CHAITANYA BHARATHI INSTITUTE OF TECHNOLOGY

DEPARTMENT OF MECHANICAL ENGINEERING

ACTION TAKEN TOWARDS STAKEHOLDERS FEEDBACK ON CURRICULUM

2023-24

SNo	Description	Action Taken/Proposed	Page No
1	Dr. P.V.R. Ravindra Reddy suggested that, due to the wide range of components in industrial and daily use, it is better to have an exclusive course on composite materials and their testing.	The course titled "Composite Materials and Testing" was introduced as Professional Elective-V in VII semester of R20 curriculum.	6, 7-8
2	Dr. P.V.R. Ravindra Reddy opined that, "Industry 4.0" may be introduced as an exclusive course, as the industries are adopting the concepts of Industry 4.0 are more and more.	The course titled "Digital Manufacturing and Industry 4.0" was introduced as Professional Elective-V in VII semester of R20 curriculum.	6, 9-10
3	Dr. R.P. Chowdary, Dr. V.V.R. Seshagiri Rao and Sri D. Ravi, expressed the opinion that, as more questions are being asked in the GATE examination in the advanced concepts of Heat Transfer which are observed to be missing in the course "ATD&HT" syllabus which combines both the subjects. Hence, it is suggested to split the course ATD&HT into 2 subjects and introduce "Heat Transfer" as an individual course with complete focus on the concepts of Heat Transfer.	Keeping in view the importance of the suggestion and on the advice of the subjects experts, ONE separate course 'Heat Transfer' was introduced in III semester and ONE course 'Applied Thermodynamics' was introduced in IV semester of R22 curriculum.	11, 12-13, 14, 15-16
4	Dr. R.P. Chowdary, Dr. V.V.R. Seshagiri Rao, Dr. K. Kishor and Sri D. Ravi opined that, as more questions are being asked in the GATE and PSU examinations on the basics of Fluid Mechanics which are not covered in the course "FPHM", which mainly focuses on applications of Fluid Laws and the basics of Fluid Mechanics are not discussed. Hence it is suggested to add Fluid Mechanics topics and rename the course as FMHM with more emphasis on Fluid Mechanics.	As the topics related to 'Fluid Mechanics' were not there in anycourse, they were added in the syllabus and the course was accordingly named 'Fluid Mechanics and Hydraulic Machines' and was introduced inIV semester of R22 curriculum.	14, 17-18

SNo	Description	Action Taken/Proposed	Page No
5	Dr. R.P. Chowdary suggested that, a course can be introduced which linksup electronic components in today engine manufacturing.	Keeping the suitability of the suggestion with the present day advancements in engine manufacturing and on the suggestion of subject experts, the course titled "Electronic Engine Management Systems" was introduced as an Elective subject in II semester of ME (Thermal Engineering) program.	19, 20-21
6	Dr. S. Narasimha Kumar suggested to include exclusive topic on Solar Energy Technologies in place of 'Design of Solar and Wind Systems'.	Based on the deliberations of subject experts, the course titled "Solar energy technologies" was introduced as an Elective subject in I semester of ME (Thermal Engineering) program and Lab for the above course was introduced.	22, 23-24
7	Dr. V.V.R. Seshagiri Rao suggested to include the course "Jet & Rocket Propulsion" for ME (Thermal Engineering) students, so as to meet the industry needs.	Based on the suggestion of subject experts, a new course "Jet & Rocket Propulsion" was introduced as an Elective course in II semester of R23 curriculum for ME (Thermal Engg) students.	19, 25-26
8	Dr. S. Solomon Raj and Mr. K. Pavan suggested to include a course on Control Systems, as it helps a student to better understand the technology in Robots & Drones and the course is an integral part of Industry 4.0 and 5.0 and it will be helpful for the students who are aspiring for Automation career.	Based on the recommendations of subject experts, a new course titled "Control System Theory" was introduced as Professional Elective-V in VII semester of R20 curriculum.	6, 27-28
9	Dr. B.V.S. Rao opined that, for the student to learn modern manufacturing techniques coupled with 3D printing, AI and IOT, a course on Digital Manufacturing which covers all modern making techniques can be included.	As per the suggestion of subject experts, a new course titled "Digital Manufacturing and Industry 4.0" was introduced as Professional Elective-V in VII semester of R20 curriculum.	6, 9-10
10	Dr. S. Narasimha Kumar suggested to include courses like Cryogenics, as this will benefit the students in future for employment and research framework.	As per the suggestions of CEG members, a new course "Cryogenic Engineering" was introduced as an Elective course in II semester of R23 curriculum for ME (Thermal Engineering) students.	19, 29-30
11	Dr. P. Anjani Devi suggested that, advanced exercises of Computer Aided Design can be added in the lab syllabus.	The syllabus was modified on consultations with the subject experts for the course "Advanced Computer Aided Design Lab" in I semester of ME (CAD/CAM) in R23 curriculum.	31, 32-33

SNo	Description	Action Taken/Proposed	Page No
12	Dr. I. Vamsi opined that, the course on Mechanical Vibrations is very important in GATE and other competitive examinations. Also, several MS programs offered by pioneering institutions are centric towards mechanical vibrations.	Keeping in view the importance of the suggestion and on the advice of the subjects experts, the course "Mechanical Vibrations" was introduced as an Elective in VII semester of R20 curriculum.	6, 33-34
13	Mr. Koustubh Soudarthi suggested that, having been working with the related industry, it will be good for the students to add the concepts of advancements in automobiles like Electric and Hybrid vehicles in controlling the pollution.	The syllabus was modified on consultations with the subject experts for the course "Automobile Engineering" in VII semester of R20 curriculum.	6, 35-36
14	Mr. Murari Pushparaj Ale, working with Random Foods LLP, Co-logic.ai, suggested to include advanced topics in the courses on Refrigeration like HVAC and Cryogenics.	As per the suggestions of CEG members and subject experts, two courses "Heating Ventilation & Air Conditioning" and "Refrigeration Technology" were introduced as Elective courses in I and II semesters of R23 curriculum for ME (Thermal Engineering) students.	19, 39-40, 22, 37-38
15	Ms. Saba Iram suggested that, keeping pace with the marketing trends, the concept of supply chain in IT field needed to be added to the syllabus.	The syllabus was modified on consultation with the subject experts for the course "Supply Chain Management" in VII semester of R20 curriculum.	6, 41-42
17	Mr. P. Sruthi Shanker, a Ph.D. student pursuing in Cargenic Mellon University, Pittsburgh, PA, USA, suggested to introduce a course on Environmental Engineering and Pollution Control Methodology, in line with the present industry needs and research framework in evolving ideas to avoid the dangers of pollution.	Keeping in view the importance of the suggestion and on the advice of the subjects experts, the course "Environmental Engineering and Pollution Control" was introduced as an Elective in I semester of R23 curriculum for ME (Thermal Engg	22, 43-44
18	Mr. Sai Manish Reddy Mekarthy working with Eli Lilly and Company, North Carolina, USA, opined that, as majority of industries are adopting the concepts of Waste Heat Recovery, introducing the respective course will be helpful.	Keeping in view the importance of the suggestion and on the advice of the subjects experts, the course "Energy Conservation and Waste Heat Recovery" was introduced as an Elective in I semester of R23 curriculum for ME (Thermal Engineering).	22, 49-50
19	Mr. M. Sri Harsha, working with Medha Servo Drives Pvt. Ltd., Cherlapally, suggested to introduce the concepts of Heat Exchangers and Turbo Machines, so as to meet the industry requirements.	As per the suggestions of CEG members and subject experts "Design of Heat Exchangers" and "Turbo Machines" were introduced as Elective courses in II semester of R23 curriculum for ME (Thermal Engineering)	19, 45-48

20	Sri Kirti Arora, parent of Mr. G. Veerabhadra, said that they mainly expecting placements.	Industry specific training programmes were conducted for the shortlisted students to improve the performance of the students in the campus placements.	51
21	Ms. Sireesha Baile, working as Manager in BHEL Corp. R&D, Hyderabad, suggested that, the topics "Steam Boilers' and 'Steam Nozzles' are there in the GATE examination, hence these topics can be included in the syllabus for the course 'Applied Thermodynamics'.	Keeping in view the importance of the suggestion and on the advice of the subjects experts, the topics "Steam Boilers' and 'Steam Nozzles' were included in the syllabus for the course 'Applied Thermodynamics' and was in IV semester of R22 Curriculum.	14, 15-16
22	Ms. Sireesha Baile, working as Manager in BHEL Corp. R&D, Hyderabad, suggested that, the topics "Transient Heat Conduction' and 'Radiation' are there in the GATE examination, hence a separate course 'Heat Transfer' can be introduced in the curriculum.	Keeping in view the importance of the suggestion and on the advice of the subjects experts, ONE separate course 'Heat Transfer' with the topics "Transient Heat Conduction' and 'Radiation' was introduced in III semester of R22 curriculum.	11, 12-13
23	Mr. R. Aravind working with INFOSYS, suggested to include multidisciplinary subject related to industry	A course 'Business analytics' which is multidisciplinary is included in III semester of R23 curriculum for ME (Thermal Engg).	52, 53-54
24	Ms. S. Sowmya Reddy working in SKYLARK SMART METERS suggested adding a smart materials course in the curriculum..	A new course 'Smart Materials and Structures' was introduced in the curriculum in II semester of R23 curriculum for ME (CAD/CAM).	55-56, 57-58

With effect from the academic year 2023-24

CHAITANYA BHARATHI INSTITUTE OF TECHNOLOGY (A)

Scheme of Instruction as per R20 Curriculum

B.E. (MECHANICAL ENGINEERING)

SEMESTER – VII

S. No.	Course Code	Title of the Course	Scheme of instruction			Scheme of Examination			Credits
			Hours per week			Duration in Hours	Maximum Marks		
			L	T	P/D		CIE	SEE	
THEORY									
1		Professional Elective - IV	3	--	--	3	40	60	3
2		Professional Elective - V	3	--	--	3	40	60	3
3		Open Elective - II	3	--	--	3	40	60	3
4		Open Elective – III	3	--	--	3	40	60	3
5	20EGM04	Gender Sensitization	2	--	--	2	--	50	*Non Credit
6	20MBC01	Engineering Economics and Accountancy	3	--	--	3	40	60	3
PRACTICALS									
7	20MEC33	Project Part-1	--	--	4	--	50	--	2
		Internship	4-6 Weeks/ 180 hours						3
TOTAL			**17**	**--**	**04**	**--**	**250**	**350**	**17+3**

L: Lecture T: Tutorial D: Drawing P: Practical

CIE - Continuous Internal Evaluation SEE – Semester End Examination

Professional Elective – IV (3/3)			Professional Elective – V (3/3)		
S.No.	Subject Code	Name of the Subject	S. No.	Subject Code	Name of the Subject
1	20MEE13	Automobile Engineering	1	20ME E17	Renewable Energy Sources
2	20MEE14	Control System Theory	2	20ME E18	Digital Manufacturing and Industry 4.0
3	20MEE15	Mechanical Vibrations	3	20ME E19	Composite Materials and Testing
4	20MEE16	Supply Chain Management	4	20ME E20	Block Chain Technology

ASSOCIATE PROFESSOR & HEAD
Department of Mechanical Engineering
Chaitanya Bharathi Institute of Technology (A)
Gandipet, Hyderabad-500 075. Telangana.

20MEE19 With Effect from the Academic Year 2023–24

COMPOSITE MATERIALS AND TESTING

(Professional Elective-V)

Instruction	3	Hours per week
Duration of SEE	3	Hours
SEE	60	Marks
CIE	40	Marks
Credits	3	

Objectives: Student will understand the

1. Types of composite materials used in commercial composites.
2. Prediction of the properties of UD lamina based on the constituent materials.
3. Method of predicting failure in composite lamina using different theories.
4. Analysis of composite laminates based on classical lamination theory.
5. Fabrication and testing methods of composite materials.

Outcomes: At the end of the course, a student should be able to

1. Understand composite materials, classification, types of matrix and fibre materials.
2. Understand types of analyses, stress strain relationships for different materials and characterization of UD lamina.
3. Understand the variation of properties with orientation and failure theories of UD lamina.
4. Analyze the laminates for stresses and strains using CLT.
5. Summarize the various fabrication methods of composite materials and measurements of properties through tests.

UNIT-I

Introduction: Introduction to composite materials, general characteristics, Fibres, Matrix materials, Interfaces, polymer matrix composites, metal matrix composites, ceramic matrix composites, Carbon fibre composites, nanocomposites, Advantages, Applications of composite materials, Military, civil, space, automotive and commercial applications.

UNIT-II

Basic Concepts and Characteristics: Stress strain relations for anisotropic, orthotropic and isotropic materials, Scales of analyses: micromechanics, macro mechanics, Elastic constants of UD lamina using MOM approach, thermal and moisture coefficients, Halpin-Tsai equations, load transfer mechanism from fibre to matrix, Restrictions on engineering constants.

