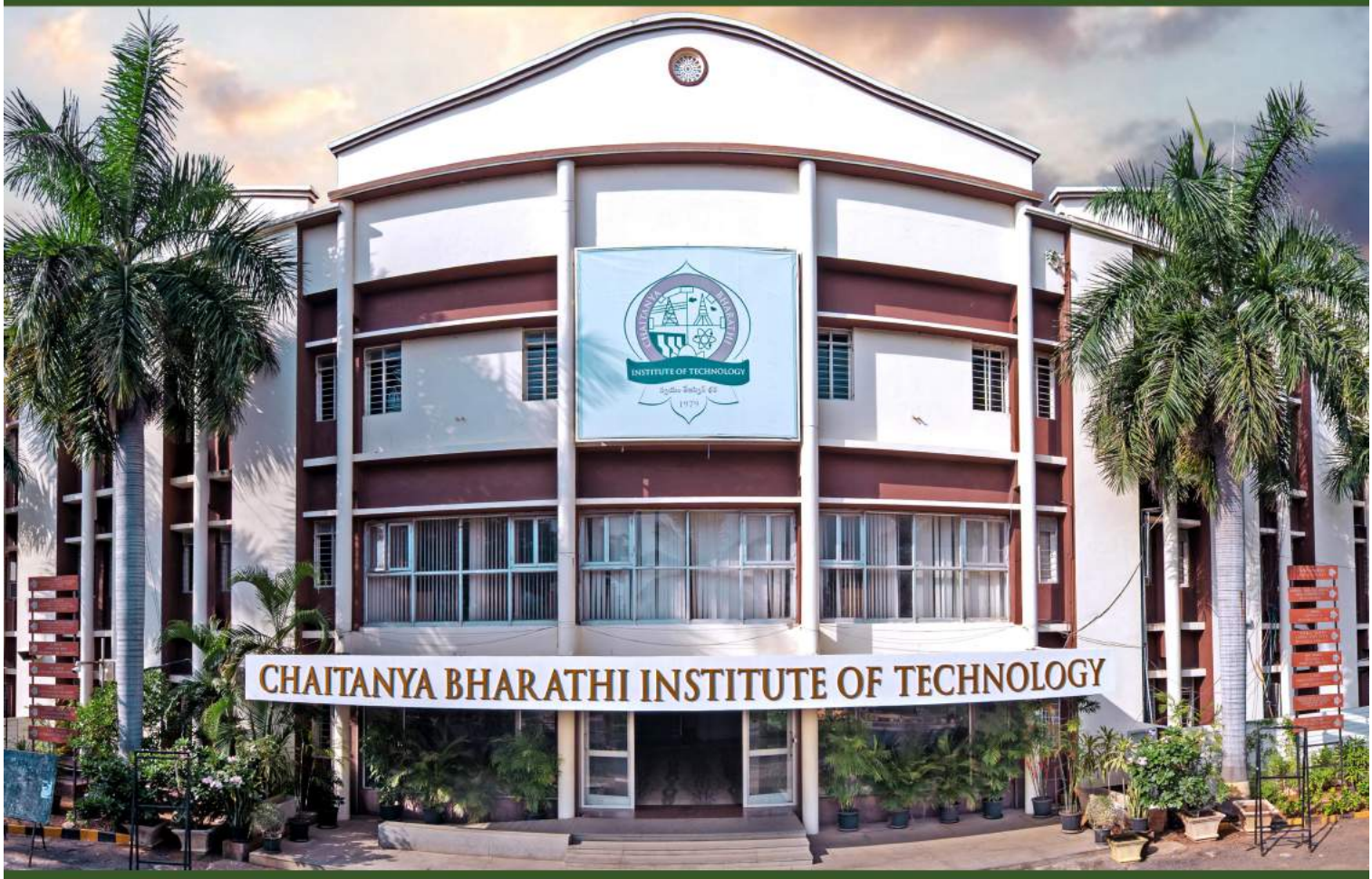
PG-R23 Curriculum
With effective from 2023-24

Mechanical - Thermal Engineering

Scheme of Instruction and Syllabi of
M.E I to IV Semester of
Two Year Degree Course



CHAITANYA BHARATHI INSTITUTE OF TECHNOLOGY
(An Autonomous Institute | Affiliated to Osmania University)
Accreditated by NBA & NAAC (A++)
Kokapet Village, Gandipet Mandal, Hyderabad -500075, Telanagana.
E-mail: principal@cbit.ac.in, Website: www.cbit.ac.in
Phone No. : 040-24193276 / 277 / 279

Scheme of Instruction and Syllabi

of

ME I to IV SEMESTERS

of

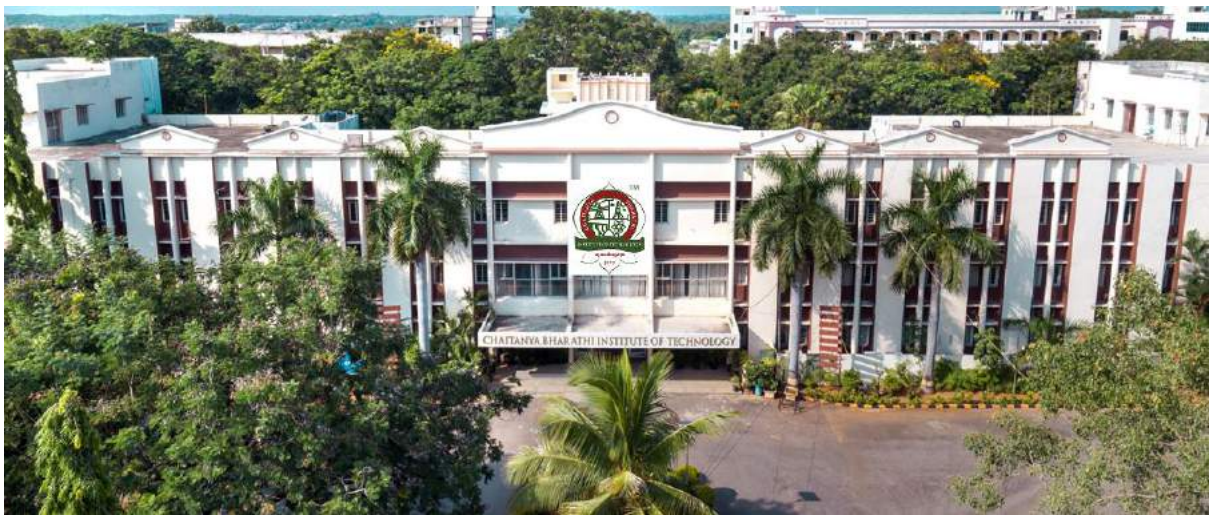
TWO YEAR PG COURSE

in

THERMAL ENGINEERING

(AICTE Model Curriculum with effect from AY 2023-24)

(R-23 Regulation)



CHAITANYA BHARATHI INSTITUTE OF TECHNOLOGY

(Autonomous Institution under UGC, Affiliated to Osmania University)

Department of Mechanical Engineering

Accredited with NAAC- (A++)

Chaitanya Bharathi (Post), Gandipet, Hyderabad–500075

CHAITANYA BHARATHI INSTITUTE OF TECHNOLOGY

OUR MOTTO: SWAYAM TEJASWIN BHAVA

Institute Vision

To be the center of excellence in technical education and research

Institute Mission

To address the emerging needs through quality technical education and advanced research

Department Vision

To be the destination for aspiring young minds to become globally competitive, enlightened, innovative, immediate contributors to the industry and successful in higher studies in the field of mechanical engineering.

Department Mission

1. To impart quality and innovative education in mechanical engineering with basic and specialized training, internships to meet the current and emerging needs of the industry.
2. To prepare the students for successful professional career by inculcating ethical, entrepreneurial and leadership qualities.
3. To foster Research and Development environment by disseminating knowledge and technology by involving the students in publications, sponsored projects and consultancy.

DEPARTMENT OF MECHANICAL ENGINEERING

Program Educational Objectives of M.E (Thermal Engineering) Program

PE01	Prepare Graduates with Good Analytical, Computational and Experimental Skills to Design and Develop Energy Efficient Systems for Sustainable Development.
PE02	Prepare Graduates with High Level of Technical Competency combined with Research and Complex Problem Solving Ability to Generate Innovative Solutions in Thermal Engineering and allied areas.
PE03	Pursue Lifelong Learning for Career and Professional Growth with a Concern for Society and Environment.
PE04	Inculcate Teamwork, Communication and Interpersonal Skills adapting to Changing needs of society.

