Advantages of fuel cell power plants, fuel cell battery powered bus system, comparison between acidic and alkaline hydrogen-oxygen fuel cells, state of art fuel cells, energy output of a fuel cell, efficiency and EMF of a fuel cell, comparison of electrolysis and the fuel cell process, operating characteristics of fuel cells, thermal efficiency, future potential.

Hybrid Energy Systems (4)

Need for hybrid systems, types, electric and hybrid electric vehicles, hydrogen powered electric vehicle.

Textbooks:

1. D.P.Kothari, K.C.Singal and Rakesh Ranjan, "Renewable Energy Sources and Emerging Technologies", Prentice Hall of India, New Delhi, 2009.

Reference Books:

1. Chetan Singh Solanki, "Renewable Energy Technologies", Prentice Hall of India, New Delhi, 2009
2. G. D. Rai, "Non- conventional Energy Sources", Khanna publishers, New Delhi, 2011.
3. Malti Goel, "Energy Sources and Global Warming", allied publishers Pvt Ltd. New Delhi, 2005.
4. S.P. Sukhatme, "Solar Energy: Principles of Thermal Collection and Storage", TMH, New
5. Delhi, 2008.

PEC-ME415– HEATING, VENTILATION AND AIR CONDITIONING (HVAC)

(CREDITS THEORY: 03)

Course code: PEC-ME415 (L- 03, T- 0, P- 0)

Course Objectives:

1. To understand the basics of Heating Ventilation and Air-Conditioning system.
2. To familiarize the general aspects of ducting and air distribution system.
3. To understand cooling-load and heating-load calculations involved in HVAC system design.
4. To compare different air conditioning systems.
5. To impart the skills for designing HVAC systems as per requirement and application.

Course Outcomes: At the end of course, student will be able to;

CO 1 Apply the concepts of psychometrics and thermodynamics to heating and cooling analysis.

CO 2 Use basic concepts from heat transfer to determine heat gained or lost from a building.

CO 3 Design air-handling systems using concepts from fluid dynamics.

CO 4 Apply good engineering principles to meet the requirements for air quality control and comfort conditions.

Articulation Matrix

➡ PO/PSO ⬇ CO	a	b	c	d	e	f	g	h	i	J	k	l	PSO1	PSO2
CO 1	3	2	2	1	2	1	2		1				2	3
CO2	2	3	2	2	2	1	2		1				2	3
CO3	3	2	3	2	2	1	2		1				2	3
CO4	3	3	2	3	2	2	2		1				2	3

Note: 1-Low, 2-Medium or 3- High

Evaluation Scheme:

Component	In-Sem Evaluation	Mid term Examination	End term Examination
Theory	20 Marks	30 Marks	50 Marks

Course Content:

Unit-I:

Introduction: Overview of Industry and Scope of HVAC, applications of HAVC, definitions and terminology. Function & Types of basic Components of Air-Conditioning and Refrigeration machines.

Unit-II:

Duct: Duct Systems- General Aspects, Duct Size, Shape, Material and Construction, Pressure in Ducts, Continuity and Bernoulli's equation for ducts, Pressure Losses in Ducts-Pressure loss due to friction in ducts, Equivalent diameter of a circular duct for rectangular duct, Friction chart for circular ducts, Dynamic losses in

ducts- Pressure loss due to enlargement in area and static regain, pressure loss due to contraction in area, pressure loss at suction and discharge of duct, pressure loss due to obstruction in a duct, Duct design-general aspects, Determination of duct size, Leakage of air and maintenance of ducts.

Air Distribution Systems: Definitions, Principles of Air-distribution, Air-handling System, Room air-distribution- Requirements of good room air-distribution, Draft, Types of supply air outlets, Arrangement of ducts, Types of air-distribution systems.

Unit-III: Load Estimation

Introduction, Cooling-load Estimate, Heating-load Estimate, Solar Radiation, Solar heat gain through Glass, Heat through Building Structures (Thermal Barrier), Infiltration, Internal Heat gains- Heat load of occupants, Electric load, Product load, Process load, System Heat Gains, Different factors to be considered in load Estimation Sheet for Comfort Application, Design of Cold Storage.

Unit-IV: Air conditioning systems

Central system, Zoned system, Unitary system, Air-conditioning Equipment, Air-conditioning Components, Air-conditioning Controls, Noise and Noise Control.

Unit-V:

Air conditioning Applications: Typical air conditioning systems such as automobile, airplane, ships, railway coach air-conditioning. All the Year-round Air-conditioner, Year-round Absorption Air-conditioner, Air-conditioning of Theatres.