UNIT-III

Elastic behaviour of UD Lamina: Transformation of stress, Strain and elastic parameters reduced and transformed stiffness matrix and compliance matrix, variation of lamina properties with orientation. Tensile and compressive strengths of UD fibre composites, Macromechanical failure theories, Max stress theory, max strain criteria, maximum work (Tsai-Hill) criterion and quadratic interaction (Tsai- Wu) criteria.

ASSOCIATE PROFESSOR & HEAD
Department of Mechanical Engineering
Chaitanya Bharathi Institute of Technology (A)
Gandipet, Hyderabad-500 075. Telangana.

UNIT-IV

Elastic Behaviour of Laminate: - Laminate Nomenclature, Kirchhoff's Hypothesis, CLT, Laminate strains and displacements - Laminate stresses & strains -Stress distributions through the thickness- Force and moment resultants-Laminate stiffness matrix: ABD Matrix-Classification of laminates and their effect on the ABD Matrix-Elastic couplings.

UNIT-V

Fabrication Processes: Hand lay-up, bag molding, autoclave processing, RTM, pultrusion, filament winding. Case studies on fabrication of composite parts/ boats/pressure vessels/automotive parts/ aerospace parts.

Testing: Fibre and matrix tests, gel time test for resins, curing cycle, tensile test, compressive test, in-plane shear test, inter-laminar shear test, flexural test.

Text Books:

1. R. M. Jones, Mechanics of Composite Materials, Mc Graw Hill Co., 2006.
2. B. D. Agarwal, Lawrence J. Broutman, K. Chandrashekhara, Analysis and performance of fiber composites, 3rd edition, Wiley & Sons, 2013.
3. M. Balasubramanian, Composite materials and processing, CRC press, 2014.

Suggested Reading:

1. Isaac M. Daniel and Ori Ishai, Engineering Mechanics of Composite Materials, Oxford University Press, 1994.
2. Sanjay K. Mazumdar, Composites manufacturing, CRC Press, 2002.

ASSOCIATE PROFESSOR & HEAD
Department of Mechanical Engineering
Chaitanya Bharathi Institute of Technology (A)
Gandipet, Hyderabad-500 075, Telangana.

20MEE18 With Effect from the Academic Year 2023–24

DIGITAL MANUFACTURING AND INDUSTRY 4.0
(Professional Elective-V)

Instruction	3	Hours per week
Duration of SEE	3	Hours
SEE	60	Marks
CIE	40	Marks
Credits	3	

Objectives:
1. Understand the concept and applications of Digital Manufacturing and Industry 4.0.
2. Relate different Additive manufacturing processes as a part of Digital Manufacturing
3. Understand the concept of Virtual prototyping, digital design and Importance of reverse engineering in Digital Manufacturing
4. To understand the concept of Industry 4.0 and allied technologies.
5. To Provide an understanding on the challenges faced and relevant industrial applications of Industry 4.0

Outcomes: At the end of the course, the students will be able to:
1. Understand the Basics and applications of Digital Manufacturing and Industry 4.0.
2. Understand the role of Additive Manufacturing, Virtual prototyping and Reverse Engineering processes and their adaptability to Digital Manufacturing.
3. Understand the concepts of digital manufacturing based product life cycle and its management.
4. Understand the concept of Industry 4.0 and allied technologies.
5. Understand the basics of Internet of things and cloud computing pertaining the fourth industrial revolution.

UNIT-I

Introduction to digital manufacturing: Definition of digital manufacturing, Operation Mode and Architecture of Digital Manufacturing System, Impact on manufacturing careers, Advantages of digital manufacturing and design, Information sharing in the digital thread, Digital twins and Files format (STL, AMF, 3MF), Multiple organizations in the manufacturing process. Introduction of Industry 4.0, case study on car manufacturing by Bosch.

UNIT-II

Additive Manufacturing Processes: Additive Manufacturing processes – Engineering polymers, metals and ceramics. Stereolithography, Selective Laser Sintering, Fused Deposition Modeling, Layered object manufacturing. Electronic Materials, Bio-printing, Food Printing. Preprocessing and Post processing in AM
Virtual Prototyping & Reverse Engineering: Virtual Prototyping, Applications, Virtual Prototyping and Virtual Manufacturing. Reverse Engineering, Application of Reverse Engineering in Digital Manufacturing. Self-Learning of Manufacturing System and Intelligent Manufacturing System.

ASSOCIATE PROFESSOR & HEAD
Department of Mechanical Engineering
Chaitanya Bharathi Institute of Technology (A)
Gandipet, Hyderabad-500 075, Telangana.

UNIT-III:

Key Technology of Digital Manufacturing: Various Digital Technologies in Product Lifecycle, Digital Equipment and Digital Processing Technology, Technology of Digital Maintenance and Diagnosis.

Product life cycle management: Introduction, Types of Product Data, Product life cycle management (PLM) systems. Features of PLM System, System architecture, Product information models, Functionality of the PLM Systems.

UNIT-IV:

Industry 4.0: Various Industrial Revolutions, Compelling Forces and Challenges for Industry 4.0, Comparison of Industry 4.0 Factory and Today's Factory, automation, data exchanges, cloud, cyber-physical systems, mobile robots, Big Data, deep machine learning, Production Systems, IoT, Challenges of implementing Industry 4.0, Impact of implementing Industry 4.0 in various sectors, Applications domains and the way forward.

UNIT –V:

Internet of Things (IoT) - IoT design methods, physical devices and enabling technologies, Industrial Internet of Things (IIoT), Smart Manufacturing.

Cloud Computing and Manufacturing- Cloud models, cloud manufacturing examples, cloud based manufacturing, Cloud service and platforms for manufacturing.

Augmented Reality and Virtual Reality in Manufacturing.

Text Books:

1 Zude Zhou, Shane (Shengquan) Xie and Dejun Chen, Fundamentals of Digital Manufacturing Science, Springer-Verlag London Limited,2012

2 Brent Stucker, David Rosen, and Ian Gibson, Additive Manufacturing Technologies, ISBN 978-1-4419-1120-9, Springer, 2010

3 Chee Kai Chua, Kah Fai Leong, 3D printing and additive manufacturing: principles and Application, 4th edition of rapid prototyping

4 Alasdair Gilchrist, Industry 4.0: The Industrial Internet of Things.

Suggested reading:

1 Lihui Wang and Andrew Yeh Ching Nee, Collaborative Design and Planning for Digital Manufacturing, Springer-Verlag London Limited, 2009

2 Venuvinod, PK; Ma, W; Rapid prototyping – Laser based and other technologies, Kluwer,2004

ASSOCIATE PROFESSOR & HEAD
Department of Mechanical Engineering
Chaitanya Bharathi Institute of Technology (A)
Gandipet, Hyderabad-500 075, Telangana.

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In line with AICTE Model Curriculum with effect from AY 2023-24

B.E. (MECHANICAL ENGINEERING)

SEMESTER – III

S. No.	Course Code	Title of the Course	Scheme of instruction			Scheme of examination			Credits
			Hours per week			Duration in Hrs	Maximum Marks		
			L	T	P/D		CIE	SEE	
THEORY									
1	22MTC10	Partial differential Equations and Statistics	3	1	-	3	40	60	4
2	22CSC35	Data Structures using Python	2	-	-	3	40	60	2
3	22MEC02	Material Science and Metallurgy	3	-	-	3	40	60	3
4	22MEC03	Strength of Materials	3	1	-	3	40	60	4
5	22MEC04	Thermodynamics	3	-	-	3	40	60	3
6	22MEC05	Heat Transfer	2	-	-	3	40	60	2
7	22EEM01	Universal Human Values II: Understanding Harmony	-	1	-	-	50	-	1
8	22CEM01	Environmental Science	2	-	-	2	-	50	Non Credit
PRACTICALS									
9	22MEC06	Material Science and Metallurgy Lab	-	-	2	3	50	50	1
10	22MEC07	Strength of Materials Lab	-	-	2	3	50	50	1
11	22CSC36	Data Structures using Python Lab	-	-	2	3	50	50	1
12	22MEC08	Heat Transfer lab	-	-	2	3	50	50	1
13	22MEI01	MOOCs/Training/Internship	2-3 weeks/90 hours				50	-	2
TOTAL			**18**	**03**	**08**	-	**490**	**610**	**23+2**
Clock Hours Per Week: 29									

L: Lecture **T: Tutorial** **D: Drawing** **P: Practical**
CIE - Continuous Internal Evaluation **SEE – Semester End Examination**

ASSOCIATE PROFESSOR & HEAD
Department of Mechanical Engineering
Chaitanya Bharathi Institute of Technology (A)
Gandipet, Hyderabad-500 075, Telangana.

22MEC05

HEAT TRANSFER

Instruction	2 L Hours per week
Duration of Semester End Examination	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	2

Course Objectives: This course aims to

1. The concepts of 1-D steady state heat conduction.
2. The concepts of heat transfer through fins and unsteady state conduction.
3. The relationship between various dimensionless numbers for free convection and forced convection.
4. The principles of radiation heat transfer.
5. The basic concepts of heat exchangers and phase change heat transfer

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

1. Estimate heat transfer through composite slabs and cylinders with and without heat generation.
2. Estimate the heat transfer through rectangular straight and pin fins; and temperature distribution in unsteady state conduction.
3. Estimate the heat transfer in case flow over plates, cylinders and flow through tubes.
4. Estimate radiation heat exchange between surfaces in different situations and the effect of radiation shield.
5. Estimate the effectiveness of heat exchanger by LMTD, NTU methods and acquire knowledge of boiling and condensation phenomenon.

CO-PO-PSO Articulation Matrix

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	1	2	-	-	-	-	-	-	1	1	-	-
CO2	3	2	2	1	1	-	-	-	-	-	-	1	1	-	1
CO3	2	3	2	1	1	-	-	-	-	-	-	1	1	-	1
CO4	2	3	2	1	1	-	-	-	-	-	-	1	1	-	2
CO5	3	2	2	1	1	-	-	-	-	-	-	1	1	-	2

UNIT-I

Modes of heat transfer, Laws of heat transfer - Fourier, Newton, Stefan-Boltzmann General conduction equation in cartesian and cylindrical coordinates, One dimensional steady state conduction through slabs, hollow cylinders with and without heat generation, steady state heat transfer through composite slabs and cylinders, critical radius of insulation.

UNIT-II

Fins: Heat transfer analysis of fins with heat dissipation environment - rectangular straight and pin fins, unsteady state conduction, Lumped parameter analysis of a body with negligible internal temperature gradients, Use of Heisler charts for solving problems of infinite slabs and cylinders.

ASSOCIATE PROFESSOR & HEAD
Department of Mechanical Engineering
Chaitanya Bharathi Institute of Technology (A)
Gandipet, Hyderabad-500 075, Telangana.

UNIT-III

Convection: Dimensional analysis and its use in free and forced convection, Buckingham pi theorem, Physical significance of different dimensionless numbers, Concepts of velocity and thermal boundary layers, Reynold's analogy for flow over plane surfaces, Calculation of heat transfer coefficient for flow over plates, cylinders and for flow through tubes in free and forced convection using empirical formulae.

UNIT-IV

Radiation: Definition of absorptivity, reflectivity and transmissivity, Concept of black-body and emissivity. Kirchoff's law, Planck's law , Wien's and Steffan Boltzmann law, Monochromatic and total emissive power, radiant heat exchange between two gray surfaces, Shape factor, Thermal circuit for radiant heat exchange between infinite parallel plates and between concentric cylinders, Radiation shields

UNIT-V

Heat Exchangers: Classification, analysis of parallel flow and counter flow heat exchangers using LMTD and NTU methods, effectiveness, simple problems.

Boiling: Boiling curve and critical heat flux for nucleate pool boiling.

Condensation: Types of condensation, convective heat transfer coefficient for Laminar Film Condensation on a Vertical Plate.

Text Books:

1. Sachdeva,R.C., "Fundamentals of Engineering Heat and Mass Transfer", New Age International (P) Ltd Publishers, New Delhi, 2010
2. Yunus A Cengel, "Heat Transfer A Practical Approach", Second Edition, Mc.Graw-Hill, 2002.

Suggested Reading:

1. Rajput, R.K., "Heat and Mass Transfer", S. Chand & Company Ltd. New Delhi, 2004.
2. Holman, J.P., "Heat Transfer", Tenth Edition, McGraw Hill Publication, New Delhi, 2010
3. Sukhatme,S.P., "A Text Book on Heat Transfer,", University Press, 2005.