Program Outcomes of M.E (Thermal Engineering) Program

PO 1	An ability to independently carry out research /investigation and development work to solve practical problems
PO 2	An ability to write and present a substantial technical report/document
PO 3	Students should be able to demonstrate a degree of mastery over the area as per the specialization of the program. The mastery should be at a level higher than the requirements in the appropriate bachelor program
PO 4	Ethics: apply ethical principles and commit to professional ethics and responsibilities and norms of engineering practice
PO 5	Project management and finance: demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work as a member and leader in a team, to manage projects and in multidisciplinary environments
PO 6	Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technology

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 - 1	2	--	--	2	--	50	Non-Credit
PRACTICALS									
7	23ME C203	Thermal Systems Lab - 1(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 – 1					
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

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

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

CHAITANYA BHARATHI INSTITUTE OF TECHNOLOGY

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

M.E. (Thermal Engineering)

SEMESTER – IV

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 C212	Industrial Project / Dissertation Phase - II	--	--	32	Viva	100	100	16
TOTAL			**--**	**--**	**32**		**100**	**100**	**16**
Clock Hours Per Week = 32									

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

Service Courses Offered by Mechanical Engineering Department

Open Elective (5/5)		
SNO	**Subj. Code**	**Name of the Subject**
1	23MEO 101	Industrial Safety
2	23MEO 102	Introduction to Optimization Techniques
3	23MEO 103	Composite Materials
4	23MEO 104	Alternative energy sources
5	23MEO 105	Computational methods

List of Subjects for ME (Thermal engineering) Course with specialization in Thermal Engineering

S.No.	Course Code	Title of the Course
Program Core Courses		
1	23ME C201	Thermodynamics and Combustion
2	23ME C202	Advanced Fluid Dynamics
3	23ME C205	Advanced Heat and Mass Transfer
4	23ME C206	Computational Fluid Dynamics
5	23ME C207	Engine Emissions and Pollution Control
Practical Courses / Mini Project with Seminar/ Dissertation		
6	23ME C203	Thermal Systems Lab -1
7	23ME C204	Solar energy Technologies Lab
8	23ME C208	Computational Fluid Dynamics Lab
9	23ME C209	Thermal systems Lab-2
10	23ME C210	Mini Project with Seminar
11	23ME C211	Industrial Project / Dissertation Phase - I
12	23ME C212	Industrial Project / Dissertation Phase - II
Program Elective Courses		
		Program Elective – I Courses
1	23ME E201	Thermal and Nuclear Power Plants
2	23ME E202	Environmental Engineering and Pollution Control
3	23ME E203	Prime Movers for Automobiles
		Program Elective – II Courses
4	23ME E204	Refrigeration Technology
5	23ME E205	Energy Conservation and Waste Heat recovery
6	23ME E206	Solar energy technologies
Program Elective – III Courses		
7	23ME E207	Heating Ventilation & Air Conditioning
8	23ME E208	Cryogenic Engineering
9	23ME E209	Design of Heat Exchangers
Program Elective – IV Courses		
10	23ME E210	Turbo Machines
11	23ME E211	Jet and Rocket Propulsion
12	23ME E212	Electronic engine management systems
Program Elective – V Courses		
13	23ME E213	Experimental Methods in Thermal Engineering
14	23ME E214	Energy systems and management
15	23ME E215	Fluid Power Systems
		Mandatory Course

1	23ME M103	Research Methodology and IPR
Audit Courses		
1	23CE A101	Disaster Mitigation and Management
2	23EE A101	Sanskrit for Technical Knowledge
3	23EC A101	Value Education
4	23ADA101	Pedagogy Studies
5	23EG A101	English for Research Paper Writing
6	23EG A102	Constitution of India
7	23EG A103	Stress Management by Yoga
8	23EG A104	Personality Development through Life's Enlightenment Skills
Open Elective Courses		
1	23CE O101	Cost Management of Engineering Projects
2	23EE O101	Waste to Energy
3	23CS O101	Business Analytics
Service Courses Offered by Mechanical Engineering Department		
1	23MEO 101	Industrial Safety
2	23MEO 102	Introduction to Optimization Techniques
3	23MEO 103	Composite Materials
4	23MEO 104	Alternative energy sources
5	23MEO 105	Computational methods

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 - 1	2	--	--	2	--	50	Non-Credit
PRACTICALS									
7	23ME C203	Thermal Systems Lab-1 (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 Heatrecovery
3	23ME E203	Prime Movers for Autonobiles	3	23ME E206	Solar energy technologies

Audit Course – 1					
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	23G A104	Personality Development through Life's Enlightenment Skills

23MEC201

THERMODYNAMICS AND COMBUSTION

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

COURSE OBJECTIVES: This course aims to

1. Review the basic laws of thermodynamics and create awareness of the importance of thermodynamic principles in engineering applications
2. Understand the behavior of real gases vis-à-vis ideal gas
3. Create awareness about the importance of combustion reactions in real time applications
4. Understand the basic principles of power cycles and its relation with combustion processes
5. Understand various methods of direct energy conversion

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

1. Apply various laws of thermodynamics to suit the engineering applications.
2. Apply the knowledge of thermodynamics for the behavior of real gases.
3. Understand the phenomenon of combustion
4. Understand the application of power cycles to engineering practice.
5. Understand various non-conventional energy conversion methods like fuel cells etc

CO-PO Articulation Matrix

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

UNIT – I

Thermodynamic Laws: Review of Thermo dynamic Laws and Corollaries – Transient Flow Analysis – Second law of thermodynamics – Entropy - Availability and unavailability – Irreversibility – Thermo dynamic Potentials – Maxwell Relations – Specific Heat Relations – Mayer's relation - Evaluation of Thermodynamic properties of working substance. Third law of thermodynamics, Nerst heat theorem, Introduction to - Statistical thermodynamics, statistical interpretations of first and second law and Entropy

UNIT – II

Real Gas Behaviour: P.V.T. surface – Equations of state – Real Gas Behaviour – Vander Waal's equation - Generalized compressibility Factor – Energy properties of Real Gases – Vapour pressure – Clausius – Clapeyron Equation – Throttling– Joule – Thompson coefficient, Non-reactive Mixture of perfect Gases – Governing Laws, Real Gas Mixture

UNIT – III

Combustion: Combustion – Combustion Reactions – Enthalpy of Formation – Entropy of Formation – Reference Levels for Tables – Heat of Reaction – Adiabatic flame Temperature, General product – Enthalpies – Equilibrium. Chemical Equilibrium of Ideal Gases – Effects of Non-reacting Gases Equilibrium in Multiple Reactions. The Van Hoff's Equation - The chemical potential and phase Equilibrium – The Gibbs phase Rule

UNIT – IV

Power Cycles: Power cycles, Review Binary vapour cycle, co-generation and combined cycles – Second law analysis of cycles – Refrigeration cycles. Thermo Dynamics of irreversible processes – Thermo electric circuits

UNIT – V

Direct Energy Conversion: Introduction – Fuel Cells - Thermo electric energy – Thermo-ionic power generation -Thermodynamic devices - Magneto Hydrodynamic Generations – Photo voltaic cells

TEXT BOOKS:

1. Younus. A. Cengel & Michael. A. Boles, "Thermodynamics: An Engineering Approach", 7/e, TMH.
2. Y.V.C. Rao. "Postulates and Statistical Thermodynamics", Allied Publishers Inc., 1994.

SUGGESTED READING:

1. P.K. Nag, "Basic and Applied Thermodynamics", TMH, 2008.
2. J.P. Holman, "Thermo Dynamics", Mc Graw Hill, 2008
3. Howell and Dedcius, "Fundamentals of Engineering Thermodynamics", McGraw Hill Inc., U.S.A.

23MEC202

ADVANCED FLUID DYNAMICS

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. Understand different types of fluid flows and various functions related to fluids
2. Learn important equations related to fluids
3. Understand the concept of boundary layer
4. Understand the isentropic behavior of gas in nozzles
5. Learn about shocks of fluids

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

1. Understand the concept of stream and velocity potential function
2. Apply of the knowledge of equations for analysis in cfd
3. Calculate thickness of boundary layer and shear stress
4. Design nozzles and diffusers
5. Estimate various parameters in fluids subjected to shocks

CO-PO Articulation Matrix

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

UNIT - I

Fluid Flows: Classification of fluids. Lagrangian and Eularian Methods of Study of fluid flow. Velocity and acceleration vectors. Circulation and Vorticity. Stream lines. Stream tube. Path lines. Streak lines and Time lines. Stream function and Potential function

UNIT - II

Laws of Fluid Flow: Continuity. Euler's and Bernoulli's equations. Incompressible and Compressible flows. Potential and viscous flows. Navier – Stoke's equation and applications

UNIT- III

Concept of Boundary Layer: Flow over an aerofoil – Lift and Drag coefficients. Boundary layer theory – laminar and turbulent boundary layers. Hydrodynamic and thermal boundary layer equations. Flow separation in boundary layers

UNIT - IV

Gas Dynamics: Energy equation for flow and non flow processes. Application of Steady flow energy equation for turbines, turbo-compressors, nozzles and diffusers. Adiabatic energy equation. Acoustic velocity, Mach Number. Stagnation properties. Relationships between static and stagnation properties. Various regimes of flow – Steady flow ellipse

UNIT - V

Principles of Gas Dynamics Applicable to Shocks: Isentropic flow through variable area passages. Design of supersonic and subsonic nozzles and diffusers. Supersonic flows. Expansion and Shock waves. Normal and Oblique Shock waves. Prandtl-Meyer and Rankine-Hugoniot Relations. Simple problems on normal and oblique shock waves.

TEXT BOOKS:

1. C. P. Kothandaraman, R. Rudramoorthy, “Basic Fluid Mechanics”, New Age Intl. Publishers, 2014.
2. S. M. Yahya,”Fundamentals of Compressible flow”, Wiley Eastern Ltd, 2014.