Textbooks:

1. Refrigeration and Air Conditioning, Arora, C.P., Tata-McGraw- Hill, New Delhi, 2003.
2. Refrigeration and Air-Conditioning by R.K. Rajput, S. Chand Publications.

Reference Books:

1. ASHRAE Handbook - Fundamentals, American Society of Heating, Refrigerating and Air - Conditioning Engineers Inc., Atlanta, USA, 2009.

SII-ME421– INTERNSHIP

(CREDITS: 02)

Course code: SII-ME421	**Contact Hours: Unsupervised learning**

Course Objectives:

1. To make students aware about different types of industries.
2. To make students understand the organization structure of the industry.
3. To study different processes and different machines.
4. To study the state of art technology used by reputed industries.
5. To make students understand the communication between management and employers and between managers and workers.
6. To study different welfare facilities provided by the company to their employees.
7. To get hands on experience on different machines.

Course Outcomes: At the end of course, students will able to;

CO 1 Increase knowledge and skill of the industrial world for practical applications.

CO 2 Develop expertise capability of practical knowledge on the site

Articulation Matrix

➡PO/PSO ⬇ CO	a	b	c	d	e	f	g	h	i	J	k	l	PSO1	PSO2
CO1	3	2	2	1	1				3	1			1	1
CO2	1											1	2	1

Note: 1-Low, 2-Medium or 3- High

Evaluation Scheme:

Sr. No.	Component	Weightage (%)	Remarks
1	Continuous Evaluation	**50**	Evaluation based on Attendance, Performance and Regular Assessment during Internship
2	End Term Evaluation	**50**	Evaluation based on Performance during Presentation and Report writing

Note:

1. Internships have to be an industrial activity as it is supposed to complete during winter/summer vacation in industry only.

2. Internships must be performed individually or in groups (Max 4 students in a group) and individual's roll/participation/ work will be evaluated through diary, reports and presentations.
3. Internships is a self-guided activity.
4. Every student will be undergoing industrial internship for minimum 4 weeks in one Engineering Industry immediately after SY/TY examination and before admitted to final year B.Tech.
5. Internship will be evaluated at the end of VIIth semester.
6. However, grading will be awarded at the end of VIII semester of the B. Tech Mechanical Engineering Program

Report writing should be done only as per given guidelines.

Course Contents:

A student is expected to study the following aspects of the industry where he/she is undergoing industrial internship.

1. Organization structures.
2. General plant layout.
3. Machine tools.
4. Production processes etc.

Evaluation method: It shall consist of oral examination/presentation of industrial internship in presence of examiners panel.

PRJ-ME422– Mini Project

(CREDITS: 02)

Course code: PRJ-ME422 (**1 Hr/week for a batch of 18 students**)

Course Objectives:

1. To motivate the students for applying engineering knowledge for benefits of society
2. To develop an ability to design and conduct experiments, as well as to analyze and interpret data
3. To develop an ability to function on multidisciplinary teams.
4. To develop an ability to identify, formulate, and solve engineering problems

Course Outcomes: At the end of course, student will be able to;

CO l. Shows ability to design, analyze and manufacture the machine/components

CO2. Understand methodology and interpret data

CO3. Develop techniques to reduce waste, pollution and energy.

CO4. Function in multidisciplinary teams, understand professional and ethical responsibility, learn presentation skills and documentation.

Articulation Matrix

➡PO/PSO ⬇ CO	a	b	c	d	e	f	g	h	i	J	k	l	PSO1	PSO2
CO1	3	3	3										2	2
CO2		3	2										2	3
CO3	1						3				3		2	3
CO4								2	3	3	2	1	2	3

Note: 1-Low, 2-Medium or 3- High

Evaluation Scheme:

Component	Continuous Evaluation	End term Evaluation
Practical	50%	50%

Note:

1. Mini Project have to be in-house activity as it is supposed to complete during academic period.
2. Mini Projects have to be performed individually or in groups (Max 3 students in a group) and individual's roll/participation/ work will be evaluated through project diary and presentations.
3. Student/group can accomplish mini project in any semester from III to VII.
4. At the start of every semester (from III to VII), registration will be open for the student/group to register themselves.
5. A guide cum mentor will be assigned for each individual/group as soon as student/group register themselves.
6. Mini project will be evaluated in same semester during which student/group register for it. Without registration mini project will not be evaluated in any case.