Data Book:

1. C.P. Kothandaraman, Heat Transfer Data Book, TMH

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B.E. (MECHANICAL ENGINEERING)

SEMESTER – IV

S. No.	Course Code	Title of the Course	Scheme of instruction			Scheme of examination			Credits
			Hours per week			Duration in Hrs	Maximum Marks		
			L	T	P/D		CIE	SEE	
THEORY									
1	22MEC09	Kinematics of Machines	3	1	-	3	40	60	4
2	22MEC10	Applied Thermodynamics	2	-	-	3	40	60	2
3	22MEC11	Fluid Mechanics and Hydraulic Machines	3	-	-	3	40	60	3
4	22MEC12	Manufacturing Processes	3	-	-	3	40	60	3
5		Professional Elective - I	3	-	-	3	40	60	3
6	22EGM01	Indian Constitution and Fundamental Principles	2	-	-	2	-	50	Non Credit
PRACTICALS									
7	22MEC13	Computer Aided Machine drawing	-	1	2	3	50	50	2
8	22MEC14	Fluid Mechanics and Hydraulic Machines Lab	-	-	2	3	50	50	1
9	22MEC15	Manufacturing Processes Lab	-	-	2	3	50	50	1
10	22MEC16	Applied Thermodynamics Lab	-	-	2	3	50	50	1
11	22MEU01	Up-skill Certification Course - I	-				25	-	0.5
TOTAL			**16**	**02**	**08**	-	**400**	**550**	**20.5**
Clock Hours Per Week: 26									

L: Lecture **T: Tutorial** **D: Drawing** **P: Practical**

CIE - Continuous Internal Evaluation **SEE – Semester End Examination**

ASSOCIATE PROFESSOR & HEAD
Department of Mechanical Engineering
Chaitanya Bharathi Institute of Technology (A)
Gandipet, Hyderabad-500 075, Telangana.

22MEC10

APPLIED THERMODYNAMICS

Instruction	2 L Hours per week
Duration of Semester End Examination	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	2

Course Objectives: This course aims to

1. The working principle of single and multi-stage reciprocating air compressor.
2. The working principle of diesel and petrol engines.
3. The combustion phenomena in IC Engines, parameters leading to abnormal combustion; cooling, lubrication and ignition systems.
4. The working principles of steam boilers.
5. The efficiency improvement methods of Rankine cycle and functioning of nozzles.

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

1. Estimate the power required and efficiency of reciprocating air compressor using the principles of thermodynamics.
2. Understand the working principle of I.C engines and their performance evaluation.
3. Understand the concepts of normal, abnormal combustion and the functioning of engine systemslike cooling, lubrication and ignition.
4. Understand the types of boilers and their performance.
5. Determine the efficiency of Rankine cycle with performance improvement techniques; Understand the nozzle performance and the condition for the maximum discharge.

CO-PO-PSO Articulation Matrix

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	2	-	1	-	-	-	-	-	-	1	1	-	1
CO2	2	2	2	-	1	1	-	-	-	-	-	1	1	-	1
CO3	2	2	2	1	1	1	-	1	-	-	-	1	1	-	1
CO4	2	1	2	-	1	-	-	-	-	-	-	1	1	-	2
CO5	2	1	-	-	-	-	-	-	-	-	-	1	1	-	2

UNIT – I

Reciprocating Air Compressors: Classification of compressors, applications of compressed air, working principle of reciprocating compressors - single stage and multi stage compressors with and without clearance, concept of optimum pressure ratio, minimum work input, various efficiencies of multi stage compressors, simple problems on reciprocating compressors.

UNIT - II

Internal Combustion Engines: Classification, working principles of 2-stroke, 4-stroke SI and CI engines, valve and port timing diagrams, performance of IC engines, Morse test, various methods of determining frictional power, various efficiencies, heat balance sheet.

UNIT - III

Combustion Phenomena: Stages of combustion in SI and CI engines, factors affecting, normal and abnormal combustion phenomenon in SI and CI engines, octane and cetane number, cooling systems, lubrication systems, batteryand magneto ignition systems of IC engines.

UNIT – IV

Steam Boilers: Classification of boilers-Fire tube boilers- Cochran boiler, Locomotive boiler and Lancashire boiler, Water tube boilers- Babcock and Wilcox boiler. Boiler mountings and accessories. Boiler performance, Types of condensers- Jet and Surface condensers.

UNIT-V

Steam power plant: Modified Rankine cycle, Cycle efficiency improvement methods, Reheating, Regeneration and Cogeneration.

Steam nozzles: Types of nozzles, Nozzle efficiency, Velocity of steam flowing through the nozzle, Mass of steam discharged from the nozzle, Condition for maximum discharge, Critical pressure ratio, Diameters of nozzle throat and exit for maximum discharge

Text Books:

1. Mahesh M. Rathore, Thermal Engineering, TMH, New Delhi, 2016
2. V. Ganeshan, Internal Combustion Engines, Tata McGraw Hill Publishing, New Delhi,2015
3. R.K. Rajput., Thermal Engineering, Laxmi Publishers, New Delhi, 2014

Suggested Readings:

1. Heywood, J.B. "Internal Combustion Engine Fundamentals", TMH, New York, 2004
2. Soman, Thermal Engineering, PHI, 2011.
3. Kulshrestha S.K., 'Thermal Engineering', Vikas Publishing, 2nd Edition, 2011

ASSOCIATE PROFESSOR & HEAD
Department of Mechanical Engineering
Chaitanya Bharathi Institute of Technology (A)
Gandipet, Hyderabad-500 075, Telangana.

22MEC11

FLUID MECHANICS AND HYDRAULIC MACHINES

Instruction week	3 L Hours per
Duration of Semester End Examination	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Course Objectives: This course aims to
1. Learn the fluid statics and properties of fluids.
2. Understand the laws related to fluid flow and their applications
3. Understand various principles and performance characteristics related to Reciprocating pumps.
4. Learn the working principle and efficiencies of hydraulic turbines
5. Come to know the working principles and performance characteristics of Centrifugal pumps.

Course Outcomes: After completion of this course, students will be able to
1. Determine the various properties of fluids
2. Understand the laws related to fluid flow and their applications
3. Acquire the knowledge of the functionality and performance of reciprocating pumps.
4. Acquire knowledge in the functionality, performance and testing of hydraulic turbines
5. Estimate the performance and testing of centrifugal pumps.

CO-PO-PSO Articulation Matrix

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	2	-	-	-	-	-	-	2	-	3	-	3	-	-	-
CO2	2	-	-	-	-	-	-	2	-	3	-	3	-	-	-
CO3	2	-	-	-	-	-	-	2	-	3	-	3	2	-	-
CO4	2	-	-	-	-	-	-	2	-	3	-	3	2	-	-
CO5	2	-	-	-	-	3	3	2	3	3	3	3	2	-	3

UNIT - I

Static Forces on Surface and Buoyancy:
Fluids, ideal and real fluids, incompressible and compressible fluids, stream lines, path lines, stream function and velocity potential, fluid statics, action of fluid pressure on surface, resultant force and center of pressure on a plane surface under uniform pressure, Equilibrium of floating bodies, stability of a submerged body, stability of floating bodies, determination of the metacentric height, determination of the position of the metacenter relative to the center of buoyancy.
Properties of fluids: Density, specific weight, specific gravity, specific volume, viscosity, Newton's law of viscosity, dynamic and kinematic viscosity, pressure

UNIT-II

Laws of Fluid Flow: Continuity theorem, Bernoulli's theorem, applications of Bernoulli's theorem, Pitot tube theoretical discharge, actual discharge and coefficient of discharge of Venturimeter, notches-rectangular, triangular, trapezoidal and stepped notches
Viscous Flow: Nature of flow-laminar, turbulent and transient flows, Reynolds number and its significance
Flow through Pipes: Head losses in pipes, pipe bends, major energy losses, loss of head due to friction in the pipe, Darcy-Weisbach equation, hydraulic gradient and total energy lines, pipes in series and parallel.

UNIT- III

Reciprocating Pumps: Classification and working principle, discharge, slip, coefficient of discharge, power required to drive the pump and efficiency, variation of pressure head due to acceleration of piston and pipe friction, ideal and actual indicator diagrams, separation, safe speed to avoid separation, air vessels, work saved, quantity of water entering into or coming out of air vessels and performance characteristic curves.

UNIT-IV

Hydraulic machines and impact of jet on vanes: Types of hydraulic machines, impulse-momentum equation and its applications, layout of hydraulic power plant-working principle, velocity triangles, impact force exerted, power developed and efficiency of jet striking at the center and at one end of a single and series of unsymmetrical moving curved vanes

Hydraulic Turbines: Classification and working, Velocity triangles, Power developed and efficiencies of Pelton wheel, Francis turbine and Kaplan turbines, Design of hydraulic turbines, Specific speed, Physical significance, Unit testing, Unit quantities, Model testing, Conditions for similarity and performance characteristic curves.

UNIT - V

Centrifugal Pumps: Classification and working principle, Comparison over reciprocating pumps, Velocity triangles, Head equivalent of workdone, Efficiencies, Pressure rise, Minimum starting speed, Specific speed, Physical significance, Model testing, Conditions of similarity, Priming, Performance characteristic curves, Common operational problems (troubles), reasons and remedies.

Text Books:

1. P.N. Modi and S.M. Seth., Hydraulics and Fluid Mechanics Including Hydraulic Machines, 22nd edition, Standard Book House, New Delhi, 2019.
2. R.K. Bansal., A Text Book of Fluid Mechanics and Hydraulic Machines, 9th edition, Laxmi Publications (P) Ltd., New Delhi, 2015.

Suggested Reading:

1. R.S. Khurmi and N. Khurmi., Hydraulics, Fluid Mechanics and Hydraulic Machines, 20th edition, S.Chand publishing, 2014
2. S. Ramamrutham., Hydraulics, Fluid Mechanics and Fluid Machines, Dhanpat Rai and Sons, New Delhi, 2004.
3. Madan Mohan Das., Fluid Mechanics and Turbomachines, PHI Learning PrivateLimited, New Delhi, 2009.

ASSOCIATE PROFESSOR & HEAD
Department of Mechanical Engineering
Chaitanya Bharathi Institute of Technology (A)
Gandipet, Hyderabad-500 075, Telangana.

CHAITANYA BHARATHI INSTITUTE OF TECHNOLOGY

(AICTE Model Curriculum with Effect from the AY 2023 – 2024)

M.E. (Thermal Engineering)

SEMESTER – II

S. No.	Course Code	Title of the Course	Scheme of Instruction			Scheme of Examination			Credits
			Hours per week			Duration of SEE in Hours	Maximum Marks		
			L	T	P		CIE	SEE	
THEORY									
1	23ME C205	Advanced Heat and Mass Transfer	3	--	--	3	40	60	3
2	23ME C206	Computational Fluid Dynamics	3	--	--	3	40	60	3
3	23ME C207	Engine Emissions and Pollution Control	3	--	--	3	40	60	3
4		Program Elective - III	3	--	--	3	40	60	3
5		Program Elective - IV	3	--	--	3	40	60	3
PRACTICALS									
6	23ME C208	Computational Fluid Dynamics Lab (Based On Core)	--	--	3	--	50	--	1.5
7	23ME C209	Thermal systems Lab-2 (Based On core/Elective)	--	--	3	--	50	--	1.5
8	23ME C210	Mini Project with Seminar	--	--	2	--	50	--	1
		TOTAL	**15**	**--**	**08**		**350**	**300**	**19**
Clock Hours Per Week = 23									

L: Lecture D: Drawing T: Tutorial **P: Practical/Mini Project with Seminar/Dissertation**
CIE - Continuous Internal Evaluation **SEE – Semester End Examination**

Programme Elective – III (3/3)			Programme Elective – IV (3/3)		
SNo	Subject Code	Name of the Subject	SNo	Subject Code	Name of the Subject
1	23ME E207	Heating Ventilation & Air Conditioning	1	23ME E210	Turbo Machines
2	23ME E208	Cryogenic Engineering	2	23ME E211	Jet and Rocket Propulsion
3	23ME E209	Design of Heat Exchangers	3	23ME E212	Electronic engine management systems

ASSOCIATE PROFESSOR & HEAD
Department of Mechanical Engineering
Chaitanya Bharathi Institute of Technology (A)
Gandipet, Hyderabad-500 075, Telangana.

23MEE212

ELECTRONIC ENGINE MANAGEMENT SYSTEMS

(Programme Elective – IV)

Instruction	3 Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

COURSE OBJECTIVES: This course aims to

1. To provide basic grounding on electronics
2. To learn the various sensors used in engine management systems
3. Give an overview of different types of ignition systems
4. To understand the significance of gasoline injection systems
5. To know the latest advancements in Diesel injection systems

COURSE OUTCOMES: After the completion of this course, the student will be able to

1. Understand the basic electronic components and controls used in Sensors
2. Explain the different types of sensors used in an automobile engine
3. Describe the ignition and injection methods used in an SI engine
4. Describe the fuel injection systems in a diesel engine and the emission control systems
5. Explain the electronic systems used in the fuel control system and the dash board unit.