SUGGESTED READING:

1. Shapiro, “Compressible fluid flow”, Ronold Press, New York, 1956.
2. S. Radhakrishnan, “Fundamentals of Compressible flow”, TMH, 2014.
3. Zoeb Hussain, “Gas Dynamics Though Problems”, Wiley, New York, 1980.

23MEE201

THERMAL AND NUCLEAR POWER PLANTS

(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. Performance of steam power plant and to observe the importance of combustion of coal
2. Combined cycle effect in gas turbine power plants
3. Different nuclear reactors and estimate the economical benefits
4. Calculation of different energy tariffs under various load conditions
5. Pressure, temperature and flow parameters of a power plant

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

1. Analyze on combustion of coal and find performance of different power plant cycles
2. Analyze the combined cycle power plants and waste heat recovery systems
3. Design various types of nuclear reactors taking safety precautions and making economically beneficial
4. Calculate the energy rates of power distribution considering the factors affecting the economy
5. Determine the pressure, temperature and flow measurements of steam and water to operate the power plant most efficiently and suggest various remedies to control pollutants

CO-PO Articulation Matrix

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

UNIT - I

Layout of Power Plants: Sources of Energy, types of Power Plants, Direct Energy Conversion System, Energy Sources in India, and Recent developments in Power Generation. Combustion of Coal, Volumetric Analysis, Gravimetric Analysis, and Flue gas analysis. Steam Power Plants: Introduction – General Layout of Steam Power Plant, Modern Coal-fired Steam Power Plants, Power Plant cycles, Fuel handling, Combustion Equipment, Ash handling, Dust Collectors

UNIT - II

Combined Cycle Power Plant: Cogeneration, Combined cycle Power Plants, Analysis, Waste-Heat Recovery, IGCC Power Plants, Fluidized Bed Combustion
– Advantages & Disadvantages

UNIT- III

Nuclear Power Plant: Nuclear Physics, Nuclear Reactors, Classification – Types of Reactors, Site Selection, Methods of enriching Uranium, Applications of Nuclear Power Plants. Nuclear Power Plants Safety: By-Products of Nuclear Power Generation, Economics of Nuclear Power Plants, Nuclear Power Plants in India, Future of Nuclear Power

UNIT - IV

Economics of Power Plant: Economics of Power Generation: Factors affecting the economics, Load Factor, Utilization factor, Performance and Operating Characteristics of Power Plants. Economic Load Sharing, Depreciation, Energy Rates, Criteria for Optimum Loading, Specific Economic energy problems

UNIT - V

Power Plant Instrumentation: Classification, Pressure measuring instruments, Temperature measurement and Flow measurement. Analysis of Combustion gases, Pollution – Types, Methods to Control

TEXT BOOKS:

1. E.L Wakil, "Power Plant Technology", Mc Graw Hill, New York, 1985.
2. J. Weis Man and R Eckert, "Modern Power Plant Engineering", PHI, New Delhi, 1983.

SUGGESTED READING:

1. S.C. Arora and S. Domkundwar, "A course in Power Plant Engineering", Dhanpat Rai & Sons 2002.

2. P. K. Nag, "Power Plant Engineering", TMH, 2003.

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

23MEE203

PRIME MOVERS FOR AUTOMOBILES

(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. learn the importance of IC engine as prime mover .
2. understand the formation of exhaust emissions and control techniques from IC engines.
3. know the possible alternative fuels to reduce pollution levels.
4. Understand the importance of EVs.
5. acquire the knowledge of hybrid vehicles.

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

1. Understand the importance of IC engine as prime mover and compare the performance on the basis of thermodynamic cycle and combustion process.
2. Understand the importance of different types of alternative fuels to reduce pollution levels
3. Understand the importance of battery vehicles in the context of increasing pollution levels with fossil fuels.
4. Identify structure importance of EVs and understanding the structure of electrical vehicles
5. Understand the importance of hybrid vehicles in the context of depletion of fossil fuels and increasing pollution levels

CO-PO Articulation Matrix

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

UNIT-I

Classification of Prime Movers; IC Engines as Prime Movers; Historical Perspective of IC Engines; IC Engines-Classification, Differences between 2-stroke and 4-stroke cycle engines, Differences between SI and CI engines.

Fuel Metering in SI and CI Engines: Brief treatment on Carburetion and fuel injection systems for SI Engines; Types of Fuel injection Systems - Individual, Unit and Common Rail (CRDI), Fuel Injectors-Nozzle types, Electronic Control Unit (ECU)

UNIT-II

Alternative Fuels: Need for Alternative fuels, Desirable Characteristics of good Alternative Fuel Liquid and Gaseous fuels for SI and CI Engines, Kerosene, Alcohols, vegetable oils and biodiesel, LPG, CNG, Bio gas, Hydrogen and engine modifications for alternative fuels.

UNIT-III

Batteries: Battery: lead-acid battery, cell discharge and charge operation, construction, advantages of lead- acid battery- Battery parameters: battery capacity, discharge rate, state of charge, state of discharge, depth of discharge, Technical characteristics-Ragone plots.

UNIT-IV

Electric vehicles: Introduction: Limitations of IC Engines as prime mover, History of EVs, EV system, components of EV-DC and AC electric machines: Introduction and basic structure Electric vehicle drive train-advantages and limitations, Permanent magnet and switched reluctance motors-EV motor sizing: Initial

acceleration, rated vehicle velocity, Maximum velocity and maximum gradeability

UNIT-V

Hybrid vehicle: Configurations of hybrids, advantages and limitations-Hybrid drive trains, sizing of components Initial acceleration, rated vehicle velocity, Maximum velocity and maximum gradeability-Hydrogen: Production-Hydrogen storage systems-reformers

Fuel Cell vehicles: Fuel cells: Introduction-Fuel cell characteristics, Thermodynamics of fuel cells-Fuel cell types:

TEXT BOOKS:

1. J.B. Heywood, Internal Combustion Engine Fundamentals, McGraw Hill Co.2018
2. H.N. Gupta, Fundamentals of Internal Combustion Engines, PHI, 2012

SUGGESTED READING:

1. C.R.Ferguson, A.T. Kirpatrick, IC Engines : Applied Thermo sciences, 2015
2. Gill P.W, Fundamentals Of Internal Combustion Engines, Oxford and IBH publishing co Pvt ltd
3. Seth Leitman and Bob Brant, Build your own electric vehicle McGraw Hill Co.2009.

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

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.

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.

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.

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 I: 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.

23MEM103

RESEARCH METHODOLOGY AND IPR

Instruction	2 Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	2

COURSE OBJECTIVES: This course aims to

1. Motivate to choose research as career
2. Formulate the research problem, prepare the research design
3. Identify various sources for literature review and data collection report writing
4. Equip with good methods to analyze the collected data
5. Know about IPR copyrights

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

1. Define research problem, review and asses the quality of literature from various sources
2. Improve the style and format of writing a report for technical paper/ Journal report, understand and develop various research designs
3. Collect the data by various methods: observation, interview, questionnaires
4. Analyze problem by statistical techniques: ANOVA, F-test, Chi-square
5. Understand apply for patent and copyrights

CO-PO Articulation Matrix

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

UNIT - I

Research Methodology: Research Methodology: Objectives and Motivation of Research, Types of Research, research approaches, Significance of Research, Research Methods verses Methodology, Research Process, Criteria of Good Research, Problems Encountered by Researchers in India, Benefits to the society in general. Defining the Research Problem: Selection of Research Problem, Necessity of Defining the Problem

UNIT - II

Literature Survey Report Writing: Literature Survey: Importance and purpose of Literature Survey, Sources of Information, Assessment of Quality of Journals and Articles, Information through Internet. Report writing: Meaning of interpretation, layout of research report, Types of reports, Mechanics of writing a report. Research Proposal Preparation: Writing a Research Proposal and Research Report, Writing Research Grant Proposal

UNIT- III

Research Design: Research Design: Meaning of Research Design, Need of Research Design, Feature of a Good Design, Important Concepts Related to Research Design, Different Research Designs, Basic Principles of Experimental Design, Developing a Research Plan, Steps in sample design, types of sample designs.

UNIT - IV

Data Collection and Analysis: Data Collection: Methods of data collection, importance of Parametric, non parametric test, testing of variance of two normal population, use of Chi-square, ANOVA, Ftest, z-test

UNIT - V

Patents and Copy Right: Patent: Macro economic impact of the patent system, Patent document, How to protect your inventions. Granting of patent, Rights of a patent, how extensive is patent protection. Copyright: What is copyright. What is covered by copyright. How long does copyright last? Why protect copyright? Related Rights: what are related rights? Enforcement of Intellectual Property Rights: Infringement of intellectual property rights, Case studies of patents and IP Protection

TEXT BOOKS:

1. C. R. Kothari, "Research Methodology, Methods & Technique", New Age International Publishers, 2004.
2. R. Ganesan, "Research Methodology for Engineers", MJP Publishers, 2011.

SUGGESTED READING:

1. Ajit Parulekar and Sarita D' Souza, "Indian Patents Law – Legal & Business Implications", Macmillan India ltd, 2006
2. B. L.Wadehra, "Law Relating to Patents, Trade Marks, Copyright, Designs & Geographical Indications", Universal law Publishing Pvt. Ltd., India 2000.
3. P. Narayanan, "Law of Copyright and Industrial Designs", Eastern law House, Delhi 2010.