7. However, grades will be awarded at the end of VIII semester of the B. Tech Mechanical Engineering Program
8. Report writing should be done only as per given guidelines.

Course Contents:

This course will be considered as exercise project before Major project. Thus, student has to carry out the all activities similar to the Major project course.

The project may include following but not limited to:

1. Extensive study and analysis of system
2. Design/Modeling and fabrication of system
3. Duplication of system with complete understanding
4. Waste to best products which involves engineering knowledge
5. Automated mechanism
6. Projects related to renewable energy
7. Efficiency improvement techniques/ideas
8. Waste management
9. Energy Management
10. Climate, Clean Development Mechanism
11. Robotic vehicle
12. Projects related automotive industry
13. IoT Projects
14. Aesthetic changeover of existing system
15. Miniaturization of existing system
16. CFD Coding /Simulation
17. Project related departmental lab development
18. Virtual experiment development
19. Optimization techniques

Evaluation method: It shall consist of oral examination/demonstration of mini project in presence of examiners panel with submission of hard/spiral bound report on project work.

PRJ-ME423– Major Project

(CREDITS: 12)

Course code: PRJ-ME423 (**06 Hrs/week for a batch of 09 students**)

Course Objectives:

Final year project is an important component of the Programme, and it satisfies many Programme outcomes. It can be undertaken in an industry or in the department. In case of the industry project the student is expected to work under the supervision of the engineer and try to solve industry problem. He shall report to department guide also and appraise him about the progress of project from time to time. For in house project students will work on a topic of relevance and are encouraged to implement innovative concepts leading to filing of patent. A group of approximately 4 students will be allotted the project topic.

The objectives of the project work are listed below:

1. To learn engineering skills and knowledge for implementation.
2. To convert concept/ideas into useful products.
3. To do innovative work leading to patent/start up.
4. To work in team for solving the problems related to society/industry

Course Outcomes: At the end of course, students will able to;

CO 1 Design, analyze and manufacture the machines/testing rigs/experimental setups.
CO 2 Customize/develop software in the relevant area.
CO 3 Solve the problems of industry through acquired knowledge during the course work.
CO 4 Exhibit presentation and documentation skills.
CO 5 Improves Communication.
CO 6 Interfaced with Technological Excellence

Articulation Matrix

➡ PO/PSO ⬇ CO	a	b	c	d	e	f	g	h	i	J	k	l	PSO1	PSO2
CO 1	1	3	3	3	3	3	2						3	3
CO2			3	3									3	3
CO3			3	3									3	3
CO4	3								3	3	3	3	3	3
CO5								3		3			3	3
CO6												3	3	3

Note: 1-Low, 2-Medium or 3- High

Evaluation Scheme:

The evaluation shall be carried out on continuous basis. There shall be two-three presentations during the semester, by the students as per the progress of the work. Each of these presentations shall be evaluated in presence of supervisor and accordingly graded. The end-term presentation shall be in presence of panel of examiners. The end-term presentation should include; literature survey, preliminary project work carried, project work plan, time schedule, data collection plan, Industry based component, details of design and drawing, lists of components, fabrication details, etc. The in-semester presentations (continuous evaluation component) and the end-term presentation shall carry a 50% weightage each.

1. The students doing project in industry have to maintain a project diary, in which continuous (at least weekly) improvement of work should be noted and should be duly signed by supervisor (industry person).
2. The students who are doing in-house project (non-industrial) should also maintain project diary and must report improvements in work to the guide/supervisor in institute 04 hours weekly at least.
3. Projects must be performed in groups (Max 4-5 student in a group) and individual's roll/participation/ work will be evaluated through project diary and presentations.
4. Project Report writing should be done only as per given guidelines.

Component	Continuous Evaluation	End term Evaluation
Practical	50%	50%

Course Content:

The project work may consist of an extensive work, study or analysis of field/industrial problems with appropriate solutions or remedies. It includes like:

1. Fabrication of model, machine, prototype based on innovative ideas.
2. Modeling and/or simulation of a system and improvements in the system.
3. Design of experiments, experimental setups, fabrication of test equipment, experimentation and Statistical analysis, comparison with the existing data.
4. Renovation of machines, testing equipment. 5. Extensive analysis of some problems solved with the help of suitable software.
5. Design, modeling, analysis and so on as deemed fit.

Term Work:

It shall consist of progress report submission during Midterm presentation and final hard bound report submission at the time of End term submission/presentation.

Practical Examination:

It shall consist of oral examination/demonstration of project in presence of guide/supervisors and external examiners or panel of the same.