CO-PO Articulation Matrix

PO/CO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	1	1	0	1	1
CO2	3	1	3	1	1	2
CO3	2	2	3	2	2	2
CO4	2	2	3	2	2	2
CO5	3	1	3	2	1	2

UNIT I

Fundamentals of automotive electronics: Components for Electronic Engine Management System- Open and Closed Loop Control Strategies- PID Control- Look Up Tables- Introduction to Modern Control Strategies Like Fuzzy Logic and Adaptive Control. Switches- Active Resistors- Transistors- Current Mirrors/Amplifiers- Voltage and Current References- Comparator- Multiplier. Amplifier- Filters A/D and D/A Converters.

UNIT II

Sensors and actuators: Inductive- Hall Effect- Thermistor - Piezo Electric - Piezo resistive- Based Sensors. Throttle Position- Mass Air Flow- Crank Shaft Position- Cam Position- Engine Speed Sensor- Exhaust Oxygen Level (Two Step- Linear Lambda and Wideband)- Knock- Manifold Temperature and Pressure Sensors. Solenoid-Relay (Four and Five Pin)- Stepper Motor

UNIT III

SI engine management : Layout and Working of SI Engine Management Systems. Group and Sequential Injection Techniques. MPFI- GDI- Advantages of Electronic Ignition Systems. Types of Solid State Ignition Systems and Their Principle of Operation- Contactless (BREAKERLESS) Electronic Ignition System- Electronic Spark Timing Control

UNIT IV

CI engine management: Fuel Injection System Parameters Affecting Combustion- Noise and Emissions in CI Engines. Electronically Controlled Unit Injection System. Common Rail Fuel Injection System. Working of Components Like Fuel Injector- Fuel Pump- Rail Pressure Limiter- Flow Limiter- EGR Valve.

UNIT V

Digital engine control system: Cold Start and Warm Up Phases- Idle Speed Control- Acceleration and Full Load Enrichment Deceleration Fuel Cut-off. Fuel Control Maps- Open Loop and Closed Loop Control –Integrated Engine Control System- Electromagnetic Compatibility – EMI Suppression Techniques – Electronic Dash Board Instruments – Onboard Diagnosis System.

TEXT BOOKS:

1. Understanding Automotive Electronics William B Ribbens, SAE 1998
2. Automobile Electronics by Eric Chowanietz SAE

Suggested references:

1. Diesel Engine Management by Robert Bosch, SAE Publications, 3rd Edition, 2004
2. Gasoline Engine Management by Robert Bosch, SAE Publications, 2nd Edition, 2004

ASSOCIATE PROFESSOR & HEAD
Department of Mechanical Engineering
Chaitanya Bharathi Institute of Technology (A)
Gandipet, Hyderabad-500 075. Telangana.

CHAITANYA BHARATHI INSTITUTE OF TECHNOLOGY

(AICTE Model Curriculum with Effect from the AY 2023 – 2024)

M.E. (Thermal Engineering)

SEMESTER – I

S. No.	Course Code	Title of the Course	Scheme of Instruction			Scheme of Examination			Credits
			Hours per week			Duration of SEE in Hours	Maximum Marks		
			L	T	P		CIE	SEE	
THEORY									
1	23ME C201	Thermodynamics and Combustion	3	--	--	3	40	60	3
2	23ME C202	Advanced Fluid Dynamics	3	--	--	3	40	60	3
3		Program Elective - I	3	--	--	3	40	60	3
4		Program Elective - II	3	--	--	3	40	60	3
5	23ME M103	Research Methodology and IPR	2	--	--	3	40	60	2
6		Audit course - I	2	--	--	2	--	50	Non-Credit
PRACTICALS									
7	23ME C203	Thermal Systems Lab - I(Based On Core)	--	--	3	--	50	--	1.5
8	23ME C204	Solar energy Technologies Lab (Based On core/Elective)	--	--	3	--	50	--	1.5
		TOTAL	**16**	**--**	**06**	**--**	**300**	**350**	**17**
Clock Hours Per Week = 22									

L: Lecture D: Drawing T: Tutorial P: Practical/Mini Project with Seminar/Dissertation

CIE - Continuous Internal Evaluation SEE – Semester End Examination

Program Elective – I (3/3)			Program Elective – II (3/3)		
S No	Subject Code	Name of the Subject	S No	Subject Code	Name of the Subject
1	23ME E201	Thermal and Nuclear Power Plants	1	23ME E204	Refrigeration Technology
2	23ME E202	Environmental Engineering and Pollution Control	2	23ME E205	Energy Conservation and Waste Heat recovery
3	23ME E203	Prime Movers for Automobiles	3	23ME E206	Solar energy technologies

Audit Course – I					
S No	Subject Code	Name of the Subject	S No	Subject Code	Name of the Subject
1	23CE A101	Disaster Mitigation and Management	5	23EG A101	English for Research Paper Writing
2	23EE A101	Sanskrit for Technical Knowledge	6	23EG A102	Constitution of India
3	23EC A101	Value Education	7	23EG A103	Stress Management by Yoga
4	23ADA101	Pedagogy Studies	8	23EG A104	Personality Development through Life's Enlightenment Skills

ASSOCIATE PROFESSOR & HEAD
Department of Mechanical Engineering
Chaitanya Bharathi Institute of Technology (A)
Gandipet, Hyderabad-500 075, Telangana.

23MEE206

SOLAR ENERGY TECHNOLOGIES

(Programme Elective – II)

Instruction	3 Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

COURSE OBJECTIVES: This course aims to

1. To clarify impression of various solar thermal energy collectors
2. To delineate the other applications and the devices used to collect solar energy
3. To study the various types and configurations of solar space conditioning system
4. To learn the various solar applications.
5. To summarize the basic economics of solar energy collection system.

COURSE OUTCOMES: After the completion of this course, the student will be able to

1. Explain the importance of renewable energy sources and sun-earth geometry
2. Analyze various applications of solar flat plate collectors
3. Evaluate technical aspects of solar concentrating collectors that are useful to society and industry
4. Asses the various applications of solar PV systems like off grid, stand alone etc.
5. Communicate technological and socio-economic issues around solar

CO-PO Articulation Matrix

PO/CO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	2	3	2	2	1
CO2	3	2	3	1	1	2
CO3	3	3	3	1	2	2
CO4	3	2	3	1	1	2
CO5	3	2	2	1	2	3

UNIT – I

Basic concepts of energy: Introduction to Renewable Energy Technologies; Energy and Environment: Global warming, acid rains, Depletion of ozone layer; Global and Indian Scenario of energy sources.

Solar energy basics: sun-earth angles, measurement of solar radiation-pyranometer, pyrheliometer, sunshine recorders.

UNIT – II

Solar flat plate collectors: flat plate collector working, cross-sections, liquid and evacuated tube type, applications: water heating, space heating, power production, solar refrigeration and air conditioning: solar operated Li-Bromide water absorption cooling system, solar industrial heating system, solar green house

UNIT – III

Solar concentrating collectors: various types of concentrating collectors, efficiency of concentrating collector formula, solar central receiver type plant, solar furnace, solar chimney, dish/stirling engine, solar pond, solar thermal electric power plant, limitations of solar thermal energy, case studies.

UNIT – IV

Solar photo voltaic: concept of conductor, insulator, semiconductor, semi conductor materials, p-n junction working principle, V-I characteristics of p-n junction, different types of solar cells, solar satellite system, block diagram of off grid, grid connected, stand alone with battery storage PV plant, combined, advantages, limitations and applications of solar PV systems.

UNIT – V

Other solar applications: solar cookers: panel and box type, water desalination(SODIS), solar dryer for various agricultural products: direct solar dryers, indirect solar dryers, mixed-mode dryers,

Solar economics: capital recovery factor, uniform annual cost, sinking fund factor, payback time: payout time without interest, with interest, effect of depreciation, inflation rate

TEXT BOOKS:

1. S.Hasan Saeed, D.K.Sharma, Non conventional energy sources, S.K Kataria & Sons second edition 2009.
2. **G.N.Tiwari, Solar Energy fundamentals, design, modelling and applications, Narosa, 2016**

SUGGESTED READING:

1. H P Garg, M Dayal, G Furlan, Physics and Technology of Solar Energy- Volume 1: Solar Thermal Applications, Springer, 2007.
2. Sukhatme S.P. J K Nayak, Solar Energy, Tata McGraw Hills P Co., ISBN: 9789352607112, 4th Edition, 2017, pp. 568.

ASSOCIATE PROFESSOR & HEAD
Department of Mechanical Engineering
Chaitanya Bharathi Institute of Technology (A)
Gandipet, Hyderabad-500 075, Telangana.

23MEE211

JET AND ROCKET PROPULSION

(Programme Elective – IV)

Instruction	3 Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

COURSE OBJECTIVES: This course aims to

1. The fundamentals of gas turbines and jet propulsion
2. Various propulsion systems of turbo prop, Ram jet
3. Performance characteristics of aircraft engines
4. Orbital velocity, space missions
5. Process of combustion in solid and liquid propellant

COURSE OUTCOMES: After the completion of this course, the student will be able to

1. Understand the fundamentals of gas turbines and jet propulsion
2. Differentiate various propulsion systems of turbo prop, Ram jet
3. Evaluate Performance characteristics of aircraft engines
4. Understand orbital velocity, space missions
5. Get process of combustion in solid and liquid propellant

CO-PO Articulation Matrix

PO/CO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	1	3	0	1	2
CO2	3	1	3	1	1	2
CO3	2	2	3	2	1	2
CO4	2	2	3	2	1	2
CO5	3	1	3	2	1	2

UNIT-I

Fundamentals of Gas Turbine theory-Then-no dynamic Cycles, open closed and semi-closed — parameters of performances —cycle modifications for improvement of performance.

Jet propulsion: Historical sketch-reaction principle — essential features of propulsion devices-Thermal Engines, Classification of— Energy flow thrust, Thrust power and propulsion efficiency-Need for Thermal Jet Engines and applications.

UNIT-I I

Thermodynamics of aircraft engines Theory of Aircraft propulsion – Thrust – Various efficiencies – Different propulsion systems – Turboprop – Ram Jet – Turbojet, Turbojet with after burner, Turbo fan and Turbo shaft. Variable thrust- nozzles – vector control.

UNIT-III

Performance characteristics of aircraft engines Engine - Aircraft matching – Design of inlets and nozzles – Performance characteristics of Ramjet, Turbojet, Scramjet and Turbofan engines.

UNIT-IV

Rocket propulsion Theory of rocket propulsion – Rocket equations – Escape and Orbital velocity – Multi-staging of Rockets – Space missions – Performance characteristics – Losses and efficiencies.

UNIT-V

Rocket thrust chamber: Combustion in solid and liquid propellant classification – rockets of propellants and Propellant Injection systems – Non-equilibrium expansion and supersonic combustion – Propellant feed systems – Reaction Control Systems - Rocket heat transfer.

ASSOCIATE PROFESSOR & HEAD
Department of Mechanical Engineering
Chaitanya Bharathi Institute of Technology (A)
Gandipet, Hyderabad-500 075, Telangana.

TEXT BOOKS:

1. Gas Turbines and propulsive systems/P.Khajurja & S.P.Dubey/Dhanpat rai pub.
2. Gas Dynamics & Space Propulsion! M.C.Ramaswamy / Jaico Publishing House.

SUGGESTED READING:

1. Rocket propulsion Elements I Suon I John 'iViley & Sons / 7 Edition.
2. Gas Turbines /Cohen, Rogers & Saana Muoo/Addision esley & Longman.
3. Gas TurbinesN, Ganesan /TMH.

ASSOCIATE PROFESSOR & HEAD
Department of Mechanical Engineering
Chaitanya Bharathi Institute of Technology (A)
Gandipet, Hyderabad-500 075. Telangana.

With effect from the academic year 2023-24

20MEE14

CONTROL SYSTEMS THEORY
(Professional Elective-IV)

Instruction	3	Hours per week
Duration of SEE	3	Hours
SEE	60	Marks
CIE	40	Marks
Credits	3	

Objectives: Student will learn the

1. To provide with basic knowledge of control systems, associated terminologies, transfer function.
2. Familiar with basic electrical, mechanical & electromechanical system and their representation in Differential Equation / Transfer function form.
3. To make students familiar with system performance analysis in time & frequency domain.
4. To understand different methods of stability analysis
5. To provide basic pathway to space representation and controllability and observability

Outcomes: At the end of the course, the students are able to

1. Understand control system, modeling and transfer functions of different systems.
2. Apply the concept of block diagram and signal flow graphs to different systems.
3. Differentiate between time domain and frequency domain techniques.
4. Examine the stability of a system using different approaches.
5. Analyze the system in state space and to find out the controllability and observability.

UNIT-I

Mathematical Modeling: Introduction to control systems , Open loop & closed loop systems, Mathematical modeling & Mechanical systems, Transfer functions from Governing equations, Electrical, hydraulic systems pneumatic, thermal systems, AC,DC servomotors &Electromechanical servo systems.