23CE A101

DISASTER MITIGATION AND MANAGEMENT

(Audit Course I and II - Common to all branches)

Instruction	2L Hours per week
Duration	2 Hours
SEE	50 Marks
CIE	0 Marks
Credits	Pass / Fail

COURSE OBJECTIVES: This course aims to

1. To equip the students with the basic knowledge of hazards, disasters, risks and vulnerabilities including natural, climatic and human induced factors and associated impacts
2. To impart knowledge in students about the nature, causes, consequences and mitigation measures of the various natural disasters
3. To enable the students to understand risks, vulnerabilities and human errors associated with human induced disasters
4. To enable the students to understand and assimilate the impacts of any disaster on the affected area depending on its position/ location, environmental conditions, demographic, etc.
5. To equip the students with the knowledge of the chronological phases in a disaster management cycle and to create awareness about the disaster management framework and legislations in the context of national and global conventions

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

1. Analyze and critically examine existing programs in disaster management regarding vulnerability, risk and capacity at different levels
2. Understand and choose the appropriate activities and tools and set up priorities to build a coherent and adapted disaster management plan
3. Understand various mechanisms and consequences of human induced disasters for the participatory role of engineers in disaster management
4. Understand the impact on various elements affected by the disaster and to suggest and apply appropriate measures for the same
5. Develop an awareness of the chronological phases of disaster preparedness, response and relief operations for formulating effective disaster management plans and ability to understand various participatory approaches/strategies and their application in disaster management

CO-PO Articulation Matrix

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

UNIT- I:

Introduction: Basic definitions- Hazard, Disaster, Vulnerability, Risk, Resilience, Mitigation, Management; classification of types of disaster-Natural and manmade; International Decade for natural disaster reduction (IDNDR); International strategy for disaster reduction (ISDR), National disaster management authority (NDMA).

UNIT- II:

Natural Disasters: Hydro meteorological disasters: Causes, Early warning systems- monitoring and management, structural and non-structural measures for floods, drought and Tropical cyclones; Geographical based disasters: Tsunami generation, causes, zoning, Early warning systems- monitoring and management, structural and non-structural mitigation measures for earthquakes, tsunami, landslides, avalanches and forest fires. Case studies related to various hydro meteorological and geographical based disasters.

UNIT- III:

Human induced hazards: Chemical disaster- Causes, impacts and mitigation measures for chemical accidents, Risks and control measures in a chemical industry, chemical disaster management; Case studies related to various chemical industrial hazards eg: Bhopal gas tragedy; Management of chemical terrorism disasters and biological disasters; Radiological Emergencies and case studies; Case studies related to major power break downs, fire accidents, traffic accidents, oil spills and stampedes, disasters due to double cellar construction in multistoried buildings.

UNIT- IV:

Disaster Impacts: Disaster impacts- environmental, physical, social, ecological, economic, political, etc.; health, psycho-social issues; demographic aspects- gender, age, special needs; hazard locations; global and national disaster trends; climate change and urban disasters.

UNIT- V:

Concept of Disaster Policies and legislation for disaster risk reduction

Management: Disaster management cycle – its phases; prevention, mitigation, preparedness, relief and recovery; risk analysis, vulnerability and capacity assessment; Post-disaster environmental response water, sanitation, food safety, waste management, disease control; Roles and responsibilities of government, community, local in situations, NGOs and other stakeholders;, DRR programmers in India and the activities of National Disaster Management Authority.

TEXT BOOKS:

1. Pradeep Sahni*," Disaster Risk Reduction in South Asia*", Prentice Hall, 2003.
2. B. K. Singh,*" Handbook of Disaster Management*: *techniques &Guidelines*", Rajat Publication, 2008.
3. Ministry of Home Affairs". *Government of India, "National disaster management plan, Part I and II",*
4. K. K. Ghosh," *Disaster Management",* APH Publishing Corporation, 2006.

SUGGESTED READING:

1. http://www.indiaenvironmentportal.org.in/files/file/disaster_management_india1.pdf
2. http://www.ndmindia.nic.in/ (National Disaster management in India, Ministry of Home Affairs)

Hazards, Disasters and your community: A booklet for students and the community, Ministry of home affairs.

23EEA101

SANSKRIT FOR TECHNICAL KNOWLEDGE

Instruction	2 Hours per week
Duration of SEE	2 Hours
SEE	50 Marks
CIE	--
Credits	0

COURSE OBJECTIVES: This course aims to

1. To get a working knowledge in illustrious Sanskrit, the scientific language in the world
2. To make the novice Learn the Sanskrit to develop the logic in mathematics, science & other subjects
3. To explore the huge knowledge from ancient Indian literature

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

1. Develop passion towards Sanskrit language
2. Decipher the latent engineering principles from Sanskrit literature
3. Correlates the technological concepts with the ancient Sanskrit history.
4. Develop knowledge for the technological progress
5. Explore the avenue for research in engineering with aid of Sanskrit

CO-PO Articulation Matrix

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

UNIT-I

Introduction to Sanskrit Language: Sanskrit Alphabets-vowels-consonants- significance of Amarakosa-parts of speech-Morphology-creation of new words- significance of synonyms-sandhi-samasa-sutras-active and passive voice-Past/ Present/Future Tense-syntax-Simple Sentences (elementary treatment only)

UNIT-II

Role of Sanskrit in Basic Sciences: Brahmagupthas lemmas (second degree indeterminate equations), sum of squares of n-terms of AP- sulba_sutram or baudhayana theorem (origination of pythogorous theorem)-value of pie- Madhava's sine and cosine theory (origination of Taylor's series).
Themeasurementsystem-time-mass-length-temp,Matterelasticity-optics-speed of light (origination of michealson and morley theory).

UNIT-III

Role of Sanskrit in Engineering-I (Civil, Mechanical, Electrical and Electronics Engineering):
Building construction-soil testing-mortar-town planning-Machine definition-crucible-furnace-air blower-Generation of electricity in a cell-magnetism-Solar system-Sun: The source of energy, the earth-Pingala chandasutram (origination of digital logic system)

UNIT-IV

Role of Sanskrit in Engineering-II (Computer Science Engineering & Information Technology): Computer languages and the Sanskrit languages- computer command words and the vedic command words-analogy of pramana in memamsa with operators in computer language-sanskrit analogy of physical sequence and logical sequence, programming.

UNIT-V

Role of Sanskrit in Engineering-III (Bio-technology and Chemical Engineering): Classification of plants-plants, the living-plants have senses-classification of living creatures, Chemical laboratory location and layout-equipment-distillation vessel-kosthi yanthram

TEXT BOOKS:

1. M Krishnamachariar, "History of Classical Sanskrit Literature", TTD Press, 1937.
2. M.R. Kale, "A Higher Sanskrit Grammar: For the Use of School and College Students", Motilal Banarsidass Publishers, ISBN-13: 978- 8120801783, 2015

SUGGESTED READING:

1. Kapail Kapoor, "Language, Linguistics and Literature: The Indian Perspective", ISBN- 10: 8171880649, 1994.
2. "Pride of India", Samskrita Bharati Publisher, ISBN: 81-87276-27-4, 2007.
3. Shri RamaVerma, "Vedas the source of ultimate science", Nag publishers, ISBN:81-7081-618-1,2005.

23ECA101

VALUE EDUCATION

Instruction	2 Hours per week
Duration of SEE	2 Hours
SEE	50 Marks
CIE	-
Credits	0

Prerequisite: Knowledge about universal human values.

Course Objectives: This course aims to

1. Understand Value Education, self-development and National development.
2. Imbibe good human values and Morals in students.
3. Let the should know about the importance of character.

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

1. Gain necessary Knowledge for self-development
2. Learn the importance of Human values and their application in day to day professional life.
3. Appreciate the need for and importance of interpersonal skills for successful career and social life
4. Emphasize the role of personal and social responsibility of an individual for all-round growth.
5. Develop a perspective based on spiritual outlook and respect women, other religious practices, equality, non-violence and universal brotherhood.

CO-PO Articulation Matrix

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

UNIT-I

Human Values, Ethics and Morals: Concept of Values, Human Values, Indian concept of humanism, Values for self-development, Social values, Individual attitudes, Work ethics, Moral and non- moral behavior, Standards and Principles based on religion, Culture and Tradition.

UNIT-II

Value Cultivation, and Self-Management: Need and Importance of cultivation of values such as Sense-of Duty, Devotion to work, Self-reliance, Confidence, Concentration, Integrity & discipline, and Truthfulness.

UNIT-III

Spiritual Outlook and Social Values: Personality and Behavior Development, Scientific attitude and Spiritual (soul) outlook, Cultivation of Social Values Such as Positive Thinking, Punctuality, Love & Kindness, avoiding fault finding in others, Reduction of anger, Forgiveness, Dignity of labor, True friendship, Universal brotherhood and religious tolerance., Happiness Vs Suffering, Love for truth, Aware of self-destructive habits, Appreciation and co-operation.

UNIT-IV

Values in Holy Books: Self-management, Good health and internal & external cleanliness, Holy books versus Blind faith, Character and Competence, Equality, Nonviolence, Humility, Role of Women.

UNIT-V

All religions and same message: Mind your mind, Self-control, Concept of soul;, Science of Reincarnation, Character and Conduct, Concept of Dharma, Cause and Effect based Karma Theory;, The qualities of Devine and Devilish;,Satwic, Rajasic and Tamasic gunas.