UNIT-II

Components of Control System: Introduction to Block diagrams & Problems, Signal flow graph & mason's gain formula, Transient response &time domain specifications of 1st order systems, 2nd order systems & time domain specifications, Steady state error, error coefficients, Sensitivity Performance Indices

UNIT-III

Time Domain Analysis: Routh criteria & root locus method, Frequency response, Bode & polar plots, Correlation between Transient & frequency response, Band width, Experimental determination of transfer function

UNIT-IV

Stability Analysis: Nyquist Criteria, Phase & gain margins, Lead, lag compensator design lead-lag compensator design, PID-controller, linearization of non linear systems

ASSOCIATE PROFESSOR & HEAD
Department of Mechanical Engineering
Chaitanya Bharathi Institute of Technology (A)
Gandipet, Hyderabad-500 075, Telangana.

UNIT-V

State Space Representation: State space representation of linear control systems, State transition matrix, Solution of State Space Equations: Zero input response and Zero state response, Concept of controllability & observability

Text Books:

1. K. Ogata, Modern control Engineering, Prentice Hall, 2015.
2. M. Gopal., Control Systems, Tata McGraw Hill, 2012.
3. D. Roy Choudhury, "Control System Engineering", PHI, 2005

Suggested Reading:

1. Norman S.Nise., Control Systems Engineering, John Wiley & sons, Inc., 2018.
2. R.C. Dorf, Modern Control systems, 12th edition Addison Wesley, 2011.

ASSOCIATE PROFESSOR & HEAD
Department of Mechanical Engineering
Chaitanya Bharathi Institute of Technology (A)
Gandipet, Hyderabad-500 075, Telangana.

23MEE208

CRYOGENIC ENGINEERING

(Programme Elective – III)

Instruction	3 Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

COURSE OBJECTIVES: This course aims to

1. Material properties at cryogenic temperatures.
2. An over view of different cryogenic liquefaction cycles.
3. Separation of cryogenic liquids in rectification column.
4. Working principle of cryogenic refrigerator.
5. Cryogenic handling techniques.

COURSE OUTCOMES: After the completion of this course, the student will be able to

1. Recall the material properties at cryogenic temperature.
2. Estimate the performance of liquefaction cycle.
3. Analyze the cryogenic separation rectification column.
4. Discuss the working principle of cryogenic refrigerator.
5. Discuss the types of vacuum pumps and various instruments used in handling of cryogens.

CO-PO Articulation Matrix

PO/CO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	2	2	1	1	2
CO2	2	1	2	1	1	2
CO3	2	2	2	1	1	2
CO4	2	1	2	1	1	2
CO5	3	1	2	1	1	2

UNIT– I

INTRODUCTION

In sight on Cryogenics, Properties of Cryogenic fluids, Material properties at Cryogenic Temperatures. Applications of Cryogenics- Mechanical, Space, Medicine, Gas industry, High energy physics, Superconductivity

UNIT– II

LIQUEFACTION CYCLES & SYSTEMS

Carnot Liquefaction Cycle, F.O.M.and Yield of Liquefaction Cycles. Inversion Curve-Joule Thomson, Effect. Linde Hampson Cycle, Precooled Linde Hampson Cycle, Claude Cycle Dual Pressure Cycle, Ortho- Para hydrogen conversion, Critical Components in Liquefaction Systems.

UNIT–III

SEPARATIONOFCRYOGENIC GASES

Binary Mixtures, T-C and H- C Diagrams, Principle of Rectification, Rectification Column Analysis-McCabe Thiele Method, Adsorption Systems for purification.

UNIT– IV

CRYOGENIC REFRIGERATORS

Joule-Thomson (J.T.) Cryocoolers, Stirling Cycle Refrigerators, Gifford-McMahon (G.M.) Cryocoolers, Pulse Tube Refrigerators Regenerators used in Cryogenic Refrigerators, Magnetic Refrigerators.

UNIT– V

HANDLING OF CRYOGENS

Cryogenic Dewar Design, Cryogenic Transfer Lines. Insulations in Cryogenic Systems, Operating principle of different Types of Vacuum Pumps, Instruments to measure Flow, Level and Temperature operating principles.

TEXT BOOKS:

1. KlausD. Timmerhaus and Thomas M.Flynn, Cryogenic Process Engineering, Plenum Press NewYork,1989.
2. Mukhopadhay Mamata, Fundamentals of cryogenic engineering, PHIlearning,2010.

SUGGESTED READING:

1. Pipkov, "Fundamentals of Vacuum Engineering", Meer Publication.
2. RandallF. Barron, "Cryogenics Systems", Second Edition Oxford University Press New York, Clarendon Press,Oxford,1985.
3. Thomas Flynn, Cryogenic Engineering, Revised and Expanded, CRC Press, 2004.

ASSOCIATE PROFESSOR & HEAD
Department of Mechanical Engineering
Chaitanya Bharathi Institute of Technology (A)
Gandipet, Hyderabad-500 075. Telangana.

CHAITANYA BHARATHI INSTITUTE OF TECHNOLOGY

(AICTE Model Curriculum with Effect from the AY 2023 – 2024)

M.E. (CAD/CAM)

SEMESTER – I

S.No.	Course Code	Title of the Course	Scheme of instruction			Scheme of examination			Credits
			Hours per week			Duration of SEE in Hours	Maximum Marks		
			L	T	P/D		CIE	SEE	
THEORY									
1	23MEC101	Computer Aided Modeling and Design	3	--	--	3	40	60	3
2	23MEC102	Digital Manufacturing	3	--	--	3	40	60	3
3		Programme Elective – I	3	--	--	3	40	60	3
4		Programme Elective - II	3	--	--	3	40	60	3
	23MEM103	Research Methodology and IPR	2	--	--	3	40	60	2
6		Audit Course - I	2	--	--	2	--	50	Non-Credit
PRACTICALS									
7	23MEC103	Advanced Computer Aided Design Lab	--	--	3	--	50	--	1.5
8	23MEC104	Digital Manufacturing Lab	--	--	3	--	50	--	1.5
TOTAL			**16**	**--**	**6**	**17**	**300**	**350**	**17**
Clock Hours Per Week = 22									

L: Lecture **D: Drawing** **T: Tutorial** **P: Practical/Mini Project with Seminar/Dissertation**

CIE - Continuous Internal Evaluation **SEE – Semester End Examination**

ASSOCIATE PROFESSOR & HEAD
Department of Mechanical Engineering
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23MEC103

ADVANCED COMPUTER AIDED DESIGN LAB

Instruction	3 Hours per week
Duration of SEE	--
SEE	--
CIE	50 Marks
Credits	1.5

COURSE OBJECTIVES: This course aims to

1. Make students generate the part models using cad software.
2. Make students generate the surface models using cad software.
3. Prepare students with advanced modeling concepts using CAD software.
4. Make students create automated drawing and apply proper annotations on them.
5. Make students generate the assembly models using cad software

COURSE OUTCOMES: After successful completion of the course the students will be able to

1. Generate complex components in the part module and
2. Assembly of the components using suitable constraints.
3. Generate engineering drawings.
4. Apply size, form and positional tolerance on the drawing
5. Apply surface modeling techniques using CAD

CO-PO Articulation Matrix

PO/CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO1	2	2	2	-	1	2
CO2	2	1	2	-	1	2
CO3	2	1	2	-	1	2
CO4	2	1	2	-	1	2
CO5	2	2	2	1	1	2

List of Experiments:

1. Sketch based Part modeling of components.
2. Feature based Modeling of components.
3. Assembly modeling of components using different constraints
4. Drafting – standard views, dimensioning, layouts, GD&T, Bill of materials, exploded views.
5. Assembly modeling of components of drill jig and study of assembly interference
6. Surface modeling of a soap bottle with its plastic tool design
7. Surface modeling of a mobile phone case
8. Surface modeling of automobile outer surface
9. Surface reconstruction from cloud point data from reverse engineering tools.
10. Solid modeling, assembly and drafting with GD&T of a tool post
11. Solid modeling, assembly and drafting with GD&T of a Gate Valve
12. CAD model preparation of an aerofoil for FE/CFD analysis.

Note: Out of the above 12 experiments, any 10 experiments must be carried out.

Suggested Reading :

1. Solidworks Essentials, "Solidworks" By Dassault Systems

ASSOCIATE PROFESSOR & HEAD
Department of Mechanical Engineering
Chaitanya Bharathi Institute of Technology (A)
Gandipet, Hyderabad-500 075, Telangana.

With Effect from the Academic Year 2023–24

20MEE15

MECHANICAL VIBRATIONS

(Professional Elective-IV)

Instruction	3	Hours per week
Duration of SEE	3	Hours
SEE	60	Marks
CIE	40	Marks
Credits	3	

Objectives:

1. To analyze free vibration, damped and undamped vibrations.
2. The principles of harmonically excited vibrations
3. The principle of damped and undamped vibrations of two degrees of freedom system
4. To develop the equations of motion for a continuous system in elongation, bending and torsion to find the natural frequencies and mode shapes.
5. The working principles of vibration measurements

Outcomes: At the end of the course, the students are able to

1. Apply Newton's law of motion and energy method to get governing differential equations of vibrating systems.
2. Analyze response of machine members in forced vibration with different excitation frequencies, Recommend suitable vibration parameters for isolation and compute critical speeds.
3. Analyze modeshape and decoupling of equation of motion for 2 degree of freedom systems.
4. Predict natural frequency and mode shape for all continuous systems.
5. Understand working principles of vibration measuring instruments.

UNIT - I

Introduction: Fundamentals of vibrations analysis, classification of vibrating systems, damping systems.
Single Degree of Freedom Systems: Formulation of equation of motion–Energy method, Rayleigh method, principle of virtual work, principal of conservation energy.
Free vibration response: Undamped, damped (viscously damped, logarithmic decrement, coulomb damping) translational & torsional systems, case studies on formulation and response calculation.

UNIT - II

Forced vibration response: Response of undamped systems to harmonic excitations, response of damped systems to harmonic excitations, response of damped systems to rotating unbalance, magnification factor, displacement transmissibility, force transmissibility, relative motion, vibration control–whirling of shafts.

UNIT - III

Two Degree of Freedom Systems: Free and forced vibration response–Formulation of equation of motion (undamped, damped), Eigen values and Eigen vectors, modal matrix, normal modes, modes superposition, coordinate coupling, principal coordinates, decoupling of equations of motion, influence coefficients, semidefinite systems, self-excitation and stability analysis.

ASSOCIATE PROFESSOR & HEAD
Department of Mechanical Engineering
Chaitanya Bharathi Institute of Technology (A)
Gandipet, Hyderabad-500 075, Telangana.

UNIT - IV

Vibrations of Continuous Systems: Vibrations of strings, bars and beams, formulation of equations of motion, characteristic equations, identification of nodes and mode shapes.

UNIT - V

Vibration Measurements and Applications: Vibration pickup, vibrometer, accelerometer, Piezoelectric transducers, electrodynamic transducers;.

Vibration exciters–mechanical and electro dynamicshakers;

Frequency measuring instruments, Fault diagnosis of rotating machinery. Application in condition monitoring systems

Text Books:

1. J.J. Thomson, Theory of vibration with Application, 5th edition, 2014.
2. S.S. Rao, Mechanical vibration, 5th edition, Pearson, 2011
3. G.S. Grover & Nigam, Mechanical vibrations, 8th edition, New Chand & Bros, 2018

Suggested Reading:

1. V.P. Singh, Mechanical vibration, 3rd edition, Dhanpath Rai & Co., 2014.
2. S. Graham Kelley. Mechanical vibration, Schaums Outline Series, TMH, 2011.

ASSOCIATE PROFESSOR & HEAD
Department of Mechanical Engineering
Chaitanya Bharathi Institute of Technology (A)
Gandipet, Hyderabad-500 075. Telangana.

With effect from the academic year 2023-24

20MEE13

AUTOMOBILE ENGINEERING

(Professional Elective-IV)

Instruction	3	Hours per week
Duration of SEE	3	Hours
SEE	60	Marks
CIE	40	Marks
Credits	3	

Objectives:

1. To learn about the layout and arrangement of principal parts of an automobile.
2. To understand working of different types of Drive train and Transmission Systems
3. To learn about different types of Steering, Axle, Wheels and Tyres.
4. To understand different types of Suspension and braking systems.
5. To learn about Alternative Energy Sources for Automobiles.

Outcomes: Student will be able to:

1. Identify principal parts of an automobile and its layout.
2. Understand the various systems in automobile like engine cooling, lubrication, ignition, electrical and air conditioning systems with the principles of thermodynamics.
3. Understand the various suspension and steering systems.
4. Analyse the functioning of drive train, transmission and braking systems.
5. Understand the importance of alternative power trains for pollution control.

UNIT - I

Engine: Engine location and its components, chassis layout - parts of the automobile body, terminology, automobile frames ; crank shaft, firing order, piston and piston rings, cylinder liners, valves and operation mechanism, VVT , Carburetion, GDI Engines, MPFI, Compression Ignition engines - Fuel Injection System and Electronic Fuel Injection system

Maintenance: Trouble shooting and overhauling, engine tune up

UNIT - II

Lubricating Systems: Wet sump, dry sump and petroil systems

Cooling systems: Water pumps, radiators, thermostat control, anti-freezing compounds

Ignition Systems: Ignition Systems – Battery, Magneto and Electronic Ignition Systems.

Electrical Systems : Main electrical circuits, Batteries and charging systems, Starting circuit, lighting system, indicating devices, warning lights, speedometer, automobile air-conditioning

UNIT - III

Wheel and tyres: Tyre construction, specification, Tyre wear and causes.

Suspension systems: Types of Suspension systems, Independent suspension, coil and leaf springs, torsion bar, shock absorbers

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Department of Mechanical Engineering
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Gandipet, Hyderabad-500 075. Telangana.

Steering Systems: Linkage arrangements and its components, steering gear box types, Electronic power steering system, Davis & Ackerman Steering, Steering geometry: caster, camber, King Pin Inclination, Toe in, toe out, wheel balancing, wheel alignment

UNIT – IV

Power Train: Clutches – Single plate & Multiplate clutches, Gearbox – Manual, and automatic gearboxes. Torque converter, propeller shaft, universal coupling, differential, four-wheel drive system

Brakes Systems: Disc and Drum Brakes, Description and operation of hydraulic brake, hand brake linkage, ABS, EBD

UNIT – V

Pollution control: Pollution control techniques used for petrol and diesel engines, PCVS, EGR, SCRT, Thermal Reactors, Catalytic converters; Euro norms and Bharat Norms.

Alternative Power Trains: Electric Vehicles, Hybrid Vehicles, Batteries used in Electric and Hybrid Vehicles, Battery charging systems. Fuel cell Vehicles – Introduction

Text Books:

1. R. K. Rajput, A Textbook of Automobile Engineering, 2nd edition, Laxmi Publications Pvt Ltd, 2007
2. Kirpal Singh, Automobile Engineering, Vol I and II",12th edition, Standard Publishers, 2011
3. P.L. Kohli, Automotive Electrical Equipment, Tata McGraw Hill, 1985.

Suggested Reading:

1. S. Srinivasan, Automotive Mechanics, 2nd edition, Tata Mc Graw Hill, 2003
2. William H. Crouse, Donald L. Anglin, "Automotive Mechanics", 10th edition, Tata Mc Graw Hill, 2007.

ASSOCIATE PROFESSOR & HEAD
Department of Mechanical Engineering
Chaitanya Bharathi Institute of Technology (A)
Gandipet, Hyderabad-500 075, Telangana.

23MEE204

REFRIGERATION TECHNOLOGY

(Programme Elective – II)

Instruction	3 Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

COURSE OBJECTIVES: This course aims to

1. To understand the classification and application of refrigerants and the need for alternative refrigerants.
2. To analyse the cycle performance of vapour compression system under varying temperature and pressure variables.
3. To analyse the performance of vapour absorption refrigeration systems
4. To teach the heat load estimation procedures and balancing aspects of Refrigeration systems
5. To teach to know about various appliances use these machinery and components

COURSE OUTCOMES: After the completion of this course, the student will be able to

1. Classify the refrigerants and understand its applications
2. Choose the most appropriate system for a particular application
3. Analyze the performance of vapour compression systems.
4. Analyze vapour absorption refrigeration system making use of principles of thermodynamics
5. Estimate the cooling load for different applications and also do system balancing analysis.

CO-PO Articulation Matrix

PO/CO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	1	2	0	1	0
CO2	1	1	2	2	0	1
CO3	2	1	3	2	1	1
CO4	2	1	2	0	2	2
CO5	3	1	3	1	2	1

UNIT - I

Fundamentals and refrigerants:

Carnot Cycle for Refrigeration, Heat Pumps – Ideal vapour cycle – Refrigerant Classification, Refrigerant designation, Refrigerant oil relationship – Environmental Impact – Montreal / Kyoto protocols– KigaliAmendment –Eco friendly Refrigerants for different refrigeration sectors, Need for Alternate refrigerants –Retrofitting aspects.

UNIT - II

Vapour Compression System: Analysis of vapour compression refrigeration cycle Reverse Carnot Cycle for vapour. Effect of suction temperature and condensing temperature on cycle performance. Practical refrigeration cycle, Subcooled liquid and super-heated vapour refrigeration cycles, their effect on performance. Multi-pressure system. Removal of flash gas, inter cooling. Compound compression Multivapour-Cascadesystem-dryicesystem.

UNIT- III

Vapour Absorption System: Absorption cycle of operation, properties of solutions, Actual vapour absorption cycle-representation on enthalpy concentration h-c diagram, Water lithium bromide absorption system. Electrolux refrigerator-Aqua Ammonia Refrigeration System, Platen-Munters systems, comparison with VCRS.

UNIT - IV

Load estimation and balancing: Estimation of Cooling Load, Cold Storages, Cool Storages, System Balancing–Graphical Analysis, Capacity modulation and Cycling Controls

ASSOCIATE PROFESSOR & HEAD
Department of Mechanical Engineering
Chaitanya Bharathi Institute of Technology (A)
Gandipet, Hyderabad-500 075, Telangana.

UNIT - V

Hydronic systems: Water piping in Chilled Water Systems, Multiple Fan Coil Units, Condensers – Multiple Condensers and Cooling Towers .System components–Expansion tank, Balancing valves, Pumping systems, Pump selection, Freeze prevention.

TEXT BOOKS:

1. C. P. Arora, "Refrigeration &Air Conditioning", Tata Mc Graw Hill, 2020.
2. Stoecker, "Refrigeration &Air Conditioning", Mc Graw Hill, 1992.

SUGGESTED READING:

1. Norman C. Harris, "Modern Air Conditioning", New York, McGraw- Hill, 1974.
2. Manohar Prasad, "Refrigeration &Air Conditioning", New Age Publishers, 2014.
3. ASHRAE Hand book.

23MEE207

HEATING VENTILATION AND AIRCONDITIONING

(Programme Elective – III)

Instruction	3 Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

COURSE OBJECTIVES: This course aims to

1. the fundamentals of air conditioning and Psychrometry
2. human comfort in dices and comfort chart
3. concepts of heat transfer through building structures using CLTD/ETDmethod.
4. various loads related to heating and cooling for buildings according to ASHRAE.
5. complete air distribution systems including fan, duct, grill, diffusers

COURSE OUTCOMES: After the completion of this course, the student will be able to

1. Understand the fundamentals of Psychrometry
2. Applyhumancomfortindicesandcomfortcharttodesignindoorconditionsof HVAC
3. Evaluate heat transfer through building structures using CLTD/ETDmethod.
4. Estimate heating and cooling loads for buildings according to ASHRAE.
5. Design and evaluate complete air distribution system including fan, duct, grill, diffusers.

CO-PO Articulation Matrix

PO/CO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	2	2	0	0	2
CO2	2	2	2	0	0	2
CO3	2	2	2	1	1	2
CO4	2	2	2	1	1	2
CO5	2	2	2	1	1	2

UNIT-I

Introduction: brief history of air conditioning and impact of air conditioning. HVAC systems and classifications, Heat Pumps.

Psychrometrics Of Air conditioning Processes:

Thermodynamic properties of moistair, Important Psychrometry properties, Psychometric chart; Psychrometric process in air conditioning equipment, applied Psychrometry, air conditioning processes, airwashers.

UNIT-II

Comfort Air Conditioning: Thermodynamics of human body, metabolic rate, energy balance and models, thermoregulatory mechanism. Comfort & Comfort chart, Effective temperature ,Factors governing optimum effective temperature, Design consideration. Selection of outside and inside design conditions.

UNIT-III

Heat Transfer Through Building Structures: Solar radiation; basic concepts, sun-earth relationship, different angles, measurement of solar load, Periodic heat transfer through wallsandroofs.Empiricalmethodstocalculateheattransferthroughwallsandroofsusingdecrementfactorandtimel agmethod.Infiltration,stackeffect,windeffect.CLTD/ETDmethod – Use of tables, Numerical and other methods, Heat transfer through fenestration –Governing equations, SHGF/SC/CLF Tables

UNIT-IV

Load Calculation: Types of air-conditioning systems, General consideration, internal heat gains, system heat gain, cooling and heating load estimate.

ASSOCIATE PROFESSOR & HEAD
Department of Mechanical Engineering
Chaitanya Bharathi Institute of Technology (A)
Gandipet, Hyderabad-500 075, Telangana.

UNIT-V

Ventilation System: Introduction- Fundamentals of good indoor air quality, need for building ventilation, Types of ventilation system, Air Inlet system. Filters heating & cooling equipment, Fans, Duct design, Grills, Diffusers for distribution of air in the workplace

TEXT BOOKS:

1. GosneyW.B.,Principles of Refrigeration, Cambridge University Press,1982.
2. ThrelkeldJ.L.,Thermal Environmental Engineering, Prentice Hall, NewJersey1962.

SUGGESTED READING:

1. Dossat, R.J.andHoran, T.J.,Principles of Refrigeration, 5thEdition, Prentice Hall, 2001.
2. Refrigeration & Airconditioning, R.C.Arora, PHI, 2010

With Effect from the Academic Year 2023–24

20MEE16

SUPPLY CHAIN MANAGEMENT

(Professional Elective-IV)

Instruction	3	Hours per week
Duration of SEE	3	Hours
SEE	60	Marks
CIE	40	Marks
Credits	3	

Objectives: Student will understand

1. The awareness about transportation and warehouse management systems.
2. The designing supply chain networks.
3. The concept of demand and supply and integrating it with supply chain management.
4. The planning and managing inventories.
5. The pricing and revenue management

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

1. Understand fundamentals of supply chain and its key concepts.
2. Design an effective supply chain network
3. Understand the essence of demand and supply and associated gaps
4. Apply inventory management techniques.
5. Evaluate pricing and revenue management systems.

UNIT-I

Concept of SCM:, Supply Chain definition, stages of supply chain, objectives, drivers of SCM-facilities, inventory, transportation, information, sourcing and pricing. Decision phases in Supply chain, pull and push processes, achieving strategic fit, expanding strategic scope. Introduction to Logistics Management.

UNIT-II

Designing the Supply Chain Network: Role of distribution in supply chain and factors influencing its network design and decisions.,Types of distribution networks – manufacturer storage with direct shipping, manufacturer storage with direct shipping and in transit merge, distributor storage with package carrier delivery, distributor storage with last mile delivery, manufacturer/distributor storage with customer pickup, retail storage with customer pick up. Framework for network design decisions-supply chain strategy, regional facility configuration, desirable sites and location choices, E-Business and Distribution network.

UNIT-III

Planning Supply and Demand: Planning demand & supply in a supply chain demand forecasting- moving averages, exponential smoothing, trend and seasonality, Risk management in forecasting. Aggregate planning, Master scheduling, Materials Requirement Planning, time phased order plan, critical ratio, product tree structures.

UNIT-IV

Planning & Managing Inventories in a Supply Chain: Inventory control, objectives of inventory management in supply chain, Deterministic inventory and probabilistic inventory control, Economic Order Quantity, quantity discounts, Reorder point. ABC analysis, FNSD analysis, VED analysis.

ASSOCIATE PROFESSOR & HEAD
Department of Mechanical Engineering
Chaitanya Bharathi Institute of Technology (A)
Gandipet, Hyderabad-500 075, Telangana.

UNIT-V

Sourcing, Pricing, Coordination and IT in Supply chain : Sourcing decisions, key sourcing related processes, In-house or outsource, pricing & revenue management, differential pricing strategies, coordination in supply chain, bullwhip effect, information technology and supply chain, supply chain macro processes- CRM, ISCM, SRM, TMF

Text Books:

1. Sunil Chopra & Peter Meindl, Supply Chain Management – Strategy, Planning and Operation, Pearson Education, Inc., Upper Saddle River, New Jersey, 2003
2. N. J. Kumar &Mukesh Bhatia, Supply Chain Management, Neha publishers & Distributors, 2010.
3. Michael H. Hugos, Essentials of Supply Chain Management, 3rd edition, John Wiley & Sons, Inc, Hoboken, New Jersy, 2011.

Suggested Reading:

1. Martin Christopher, Logistics & Supply Chain Management, 5th edition, Financial Times Series, 2010.
2. Dobler Donald. W, David.N.Burt, Purchasing & supply Management Text & Cases, McGraw- Hill, 1996.
3. A.K. Chitale, R.C, Gupta, Materials Management-Text and Cases, Prentice-Hall Of India Pvt Limited, 2007.