TEXT BOOKS:

1. Chakraborty, S.K. "Values & Ethics for organizations Theory and practice", Oxford University Press, New Delhi, 1998.

SUGGESTED READING:

1. Jaya Dayal Goyandaka, "Srimad Bhagavad Gita with SanskritText, Word Meaning and Prose Meaning", Gita Press, Gorakhpur, 2017.

23ADA101

PEDAGOGY STUDIES

Instruction	2 Hours per week
Duration of SEE	2 Hours
SEE	50 Marks
CIE	--
Credits	0

COURSE OBJECTIVES: This course aims to

1. To present the basic concepts of design and policies of pedagogy studies.
2. To provide understanding of the abilities and dispositions with regard to teaching techniques, curriculum design and assessment practices.
3. To familiarize various theories of learning and their connection to teaching practice.
4. To create awareness about the practices followed by DFID, other agencies and other researchers.
5. To provide understanding of critical evidence gaps that guides the professional development.

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

1. Illustrate the pedagogical practices followed by teachers in developing countries both in formal and informal classrooms.
2. Examine the effectiveness of pedagogical practices.
3. Understand the concept, characteristics and types of educational research and perspectives of research.
4. Describe the role of classroom practices, curriculum and barriers to learning.
5. Understand Research gaps and learn the future directions.

CO-PO Articulation Matrix

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

UNIT-I

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

UNIT-II

Thematic Overview: Pedagogical practices followed by teachers in formal and informal classrooms in developing countries - Curriculum, Teacher education.

UNIT-III

Evidence on the Effectiveness of Pedagogical Practices: Methodology for the in depth stage: quality assessment of included studies - How can teacher education (curriculum and Practicum) and the school curriculum and guidance material best support effective pedagogy? - Theory of change - Strength and nature of the body of evidence for effective pedagogical practices - Pedagogic theory and pedagogical approaches - Teachers' attitudes and beliefs and pedagogic strategies.

UNIT-IV

Professional Development: alignment with classroom practices and follow up support - Support from the head teacher and the community – Curriculum and assessment - Barriers to learning: Limited resources and large class sizes.

UNIT-V

Research Gaps and Future Directions: Research design – Contexts – Pedagogy - Teacher education - Curriculum and assessment – Dissemination and research impact.

TEXT BOOKS:

1. Ackers J, Hardman F, "Classroom Interaction in Kenyan Primary Schools, Compare", 31 (2): 245 – 261, 2001.
2. Agarwal M, "Curricular Reform in Schools: The importance of
3. evaluation", Journal of Curriculum Studies, 36 (3): 361 – 379, 2004.

SUGGESTED READING:

1. Akyeampong K, "Teacher Training in Ghana – does it count? Multisite teacher education research project (MUSTER)", Country Report 1.London: DFID, 2003.
2. Akyeampong K, Lussier K, Pryor J, Westbrook J, "Improving teaching and learning of Basic Maths and Reading in Africa: Does teacher Preparation count?, International Journal Educational Development, 33 (3): 272- 282, 2013.
3. Alexander R J, "Culture and Pedagogy: International Comparisons in Primary Education", Oxford and Boston: Blackwell, 2001.

4 . Chavan M, "Read India: A mass scale, rapid, 'learning to read' campaign", 2003.

WEB RESOURCES:

1. https://onlinecourses.nptel.ac.in/noc17_ge03/preview
2. www.pratham.org/images/resources%20working%20paper%202.pdf.

23EGA101

ENGLISH FOR RESEARCH PAPER WRITING

Instruction	2 L Hours per Week
Duration of SEE	2 Hours
SEE	50 Marks
CIE	-
Credits	0

Prerequisite: Writing to express on science and technological concepts with good taste for research and development.

COURSE OBJECTIVES: This course aims to

1. Motivate learners for academic writing and thus encourage them for continuous professional updating and up-gradation.
2. Facilitate a practical understanding of the multiple purposes of Writing Research Papers and help them infer the benefits and limitations of research in science and technology.
3. Brainstorm and develop the content, formulating a structure and illustrating the format of writing a research paper.
4. Survey and select a theme/topic for a thorough reading and to writing a research paper.
5. Understand to implement the intricacies of writing and publishing a research paper.

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

1. Improve work performance and efficiency, illustrate the nuances of research paper writing and draw conclusions on professional usefulness.
2. Classify different types of research papers and organize the format and citation of sources.
3. Explore various formats of APA, MLA and IEEE and set up for writing a research paper.
4. Draft paragraphs and write theme based thesis statements in a scientific manner.
5. Develop an original research paper while acquiring the knowledge of how and where to publish their papers.

CO-PO-PSO Articulation Matrix

PO/PSO/CO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
CO 1	1	2	1	-	3	2	1	-	1
CO 2	1	1	1	-	1	2	-	-	1
CO 3	2	2	2	1	1	1	-	-	1
CO 4	2	2	1	1	2	2	1	1	1
CO 5	3	3	1	2	3	2	1	-	1

UNIT - I

Academic Writing: Meaning & Definition of a research paper; Purpose of a research paper - Scope, Benefits, Limitations and outcomes for professional development, An introduction to methods and Approaches of Research.

UNIT - II

Research Paper Format: Title - Abstract - Introduction - Discussion - Findings - Conclusion - Style of Indentation - Font size/Font types - Indexing - Citation of sources.

UNIT - III

Process of Writing a Research Paper, Writing to Draft a Format, Develop Content, Adapting, Reviewing, Paraphrasing& Plagiarism Checks.

UNIT - IV

Choosing a topic - Thesis Statement - Outline - Organizing notes - Language of Research - Word order, Paragraphs - Writing first draft-Revising/Editing - The final draft and proof reading. Understanding APA, MLA, IEEE formats.

UNIT - V

Research Paper Publication, Reputed Journals –Paid, Free and peer reviewed journals, National/International - ISSN No, No. of volumes, Scopus Index/UGC Journals. Getting Papers Published.

TEXT BOOKS:

1. Kothari, C. R. and Gaurav, Garg, "Research Methodology Methods and Techniques", 4thEdition, New Age International Publishers, New Delhi, 2019.
2. Ellison, Carroll. "Writing Research Papers", McGraw Hill's Concise Guide, 2010.
3. Lipson, Charles. "Cite Right: A Quick Guide to Citation Styles-- MLA, APA, Chicago, the Sciences, Professions, and More", 2nd Edition,. University of Chicago Press. Chicago, 2018.

SUGGESTED READING:

1. Day, Robert A. "How to Write and Publish a Scientific Paper", Cambridge University Press, 2006
2. Girden, E. R. "MLA Handbook for Writers of Research Papers", 7th Edition, East West Press Pvt. Ltd, New Delhi, 2009
3. Bailey, Stephen. "Academic Writing: A Handbook for International Students", Routledge, 2018

Online Resources:

1. https://onlin://onlinecourses.nptel.ac.in/noc 18_mg13/preview
2. https://nptel.ac.in/courses/121/106/121106007/
3. https://www.classcentral.com/course/swayam-introduction-to-research-5221

Writing Tools:

1. https://owl.purdue.edu/owl_exercises/index.html - The Owl writing lab
2. https://www.turnitin.com/login_page.asp?lang=en_us – Turn tin software

23EGA102

CONSTITUTION OF INDIA

Instruction	2 L Hours per Week
Duration of SEE	2 Hours
SEE	50 Marks
CIE	-
Credits	0

Prerequisite: Knowledge on basics of the Constitution and the Government.

Course Objectives: **This course aims to:**

1. The history of Indian Constitution and its role in the Indian democracy.
2. Address the growth of Indian opinion regarding modern Indian intellectuals' constitutional role and entitlement to civil and economic rights as well as the emergence of nationhood in the early years of Indian nationalism.
3. Have knowledge of the various Organs of Governance and Local Administration.

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

1. Understand the making of the Indian Constitution and its features.
2. Understand the Rights of equality, the Right of freedom and the Right to constitutional remedies.
3. Have an insight into various Organs of Governance - composition and functions.
4. Understand powers and functions of Municipalities, Panchayats and Co-operative Societies.
5. Understand Electoral Process, special provisions.

CO-PO-PSO Articulation Matrix

PO/PSO/CO	PO1	PO2	PO3	PO4	PO5	PO6
CO 1	2	1	-	1	1	1
CO 2	2	1	-	1	1	1
CO 3	2	1	-	1	1	1
CO 4	2	1	-	1	1	1
CO 5	2	-	-	1	1	1

UNIT-I

History of making of the Indian constitutions - History, Drafting Committee (Composition & Working). **Philosophy of the Indian Constitution**: Preamble, Salient Features.

UNIT-II

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

UNIT-III

Organs of Governance - Parliament : Composition, Qualifications, Powers and Functions.
Union executives : President, Governor, Council of Ministers, Judiciary, appointment and transfer of judges, qualifications, powers and functions.

UNIT-IV

Local Administration - District's Administration head: Role and importance. Municipalities: Introduction, Mayor and role of Elected Representative, CEO of Municipal Corporation. Panchayati Raj: Introduction, PRI: Zilla Panchayat, Elected Officials and their roles, CEO Zilla Panchayat: positions and role.

Block level: Organizational Hierarchy (Different departments) Village level: role of elected and appointed officials. Importance of grass root democracy.