ASSOCIATE PROFESSOR & HEAD
Department of Mechanical Engineering
Chaitanya Bharathi Institute of Technology (A)
Gandipet, Hyderabad-500 075, Telangana.

23MEE202

ENVIRONMENTALENGINEERINGAND POLLUTION CONTROL

(Programme Elective – I)

Instruction	3 Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

COURSE OBJECTIVES: This course aims to

1. Harmful effects of pollutants and their control
2. Different techniques adopted in solid waste management
3. Causes and remedies for water pollution
4. Other types of pollution like oils, pesticides, noise etc
5. Controlling methods adopted to reduce pollution from their power plants

COURSE OUTCOMES: After the completion of this course, the student will be able to

1. Estimate air pollutants and suggest suitable remedial methods to control them
2. Suggest a suitable solid waste disposal system
3. Suggest suitable remedy to control water pollution
4. Suggest suitable remedy to control other pollutants like oils, pesticides, noise etc.
5. Suggest a suitable instrumentation for pollution control

CO-PO Articulation Matrix

PO/CO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	2	2	0	0	2
CO2	2	2	2	0	0	2
CO3	2	2	2	1	1	2
CO4	2	2	2	1	1	2
CO5	2	2	2	1	1	2

UNIT - I

Air Pollution: Sources and Effect - Acid Rain - Air Sampling and Measurement - Analysis of Air Pollutants - Air Pollution Control Methods and Equipments - Issues in Air Pollution control.

UNIT - II

Solid Waste Management: Sources and Classification - Characteristics of solid waste-Potential methods of solid waste Disposal – Process and Equipments for Energy Recovery from Municipal Solid Waste and Industrial Solid Waste

UNIT- III

Water Pollution: Sources and Classification of Water Pollutants - Characteristics - Waste Water Sampling Analysis - Waste Water Treatment - Monitoring compliance with Standards - Treatment, Utilization and Disposal of Sludge

UNIT - IV

Other Types of Pollution: Noise Pollution and its impact - Oil Pollution – Pesticides Radioactivity Pollution Prevention and Control

UNIT - V

Pollution from Thermal Power Plants and Control Methods: Instrumentation for pollution control - Water Pollution from Tanneries and other Industries and their control

TEXT BOOKS:

1. G. Masters, "Introduction to Environmental Engineering and Science", Prentice –Hall, International Editions,1988..
2. S. Peavy, D. R. Rowe and G. Tchobanoglous, "Environmental Engineering", McGraw- Hill Book

Company, NY, 1985.

SUGGESTED READING:

1. H. Ludwig and W. Evans, "Manual of Environmental Technology in Developing Countries", 1991.
2. "Environmental Considerations in Energy Development", Asian Development Bank (ADB), Manilla, 1991

23MEE209

DESIGN OF HEAT EXCHANGERS

(Programme Elective – III)

Instruction	3 Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

COURSE OBJECTIVES: This course aims to

1. Importance of heat exchanger in engineering application
2. Various co-relations for forced convection heat transfer coefficients for different geometries
3. Importance of pressure drop and its effect on heat transfer rate
4. Working principle of hair pin heat exchanger
5. Design concepts of condensers and heat pipe

COURSE OUTCOMES: After the completion of this course, the student will be able to

1. Explain different types of heat exchangers, LMTD method and NTU methods
2. List out co-relations for forced convection heat transfer coefficient for various geometries
3. Estimate the pressure drop in laminar and turbulent flow in heat exchangers
4. Determine pressure drop in hair pin and finned tube heat exchangers
5. Explain design and operational considerations in condensers and heat pipes

CO-PO Articulation Matrix

PO/CO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	2	3	1	1	2
CO2	2	2	3	1	1	2
CO3	2	2	3	1	1	2
CO4	2	2	3	1	1	2
CO5	2	2	3	1	1	2

UNIT - I

Heat Exchanger Types and Design Methods: Tubular heat exchangers, plate heat exchangers, extended surface heat exchangers, flow arrangements, applications, overall heat transfer coefficient, multi-pass and cross flow heat exchangers, LMTD method, NTU method for heat exchanger analysis

UNIT – II

Forced Convection Heat Transfer Coefficient: Laminar forced convection in ducts and concentric annuli, turbulent forced convection in ducts and circular pipes, heat transfer in helical coils, and spirals and heat transfer in bends

UNIT– III

Pressure Drop and Fouling: Tube side pressure drop in laminar and turbulent flows, pressure drop in bends and fittings, Fouling of heat exchangers, basic considerations, effect of fouling on heat transfer and pressure drop.

UNIT - IV

Hair Pin and Finned Heat Exchangers: Pressure drop-hydraulic diameter, hair pin heat exchanger, parallel and series arrangements of hairpins, total pressure drop, compact heat exchangers, plate-fin heat exchangers, tube fin heat exchangers, pressure drop for fin tube heat exchanger

UNIT - V

Condensers: Horizontal shell and tube condensers, plate condensers, air cooled condensers, design and operational considerations, Heat pipe, working principle, heat pipe components and materials

ASSOCIATE PROFESSOR & HEAD
Department of Mechanical Engineering
Chaitanya Bharathi Institute of Technology (A)
Gandipet, Hyderabad-500 075, Telangana.

TEXT BOOKS:

1. Donald Q. Kern, "Process Heat Transfer", TMH Publications, 1963.
2. Sadik Kakac and Hongtan Liu, "Heat Exchangers-Selection, Rating and Thermal Design", 3/e, CRC Press, 2012.
3. David Reay and Peter Kew, "Heat Pipes, Theory, design and Applications", Butterworth-Heinemann (Elsevier), 5/e, 2006.

SUGGESTED READING:

1. S. Kakac, A. E. Bergles and F. Mayinger, "Heat Exchangers, Thermal, Hydraulic Fundamentals and Design", Hemisphere Publications, 1981.
2. "Standards of Tubular Exchangers Manual Association (TEMA)", 7/e, 1988.

ASSOCIATE PROFESSOR & HEAD
Department of Mechanical Engineering
Chaitanya Bharathi Institute of Technology (A)
Gandipet, Hyderabad-500 075, Telangana.

23MEE210

TURBO MACHINES

(Programme Elective – IV)

Instruction	3 Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

COURSE OBJECTIVES: This course aims to

1. Principles and equations of turbo machinery
2. Velocity triangle and power developed by steam turbines
3. Working principles of Pelton, Francis and Kaplan turbines
4. Working principles of axial flow compressor and centrifugal compressor and their performance
5. Power required for rotary compressors and power developed bygas turbines

COURSE OUTCOMES: After the completion of this course, the student will be able to

1. Apply gas dynamics equations depending upon applications
2. Estimate the power developed by steam turbines
3. Calculate hydraulic efficiency of impulse and reaction turbines
4. Find the efficiency, pressure rise, degree of reaction, slip factor and performance of axial flow and centrifugal compressors
5. Understand cycles and improve the cycle efficiency in gas turbines

CO-PO Articulation Matrix

PO/CO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	2	3	1	0	2
CO2	2	2	3	2	2	2
CO3	2	2	3	2	2	2
CO4	2	2	3	1	2	2
CO5	2	2	3	2	2	2

UNIT - I

Fundamentals of Turbo Machines: Classifications, Applications, Isentropic flow, Energy transfer, Efficiencies, Static and Stagnation conditions, Fluid equations continuity, Euler's, Bernoulli's equation and its applications. Euler's flow through variable cross sectional areas.

UNIT - II

Steam Turbines: Convergent and Convergent-Divergent nozzles, Energy Balance, Effect of back pressure, Design of nozzles. Steam Turbines: Impulse turbines, Work done and Velocity triangle, Efficiencies, Compounding

UNIT- III

Hydraulic Turbines: Introduction, Classification of turbines, Impulse and reaction turbines, construction, working and performance of Pelton, Francis and Kaplan Turbines, Selection of turbines: specific speed, unit quantities.

UNIT - IV

Axial Flow Compressors and Centrifugal Compressors: Work and velocity triangles, Efficiencies, Stage pressure rise, Degree of reaction, Performance of compressors, Velocity triangles and efficiencies; slip factor, performance of compressors.

UNIT - V

Gas Turbines: Principle of working – Classification – Joule's cycle – work done and efficiency – Brayton Cycle – Optimum Pressure ratio for maximum power and maximum efficiency – Pmax and ηmax – Improvement in cycle performance – Intercooling, Reheating and Regeneration (Heat exchanging) – Problems using these principles.

TEXT BOOKS:

1. S. M. Yahya, "Turbines, Compreessors and Fans", 4/e, Tata McGraw- Hill Education Pvt. Ltd., 2010.
2. G.Gopalakishnan and D. Prithvi Raj, "Atreatise on Turbomachines", Scitec Publications, Chennai, 2002.
3. Seppo. A. Korpela, "Principles of Turbomachinery", John Wiley & sons Inc. Publications, 2011.

SUGGESTED READING:

1. R. K. Turton, "Principles of Turbomachinery", E & F N Spon Publishers, London & New York,2004.
2. Dennis G. Shepherd, "Principles of Turbomachines", Macmillan, 2007.

23MEE205

ENERGY CONSERVATION AND WASTE HEAT RECOVERY

(Programme Elective – II)

Instruction	3 Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

COURSE OBJECTIVES: This course aims to

1. Pattern of energy use aad issues related to energy
2. the design of waste heat recovery systems, efficient power cycles and power generation system.
3. heat exchanger network analysis by pinch technique
4. direct energy conversion device, industrial process heating
5. Magneto hydro dynamic generation, Thermo-ionic generation

COURSE OUTCOMES: After the completion of this course, the student will be able to

1. understand the potential of waste heat recovery.
2. understand the principles of thermoelectric generators
3. recognize other waste heat recovery systems
4. analyze thermoelectric generators and heat pump
5. understand the latest technologies of waste heat recovery

CO-PO Articulation Matrix

PO/CO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	1	2	0	1	1
CO2	1	1	2	2	0	1
CO3	2	1	3	2	1	1
CO4	2	1	2	0	2	2
CO5	3	1	3	1	2	1

UNIT - I

Introduction of Energy Conservation and Waste Heat Recovery: Pattern of energy use, Potential of waste heat recovery (WHR), Source of waste heat, Utilization and category of waste heat, Relationship of WHR with other energy issues, Thermodynamic principle of waste heat recovery, Exergy and second law efficiency.

UNIT - II

Recapitulation of Common Power Cycles: Vapour power cycle, Gas turbine cycle, Combined cycle, Co-generation, Tri-generation, Poly-generation, Heat recovery steam generator, Thermodynamic cycle for low temperature application.

UNIT- III

Heat Exchanger and Waste Heat Recovery Systems: Introduction and classification of heat exchanger, Methods and analysis of heat exchanger, Regenerators, Special recuperators, Heat exchanger network analysis by pinch technique, Heat pipe.

UNIT - IV

Thermoelectric Generators and Heat Pump: Introduction to direct energy conversion device, Thermoelectric generation (TEG) basics, Thermoelectric element, Application of TEG, TEG performance analysis, Performance optimization, Heat pump system and application, Industrial process heating heat pump.

UNIT - V

Other Waste Heat Recovery Systems: Magneto hydro dynamic generation, Thermo-ionic generation, Thermo-photovoltaic generation, Waste heat recovery from incinerator plant, Prime mover exhausts, Case studies and energy economics.

ASSOCIATE PROFESSOR & HEAD
Department of Mechanical Engineering
Chaitanya Bharathi Institute of Technology (A)
Hyderabad-500 075. Telangana.

TEXT BOOKS:

1. Ennio Macchi , Marco Astolfi, Organic Rankine Cycle (ORC) Power Systems: Technologies and Applications, Woodhead Publishing, 1st edition 2016 .
2. Dale R. Patrick,Stephen W. Fardo, Ray E. Richardson, Brian W. Fardo, Energy Conservation Guidebook, Third Edition, River Publishers, 2014

SUGGESTED READING:

1. D. A. Reay, E & F. N. Span , Heat Recovery System , London, 1979
2. C. C. S. Reddy and S. V. Naidu , Waste Heat Recovery Methods and Technologies, , National University of Singapore.
3. Ramesh K. Sash and Dusan P. Sekulic , Fundamental of Heat Exchanger Design, Wiley, 2003.

ASSOCIATE PROFESSOR & HEAD
Department of Mechanical Engineering
Chaitanya Bharathi Institute of Technology (A)
Gandipet, Hyderabad-500 075. Telangana.

CHAITANYA BHARATHI INSTITUTE OF TECHNOLOGY
An Autonomous Institute | Affiliated to Osmania University
Kokapet Village, Gandipet Mandal, Hyderabad, Telangana 500075. www.cbit.ac.in

COMMITTED TO RESEARCH, INNOVATION AND EDUCATION 44 years

DEPARTMENT OF MECHANICAL ENGINEERING

CIRCULAR

Date: 29-08-2023

The following online training sessions are scheduled for the benefit of its final year students enabling them to equip with all necessary inputs to improve the campus placements. All the students are advised to make best use of this opportunity and get benefitted.

S. No	Date	Topic Name	Faculty Name	Timings
1	30-08-2023	Strength of Materials	Dr. Soloman Raj	7:30 to 9:00 PM
2	31-08-2023	Strength of Materials	Dr. Soloman Raj	7:30 to 9:00 PM
3	01-09-2023	CAD & FEM	Dr. Indira Priyadarshini	7:30 to 9:00 PM
4	02-09-2023	Quantitative aptitude	Sri A. Chandrakanth	7:30 to 9:00 PM
5	04-09-2023	Manufacturing Process	Dr. PVR Ravindra Reddy	7:30 to 9:00 PM
6	05-09-2023	Thermodynamics	Dr. R.P. Chowdary	7:30 to 9:00 PM
7	06-09-2023	Design of Machine Elements	Dr. G Laxmaiah	7:30 to 9:00 PM
8	07-09-2023	Communication Skills	Sri P. R.K. Prasad	7:30 to 9:00PM

ASSOCIATE PROFESSOR & HEAD
Department of Mechanical Engineering
Chaitanya Bharathi Institute of Technology (A)
Gandipet, Hyderabad-500 075. Telangana.

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CHAITANYA BHARATHI INSTITUTE OF TECHNOLOGY

(AICTE Model Curriculum with Effect from the AY 2023 – 2024)

M.E. (Thermal Engineering)

SEMESTER – III

S. No.	Course Code	Title of the Course	Scheme of Instruction			Scheme of Examination			Credits
			Hours per week			Duration of SEE in Hours	Maximum Marks		
			L	T	P		CIE	SEE	
THEORY									
1		Program Elective – V	3	--	--	3	40	60	3
2		Open Elective*	3	--	--	3	40	60	3
		Audit Course-2	2	--	--	2	--	50	Non-Credit
3	23ME C211	Industrial Project / Dissertation Phase – I	--	--	20	--	100	--	10
		TOTAL	**8**	**--**	**20**		**180**	**170**	**16**
Clock Hours Per Week = 28									

L: Lecture D: Drawing T: Tutorial **P: Practical/Mini Project with Seminar/Dissertation**
CIE - Continuous Internal Evaluation **SEE – Semester End Examination**

Programme Elective – V (3/3)			Open Elective (3/3)_ DEPARTMENT OF CSE/EEE/ECE and Allied Branches		
S.No	Subject Code	Name of the Subject	SNo	Subject Code	Name of the Subject
1	23ME E213	Experimental Methods in Thermal Engineering	1	23CE O101	Cost Management of Engineering Projects
2	23ME E214	Energy systems and management	2	23EE O101	Waste to Energy
3	23ME E215	Fluid Power Systems	3	23CS O101	Business Analytics

Audit Course – 2					
S NO	Subject Code	Name of the Subject	S NO	Subject Code	Name of the Subject
1	23CE A101	Disaster Mitigation and Management	5	23EG A101	English for Research Paper Writing
2	23EE A101	Sanskrit for Technical Knowledge	6	23EG A102	Constitution of India
3	23EC A101	Value Education	7	23EG A103	Stress Management by Yoga
4	23ADA101	Pedagogy Studies	8	23EG A104	Personality Development through Life's Enlightenment Skills

ASSOCIATE PROFESSOR & HEAD
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23CSO101

BUSINESS ANALYTICS

Open Elective – VI

Instruction	3 L Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Pre-requisites: Basic of programming, basic mathematics.

COURSE OBJECTIVES: This course aims to

1. Understanding the basic concepts of business analytics and applications.
2. Study various business analytics methods including predictive, prescriptive and prescriptive analytics.
3. Prepare the students to model business data using various data mining, decision making methods.

COURSE OUTCOMES: After the completion of this course, the student will be able to

1. Identify and describe complex business problems in terms of analytical models.
2. Apply appropriate analytical methods to find solutions to business problems that achieve statedobjectives.
3. Interpret various metrics, measures used in business analytics
4. Illustrate various descriptive, predictive and prescriptive methods and techniques.
5. Model the business data using various business analytical methods and techniques.
6. Create viable solutions to decision making problems.

CO-PO Articulation Matrix

CO/PO	PO1	PO2	PO3	PO4	PEO1	PEO2	PEO3
CO1	3	2	2	1	1	-	-
CO2	3	3	2	1	-	3	3
CO3	3	3	3	1	-	-	-
CO4	3	3	3	1	-	-	-
CO5	3	3	3	1	-	-	-
CO6	3	3	3	1	-	-	-

UNIT - I

Introduction to Business Analytics: Introduction to Business Analytics, need and science of data driven (DD) decision making, Descriptive, predictive, prescriptive analytics and techniques, Big data analytics, Web and Social media analytics, Machine Learning algorithms, framework for decision making, challenges in DD decision making and future.

UNIT - II

Descriptive Analytics: Introduction, data types and scales, types of measurement scales, population and samples, measures of central tendency, percentile, decile and quadrille, measures of variation, measures of shape-skewness, data visualization.

UNIT - III

Forecasting Techniques: Introduction, time-series data and components, forecasting accuracy, moving average method, single exponential smoothing, Holt's method, Holt-Winter model, Croston's forecasting method, regression model for forecasting, Auto regression models, auto-regressive moving process, ARIMA, Theil's coefficient

UNIT - IV

Decision Trees: CHAID, Classification and Regression tree, splitting criteria, Ensemble and method and random forest. Clustering: Distance and similarity measures used in clustering, Clustering algorithms, K-Means and Hierarchical algorithms, Prescriptive Analytics- Linear Programming (LP) and LP model building,

UNIT-V

Six Sigma: Introduction, introduction, origin, 3-Sigma Vs Six-Sigma process,cost of poor quality, sigma score, industry applications, six sigma measures, DPMO, yield, sigma score, DMAIC methodology, Six Sigma toolbox.

TEXT BOOKS:

1. U Dinesh Kumar, "Business Analytics", Wiley Publications, 1st Edition, 2017
2. Marc J. Schniederjans, Dara G. Schniederjans, Christopher M. Starkey, "Business analytics Principles, Concepts, and Applications with SAS", Associate Publishers, 2015

SUGGESTED READING:

1. S. Christian Albright, Wayne L. Winston, "Business Analytics - Data Analysis and Decision Making",5th Edition, Cengage, 2015.

ASSOCIATE PROFESSOR & HEAD
Department of Mechanical Engineering
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CHAITANYA BHARATHI INSTITUTE OF TECHNOLOGY

(AICTE Model Curriculum with Effect from the AY 2023 – 2024)

M.E. (CAD/CAM)

SEMESTER – II

S.No	Course Code	Title of the Course	Scheme of instruction			Scheme of examination			Credits
			Hours per week			Duration of SEE in Hours	Maximum Marks		
			L	T	P/D		CIE	SEE	
THEORY									
1	23MEC105	Finite Element Techniques	3	--	--	3	40	60	3
2	23MEC106	Mechanical Design and Analysis	3	--	--	3	40	60	3
3	23MEC107	Mechanics of Composite Materials	3	--	--	3	40	60	3
4		Program Elective - III	3	--	--	3	40	60	3
5		Program Elective - IV	3	--	--	3	40	60	3
PRACTICALS									
6	23MEC108	Computer Aided Engineering Lab	--	--	3	--	50	--	1.5
7	23MEC109	Computer Aided Mechanical Design and Analysis Lab	--	--	3	--	50	--	1.5
8	23MEC110	Mini Project with Seminar	--	--	2	--	50	--	1
TOTAL			**15**	**--**	**8**	**15**	**350**	**300**	**19**
Clock Hours Per Week = 23									

L: Lecture D: Drawing T: Tutorial
P: Practical/Mini Project with Seminar/Dissertation
CIE - Continuous Internal Evaluation
SEE – Semester End Examination

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Programme Elective – III (3/3)			Programme Elective – IV (3/3)		
SNO	Subject Code	Name of the Subject	SNO	Subject Code	Name of the Subject
1	23MEE206	Computational Fluid Dynamics	1	23MEE109	Multibody Dynamics
2	23MEE107	Smart Materials and Structures	2	23MEE110	Tribology in Design
3	23MEE108	Fracture Mechanics	3	23MEE111	Failure Analysis and Design

ASSOCIATE PROFESSOR & HEAD
Department of Mechanical Engineering
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23MEE107

SMART MATERIALS AND STRUCTURES

(Programme Elective – III)

Instruction	3 Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

COURSE OBJECTIVES: This course aims to

1. Provide the basics of smart materials.
2. Make students analyze Constitutive Relationships.
3. Understand the Mathematical modeling for response of piezo beam.
4. Understand High-Band Width, Low Strain Smart Sensors.
2. Apply the smart materials to engineering problems.

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

1. Understand basics of smart materials.
2. Analyze direct and reverse effect of piezo.
3. Understand and Evaluate Principles of piezo, Magnetostrictive materials, SMA.
4. Analyze design of piezoelectric materials
5. Understand High-Band Width, Low Strain Smart Sensors and Intelligent Devices

CO-PO Articulation Matrix

PO/CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO1	3	1	2	1	1	1
CO2	3	1	2	1	1	-
CO3	3	1	2	1	-	1
CO4	3	1	2	1	1	1
CO5	3	1	2	1	-	-

Unit-I.

Overview of Smart Materials: Piezoelectric Materials : Introduction to Smart Material , What is a Smart Material, Applications of Smart Material, Applications of Smart Material ,Smart systems using Smart Material Materials, Smart Actuators, Direct and Reverse Effects, Piezoelectric Materials, History of Piezoelectricity, Piezoelectric Materials, Piezoelectric Materials, Piezoceramic Actuator, Constitutive Relationship, Piezoceramic Polymers &Composites Composites Bimorphs & Piezostacks.

Unit II.

Magnetostrictive Smart Materials & Active Smart Polymer: What is Magnetostriction, Some Examples, A Brief History of Magnetostrictive Material Materials, What are the different effects of Magnetostriction? The Constitutive Relationship, Actuators Developed using Terfenol D, Sensors Developed using Terfenol-D., Magnetostrictive Composites. What is Active Smart Polymer Classifications of Electro active Polymers , The Constitutive Relationship, Actuators Developed using EAP, Sensors Developed using EAP, Future of IPMC Ionic Polymer Metal Composite (IPMC), Actuators Developed using IPMC Actuators Developed using IPMC , Sensors Developed using IPMC, Future of IPMC What is Shape Memory Effect? Metallic alloys that show Shape Metallic alloys that show Shape Memory Effect, The Constitutive Relationship , Actuators Developed using SMA, Sensors Developed using SMA, Future of SMA.

ASSOCIATE PROFESSOR & HEAD
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Unit III:

Modelling of Piezoelectric Material: Piezoelectric Property, Crystal structure Crystal Structure, Constitutive Relationship, Active Strain Evaluation, Piezoelectric Coefficients, A Comparison of Properties, Comparison of Properties, Actuators Developed using Piezoelectric Material induced Strain Actuation (ISA), Uniform Strain Model, Static Equilibrium Configuration against ,Uniform Strain Uniform Strain Configuration against Bending Strain, ISA – Euler-Bernoulli Model , ISA Model for Magnetostrictive Model for Magnetostrictive Mini Actuator, Active Fibre Composite Actuation.

Unit IV

High-Band Width, Low Strain Smart Sensors: Piezoelectric Actuators – Piezoceramic Unimorph and Bimorphsp, Amplified Piezoactuators Piezoelectric Composites– Piezoelectric Composites – Piezo-transducres, Electrostrictive (PMN) Actuators, Magnetostrictive Actuators, Magnetostrictive Actuators , Terfenol-D Actutaors as MMA, Terfenol D Composites, Delamination Sensing and Vibration Control using Magnetostrictive Control using Magnetostrictive Materials, Piezoelectric Inchworm Devices ¬Piezoelectric Fuel Injectors , Ultrasonic Motors.

Unit V

Intelligent Devices based on Smart Materials: Piezoelectric Inchworm Devices, Inchworm devices for Actuation, Sizes and Specifications, Inchworm Devices for Locomotion, Unimorph Thunder, Rainbow Actuators, Rainbow and Thunder Actuation, Active Elasto-dynamic Motion, A Case history of Sensor Application, Introduction to MEMS Devices, MEMS based Accelerometers.

Text Books:

1. Brian Culshaw, Smart Structures and Materials, Artech House, 2000
2. Gauenzi, P., Smart Structures, Wiley, 2009

SUGGESTED READING:

1. Cady, W. G., Piezoelectricity, Dover Publication
2. https://nptel.ac.in/courses/112104173.

ASSOCIATE PROFESSOR & HEAD
Department of Mechanical Engineering
Chaitanya Bharathi Institute of Technology (A)
Gandipet, Hyderabad-500 075. Telangana.