UNIT-V

Election commission: Election Commission: Role and functioning, Chief Election Commissioner and Election Commissioners, State Election Commission :Role and functioning. Institute and Bodies for the welfare of SC/ST/OBC and women**.**

TEXT BOOKS:

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

SUGGESTED READING:

1. Bhargava, Rajeev. (ed), "Politics and Ethics of the Indian Constitution", OUP, 2008.
2. NCERT, Indian Constitution at Work, 1st Edition, Government of India, New Delhi 2006, reprinted in 2022.
3. Ravindra Sastry, V. (ed.), Indian Government & Politics, 2nd edition, Telugu Akademy, 2018.

Online Resources:

1. http://www.nptel.ac.in/courses/103107084/Script.pdf

23EGA103

STRESS MANAGEMENT BY YOGA

Instruction	2Hours per week
Duration of SEE	2 Hours
SEE	50 Marks
CIE	--
Credits	0

COURSE OBJECTIVES: This course aims to

1. Creating awareness about different types of stress and the role of yoga in the management of stress.
2. Promotion of positive health and overall wellbeing (Physical, mental, emotional, social and spiritual).
3. Prevention of stress related health problems by yoga practice.

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

1. Understand yoga and its benefits.
2. Enhance Physical strength and flexibility.
3. Learn to relax and focus.
4. Relieve physical and mental tension through asanas.
5. Improve work performance and efficiency.

CO-PO Articulation Matrix

PO/CO	PO1	PO2	PO3	PO4	PO5	PO6
CO 1	1	1	-	1	1	1
CO 2	1	-	-	1	1	1
CO 3	1	-	-	1	1	1
CO 4	1	1	-	1	1	1
CO 5	1	1	-	1	1	1

UNIT I

Meaning and definition of Yoga - Historical perspective of Yoga - Principles of Astanga Yoga by Patanjali.

UNIT II

Meaning and definition of Stress - Types of stress - Eustress and Distress. Anticipatory Anxiety and Intense Anxiety and depression. Meaning of Management- Stress Management.

UNIT III

Concept of Stress according to Yoga - Stress assessment methods - Role of Asana, Pranayama and Meditation in the management of stress.

UNIT IV

Asanas- (5 Asanas in each posture) - Warm up - Standing Asanas - Sitting Asanas - Prone Asanas - Supine asanas - Surya Namaskar.

UNIT V

Pranayama- Anulom and Vilom Pranayama - Nadishudhi Pranayama - Kapalabhati Pranayama - Bhramari Pranayama - Nadanusandhana Pranayama.

Meditation techniques: Om Meditation - Cyclic meditation: Instant Relaxation technique (QRT), Quick Relaxation Technique (QRT), Deep Relaxation Technique (DRT).

SUGGESTED READING:

1. Janardhan, Swami, "Yogic Asanas for Group Training - Part-I": Yogabhyasi Mandal, Nagpur.
2. Vivikananda, Swami, "Rajayoga or Conquering the Internal Nature", Advaita Ashrama (Publication Department), Kolkata.
3. Nagendra H.R and R. Nagaratna, “Yoga Perspective in Stress Management”, Swami Vivekananda Yoga

Prakashan, Bangalore.

Online Resources:

1. https://onlinecourses.nptel.ac.in/noc16_ge04/preview
2. https://freevideolectures.com/course/3539/indian-philosophy/11

23EGA104

PERSONALITY DEVELOPMENT THROUGH LIFE'S ENLIGHTENMENT SKILLS

Instruction	2 L Hours per Week
Duration of SEE	2 Hours
SEE	50 Marks
CIE	-
Credits	0

Prerequisite: Awareness on Personality Development.

COURSE OBJECTIVES: This course aims to

1. Learn to achieve the highest goal happily.
2. Become a person with stable mind, pleasing personality and determination.
3. Awake wisdom among themselves.

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

1. Develop their personality and achieve their highest goal of life.
2. Lead the nation and mankind to peace and prosperity.
3. Practice emotional self regulation.
4. Develop a positive approach to work and duties.
5. Develop a versatile personality.

CO-PO-PSO Articulation Matrix

PO/PSO/CO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
CO 1	1	1	-	1	1	1	-	1	-
CO 2	1	-	-	1	1	1	-	1	-
CO 3	1	-	-	1	1	1	-	1	-
CO 4	1	1	-	1	1	1	-	1	-
CO 5	1	1	-	1	1	1	-	1	-

UNIT - I

Neetisatakam – Holistic development of personality - Verses 19, 20, 21, 22 (Wisdom) - Verses 29, 31, 32 (Pride and Heroism) - Verses 26,28,63,65 (Virtue).

UNIT – II

Neetisatakam – Holistic development of personality (cont'd) - Verses 52, 53, 59 (dont's) - Verses 71,73,75& 78 (do's) - Approach to day to day works and duties.

UNIT - III

Introduction to Bhagavadgeetha for Personality Development – Shrimad BhagawadGeeta: Chapter 2– Verses 41, 47, 48 - Chapter 3 – Verses 13,21,27,35 - Chapter 6 – Verses 5,13,17,23,35 - Chapter 18 – Verses 45, 46, 48 Chapter – 6: Verses 5, 13, 17, 23, 35; Chapter – 18: Verses 45, 46, 48.

UNIT - IV

Statements of basic knowledge – Shrimad BhagawadGeeta: Chapter 2- Verses 56, 62,68 - Chapter 12 – Verses 13, 14, 15, 16, 17, 18 - Personality of Role model from Shrimad BhagawatGeeta.

UNIT - V

Role of Bahgavadgeeta in the present scenario - Chapter 2 – Verses 17 - Chapter 3 – Verses 36, 37, 42 - Chapter 4 – Verses 18, 38, 39 - Chapter 18 – Verses 37, 38, 63.

TEXT BOOKS:

1. Gopinath, P., “Bhartrihari’s Three Satakam(Niti-sringar-vairagya)”, Rashtriya Sanskrit Sansthanam, New Delhi, 2018.
2. Swarupananda, Swami, “Srimad Bhagavad Geeta”, Advaita Ashram (Publication Dept), Kolkata, 2017.

Online Resources:

1. http://nptel.ac.in/downloads/109104115/

23MEC203

THERMAL SYSTEMS LAB-1

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

Course Objectives: This course aims to:
1. Evaluate the performance of I.C Engine
2. Determine heat transfer coefficient in two phase heat transfer
3. Determine effectiveness of cross flow heat exchanger
4. Evaluate the thermal properties of fluids
5. Isentropic coefficient of air

COURSE OUTCOMES: After the completion of this course, the student will be able to
1. Estimate the thermal efficiency of IC engine.
2. Prove that value of convection heat transfer coefficient is very high with two phase heat transfer.
3. Estimate the effectiveness of cross flow heat exchanger and prove that it is very high compared with other configurations.
4. Find out properties of fluids such as coefficient of thermal expansion, enthalpy of fusion.
5. Determination of Isentropic coefficient of air.

CO-PO Articulation Matrix

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

List of Experiments:
1. Performance Evaluation on single/multi cylinder 4-stroke SI Engine.
2. Performance Evaluation on single/multi cylinder 4 stroke CI Engine.
3. Heat Balance sheet on multi cylinder 4-stroke SI Engine.
4. Determination of heat transfer coefficient in Film wise and Drop wise condensation
5. To determine the effectiveness of Cross flow Heat Exchanger.
6. Heat Pipe Demonstration
7. Determination of coefficient of thermal expansion of Solids, Liquids and Gases
8. Determination of thermal capacity of Solids
9. Determination of isentropic coefficient of air by Clement-Desormes method
10. Measure of enthalpy of fusion and solidification

TEXT BOOKS:
1. Younus. A. Cengel & Michael A. Boles, “Thermodynamics An Engineering Approach”, 7/e, TMH.
2. Y.V.C. Rao. “Postulates and Statistical Thermodynamics”, Allied Publishers Inc., 1994.

SUGGESTED READING:
1. P.K. Nag, “Basic and Applied Thermodynamics”, TMH, 2008.
2. J.P.Holman, “Thermo Dynamics”, Mc Graw Hill, 2008.
3. Howell and Dedcius, “Fundamentals of Engineering Thermodynamics”, McGraw Hill Inc., U.S.A.

23ME C204

SOLAR ENERGY TECHNOLOGIES LAB

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

COURSE OBJECTIVES: This course aims to

1. Concepts of flat plate collector for different working conditions
2. The working of trough collector at fixed and different flow rates
3. I-V and P-V characteristics of PV module
4. The Wind turbine working and factors effecting its performance
5. Functioning of wind solar hybrid systems

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

1. Find the performance of flat plate collector with different radiation levels
2. Determine the performance of trough collector
3. Analyze I-V and P-V characteristics of PV module
4. Evaluate cut-in speed and efficiency of wind turbine
5. Estimate the efficiency of solar-wind hybrid system

CO-PO Articulation Matrix

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

List of Experiments:

1. Performance evaluation of solar flat plate collector in thermosiphonic mode at different radiation levels
2. Performance evaluation of solar flat plate collector in forced mode at different radiation levels
3. Performance evaluation of solar flat plate collector in in thermosyphonic mode at different tilt angles
4. Determination of performance parabolic trough collector with fixed parameters
5. Determination of performance parabolic trough collector at different flow rates.
6. To demonstrate I-V and P-V characteristics of PV module with varying radiation and temperature level.
7. To demonstrate I-V and P-V characteristics in series and parallel combination of PV modules.
8. To determine the effect of tilt angle and shading on PV module output power.
9. To determine the cut-in speed and TSR of wind turbine experimentally.
10. To evaluate coefficient of performance of wind turbine and draw various performance curves.
11. To evaluate the efficiency of charge controller with wind-solar hybrid system.
12. To study various biomass plant models suitable for Indian scenario.

TEXT BOOKS:

1. S.Hsan 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. P. Sukhatme “Solar Energy”, Tata Mcgraw Hill Publishing, 2004
2. N.k. Bansal, “Non Conventional Energy Sources”.Vikas Publishing, 2009.

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

23MEC205

ADVANCED HEAT AND MASS TRANSFER

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. Understand the basic principles of fins and unsteady state heat transfer applied to industries.
2. Learn various equations and their application in engineering heat transfer
3. Understand boundary layer concept and their applications
4. Learn about principles of phase heat transfer and radiation heat transfer
5. Learn about mass transfer and its applications in process industries

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

1. Apply the equations pertaining to unsteady state heat transfer and knowledge in extended surfaces
2. Evaluate mass, momentum and energy equations with approximate and exact methods
3. Apply heat transfer knowledge in calculation of boundary layer thickness and various dimensionless numbers
4. Evaluate heat transfer coefficients under phase change phenomena and radiation heat transfer
5. Apply the knowledge of mass transfer in process industries

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:

Introduction to Different Modes of Heat Transfer: Governing Laws , Initial and boundary conditions. **Heat Conduction** – Development of Governing equation for 1D, 2D and 3D; steady and transient heat conduction – Solution of 1D steady state heat conduction – Composite slab, cylinder and sphere. **Systems with heat generation** – Variable thermal conductivity – Fins 2D Steady State Heat conduction – Use of conduction shape factors

UNIT - II:

Transient heat conduction: Lumped system analysis-Infinite Bodies - Heisler charts-semi infinite solid - 2D transient heat conduction using product solutions.

Forced Convection: Equations of fluid flow-concepts of continuity, momentum equations-derivation of energy equation-methods to determine heat transfer coefficient: Analytical methods-dimensional analysis and concept of exact solution. Approximate method-integral analysis – Von Karman Integral Momentum and Energy Equations – Determination of laminar heat transfer coefficient for different velocity and temperature profiles for flow over a flat plate

UNIT - III:

External flows: Flow over a flat plate: Application of empirical relations to various geometries for laminar and turbulent flows.

Internal flows: Flow Classification based on hydrodynamic &thermal entry lengths- Fully developed flow: integral analysis for laminar heat transfer coefficient-constant wall temperature and constant heat flux boundary conditions-; use of empirical correlations for determination of heat transfer coefficient and friction factor for different types of internal flow applications.

UNIT - IV:
Free Convection: Approximate analysis on laminar free convective heat transfer-Boussinesque approximation-different geometries-combined free and forced convection.
Boiling and condensation: Boiling curve-correlations-Nusselt's theory of film condensation on a vertical plate-assumptions & correlations of film condensation for different geometries.

UNIT- V:
Thermal Radiation: Fundamental principles, Radiation exchange between surfaces - View factor, Radiation shields, Multimode heat transfer.
Mass Transfer: Fick's law of diffusion, Analogy between heat transfer and mass transfer, Mass diffusion and mass convection.

TEXT BOOKS:
1. Necati Ozisik, "Heat Transfer", TMH, 1998.
2. Incropera Dewitt, "Fundamentals of Heat & Mass Transfer", John Wiley, 2007.
3. Yunus A. Cengel, "Heat Transfer: A basic approach", TMH, 2008.

SUGGESTED READING:
1. R. C. Sachdeva, "Fundamentals of Engineering Heat & Mass Transfer", New Age International Publications, 2010.
2. J.P. Holman, "Heat Transfer", Mc Graw Hill, 2008
3.

23MEC206

COMPUTATIONAL FLUID DYNAMICS

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. Basic equations and concept of CFD.
2. Concept of PDEs and finite difference methods.
3. Crank-Nihcolson, Implicit and Explicit methods & Jacobi, Gauss Seidel and ADI methods.
4. Various types of grid generation and errors in numerical solution.
5. Importance of FVM.

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

1. Derive CFD governing equations and turbulence models.
2. Apply different PDEs and know the importance of Taylor series of expansion.
3. Solve simultaneous linear equations with various methods.
4. Understand errors, stability, consistency and develop O,H and C grid generated models.
5. Utilize FVM for heat transfer problems.

CO-PO Articulation Matrix

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

UNIT - I

Governing Equations: Continuity, Momentum and Energy equations, Navier Stokes equations, Reynolds and Favre averaged N – S equations. Introduction to turbulence, Turbulence models-mixing length model, K-å turbulence Model.

UNIT - II

Classification of PDEs: Elliptic, parabolic and hyperbolic equations, Initial and boundary conditions. Concepts of Finite difference methods – forward, backward and central difference, explicit, Implicit and Crank Nicholson.

UNIT- III

Finite Difference Solutions: Solution of simultaneous linear equations: Jacobi, Gauss Seidel, TDMA, ADI, solution for viscous incompressible flow using Vorticity Stream function method, MAC method.

UNIT - IV

Grid Generation: Grid Generation- Types of grid O,H,C. Coordinate transformation, Unstructured grid generation, Errors, Consistency, Stability analysis by von Neumann. Convergence criteria

UNIT - V

Finite Volume Method: Introduction to Finite volume method, Finite volume formulations for diffusion equation, convection diffusion equation, Staggered grids SIMPLE and SIMPLE R algorithms.

TEXT BOOKS:

1. P.S. Ghoshdastidar, Computational Fluid Dynamics and Heat Transfer, Cengage, 2017.
2. John D. Anderson, “Computational Fluid Dynamics”, Mc Graw Hill Inc., 2018.
3. H. K. Versteeg and Malala Shekara, “Introduction to Finite Volume Method”, Pearson, 2015.

SUGGESTED READING:

1. K. Muralidhar and T. Sundararajan T., “Computational Fluid flow and Heat transfer”, Narosa Publishing House, 2003.
2. S.V. Patankar, “Numerical Heat transfer and Fluid flow”, Hemisphere Publishing Company, New York, 1980.

23MEC207

ENGINE EMISSIONS AND POLLUTION CONTROL

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. Basic Combustion phenomena in spark ignition engine.
2. Concept of supercharging and turbo charging.
3. Sources of pollutants, Effect of emissions on environment and human beings.
4. Working of NDIR and FID techniques, Smoke analyzer, NOx analyzers
5. Need for alternative fuels and vvarious types like alcohols, hydrogen etc.

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

1. Understand the importance of IC engine as prime mover and the combustion phenomenon in SI engine.
2. Understand the phenomenon of combustion in CI engine along with turbocharging and supercharging
3. Understand the formation of different pollutants in IC engines and their effect on environment and human beings.
4. Understand the measurement and control techniques of various pollutants from IC engines.
5. Understand the significance of various alternative liquid and gaseous fuels in IC engines

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 to IC Engines: IC engine as a prime mover, Contribution of IC engines for global warming and green house effect.

Spark Ignition Engines: Combustion phenomena (normal and abnormal), Detonation, Ignition quality, Performance of leaded and unleaded petrol. Combustion chambers in SI engines

UNIT - II

Compression Ignition Engines: Normal and abnormal combustion, Effect of supercharging and turbo charging on pollutants. Combustion chambers in CI engines.

UNIT- III

Pollutant emissions from IC Engines: Sources of pollutants, Effect of emissions on environment and human beings, Pollutants of carbon monoxide, UBHC, Oxides of Nitrogen (NO-NO_X), Particulate matter and aldehydes, Mechanism of formation of pollutants, Engine variables those affecting pollutant formation and methods to control pollutants

UNIT - IV

Measurement of engine emissions-NDIR and FID techniques, Smoke analyzer, NO_x analyzers, Pollution control strategies, EGR technique, SCRT, Reduction of pollutants by chemical methods, Catalytic converters and thermal reactors, Particulate traps, Fumigation, Secondary air injection, PCV system, Emission norms, EURO and Bharat stage norms.

UNIT - V

Alternative Fuels: Need for alternative fuels, Desirable characteristics of good alternative fuel, Liquid and Gaseous fuels for SI and CI Engines, Alcohols, Manufacturing of Methanol, Ethanol and Butanol, Vegetable oils and manufacturing of biodiesel by single-stage and two-stage methods, LPG, CNG, Bio gas, Hydrogen, performance and emission characteristics with above alternative fuels.

.

TEXT BOOKS:

1. J.B. Heywood, Internal Combustion Engine Fundamentals, McGraw Hill Co., 2018
2. Obert, E.F., Internal Combustion Engine and Air Pollution, International Text Book Publishers, 1983.

SUGGESTED READING:

1. C.R.Ferguson, A.T. Kirpatrick, IC Engines : Applied Thermosciences, Wiley publications, 2015
2. Gill P.W, Fundamentals of Internal Combustion Engines, Oxford and IBH publishing Co Pvt Ltd, 2007.
3. B.P. Pundir, Engine Emissions: Fundamentals and advances in control, Narosa Publishing House, 2017

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. ApplyhumancomfortindicesandcomfortcharttodesignindoorconditionsofHVAC
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.

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

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.

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

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.

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.

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.

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 esIey & Longman.
3. Gas TurbinesN, Ganesan /TMH.

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

23MEC208

COMPUTATIONAL FLUID DYNAMICS LAB

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

COURSE OBJECTIVES: This course aims to

1. Basic steps in a CFD simulation: ANSYS Workbench design modular and meshing
2. Simulation of laminar, turbulent, internal flow, steady and unsteady problems
3. Simulation of steady and unsteady problems
4. Physics setup involves boundary conditions
5. Solution of thermal related problems

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

1. Analyze laminar flow problems in plates and pipes
2. Solve steady and unsteady flow past a cylinder
3. Perform analysis for free and forced convection
4. Evaluate the effect of angle of attack and velocity on NACA aerofiol
5. Simulate compressible flow in a nozzle, premixed combustion

CO-PO Articulation Matrix

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

Verify the following numerical problems in ANSYS Fluent or CFX

List of Experiments:

1. Study of flat plate boundary layer
2. Development of the numerical solution to a laminar pipe flow problem
3. Simulation of Steady and unsteady flow past a cylinder
4. Simulate steady free convection in the pipe flow and plot the velocity, temperature, pressure variation
5. Simulate forced convection in a pipe cross section
6. Study the mixing pattern of hot and cold fluid in L/T pipe section
7. Analyze angle of attack effect on NACA0012 aerofoil
8. Study and calculate the mach number, pressure and temperature distribution in the nozzle
9. Analyze the pressure coefficient along the wedge and drag coefficient with supersonic flow over a wedge
10. Study blood flow in an idealized bifurcated blood vessel
11. Analyze external flow pattern over wind turbine blade
12. Study partially premixed combustion in cylindrical combustion chamber

Note: Out of the above 12 experiments, any **ten (10)** experiments have to be carried out.

TEXT BOOKS:

1. John D Anderson, “Computational Fluid Dynamics”, Mc Graw Hill, Inc., 2015.
2. H.K.Versteeg and Malala Shekara, “Introduction to Finite Volume Method”, Pearson, 2015

SUGGESTED READING:

1. J.H. Ferziger and M. Peric, “Computational Methods for Fluid Dynamics”, Springer.
2. K. Muralidhar and T. Sundararajan T, “Computational Fluid flow and Heat transfer”, Narosa Publishing House, 2003

23MEC209

THERMAL SYSTEMS LAB-2

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

COURSE OBJECTIVES: This course aims to

1. To understand the working of principle of axial flow fan and centrifugal blower.
2. To evaluate the COP of Refrigeration tutor and AC tutor.
3. To determine the pressure distribution in nozzle; drag and lift coefficients for contoured bodies.
4. To determine the pressure distribution for aerofoil section.
5. To understand flow visualization studies over different aerodynamic bodies.

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

1. Demonstrate the performance of axial flow fan and centrifugal blower.
2. Study of COP of refrigeration/air conditioning tutor.
3. Understand the behavior of flow properties over different models using subsonic wind tunnel.
4. Demonstrate experimentally the pressure distribution over circular, symmetric and cambered airfoils and evaluate lift and drag.
5. Illustrate flow visualization studies at low speeds over different aerodynamic bodies.

CO-PO Articulation Matrix

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

List of Experiments:

1. Performance test on Axial flow compressor.
2. Determination of COP of Refrigeration tutor.
3. Determination of COP of Air-conditioning tutor.
4. Determination of overall efficiency of centrifugal blower.
5. Determination of pressure distribution for an aerofoil.
6. Determination of pressure distribution for convergent and divergent nozzle.
7. Determination of pressure distribution for a cylinder
8. Determination of lift and drag coefficient for different contours
9. Determination of Sensible and Latent heat loads for a class room.
10. Flow visualization studies over aerofoil.

TEXT BOOKS:

1. S M Yahya, Fundamentals of Compressible Flow, New Age International Publishers, 2014.
2. Mahesh M. Rathore, Thermal Engineering, TMH, New Delhi, 2010
3. M L Mathur & F S Mehta, Thermal Engineering, Jain Brothers, New Delhi, 2014

SUGGESTED READING:

1. V. Ganeshan, Gas Turbines, Tata Mc Graw Hills, New Delhi, 2010.
2. R.K. Rajput, Heat Transfer, Laxmi Publication, 2014

Note : Out of the above 12 experiments, any ten experiments have to be carried out.

23MEC210

MINI PROJECT WITH SEMINAR

Instruction	2 Hours per week
Duration of SEE	--
SEE	--
CIE	50 Marks
Credits	1

COURSE OBJECTIVES: This course aims to

1. The mini-project shall contain a clear statement of the research objectives, background of work, literature review, techniques used, prospective deliverables, and detailed discussion on results conclusions and references.
2. Expose and practice of searching and referring the required literature.
3. Provide a good initiation for the student(s) towards R&D.

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

1. Formulate a specific problem and give solution
2. Develop model/models either theoretical/practical/numerical form
3. Solve, interpret/correlate the results and discussions
4. Conclude the results obtained
5. Write the documentation in standard format

CO-PO Articulation Matrix

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

Guidelines:

1. As part of the curriculum in the II- semester of the program each students shall do a mini project, generally comprising about three to four weeks of prior reading, twelve weeks of active research, and finally a presentation of their work for assessment.
2. Each student will be allotted to a faculty supervisor for mentoring.
3. Mini projects should present students with an accessible challenge on which to demonstrate competence in research techniques, plus the opportunity to contribute something more original.
4. Mini projects shall have interdisciplinary/ industry relevance.
5. The students can select a mathematical modeling based/Experimental investigations or Numerical modeling.
6. All the investigations are clearly stated and documented with the reasons/explanations.
7. The mini-project shall contain a clear statement of the research objectives, background of work, literature review, techniques used, prospective deliverables, and detailed discussion on results, conclusions and references.

Department committee: Supervisor and two faculty coordinators

Guidelines for awarding marks in CIE (Continuous Internal Evaluation): Max. Marks: 50		
Evaluation by	**Max .Marks**	**Evaluation Criteria / Parameter**
Supervisor	20	Progress and Review
	05	Report
Department Committee	05	Relevance of the Topic
	05	PPT Preparation
	05	Presentation
	05	Question and Answers
	05	Report Preparation

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	23AD A101	Pedagogy Studies	8	23EG A104	Personality Development through Life's Enlightenment Skills

23ME E213

EXPERIMENTAL METHODS IN THERMAL ENGINEERING

(Programme Elective - V)

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 learn the importance of general measurement system
2. To understand the thermo meters. thermo couples for temperature
3. To get the working of pressure measuring instruments
4. To learn the concepts of radiation measurement
5. To understand the latest technologies like PID controllers

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

1. Understand the concepts of errors in measurements.
2. Recognize different techniques of temperature measurement.
3. Manage with different pressure and flow measuring instruments.
4. Understand working of radiation measuring equipment.
5. Familiarize with advanced measurement techniques.

CO-PO Articulation Matrix

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

UNIT - I

Basics of Measurements: Introduction, General measurement system, Signal flow diagram of measurement system, Inputs and their methods of correction, Presentation of experimental data, Errors in measurement, Propagation of errors, Uncertainty analysis, Regression analysis, Design of experiments.

UNIT - II

Temperature Measurement: Bimetallic thermometers, Liquid-in-glass, Pressure thermometer, Semiconductor sensors, Digital thermometers, Pyrometers

Thermal Analysis Techniques: Measurements in combustion: Species concentration, Reaction rates, Flame visualization, charged species diagnostics, Particulate size measurements.

UNIT - III

Fluid pressure measurement: Mechanical & Electrical types, High pressure & Low pressure measurements, Differential Pressure Transmitters.

Flow measurements: Industrial flow measuring devices, selection and calibration, 2d/3d flow measurement and turbulence measurement, Anemometers, Weirs and flumes, Laser Doppler anemometer, Ultrasonic flow meter, Flow visualization techniques, Totalizer for Industrial Liquids

UNIT - IV

Thermal and Transport Property Measurement: Measurement of thermal conductivity of solids and fluids, Diffusivity, Viscosity, Humidity and gas composition

Nuclear and Thermal Radiation Measurement: Nuclear radiation and neutron detection, Measurement of reflectivity, Transmissivity and emissivity, Solar radiation measurements.

UNIT - V

Advancement in measurements: Data logging and acquisition, Use of sensors for error reduction, Elements of micro computer interfacing, Intelligent instruments and their use, Basics of P, PI, PID controllers, Pneumatic and hydraulic controllers, Electronic controllers

TEXT BOOKS:

1. Thomas G Beckwith., Mechanical Measurements, Pearson publications, 2007.
2. Ernest O Doebelin., Measurement systems, Tata McGraw Hill publications, 2006.

SUGGESTED READING:

1. J P Holman., Experimental Methods for Engineers, Tata McGraw Hill publications, 2004.
2. C.S. Raman, G.R. Sharma and V.S.V. Mani., Instrumentation Devices and Systems, 2nd Edition, Tata McGraw-Hill., 2001.
3. A.S. Morris., Principles of Measurements and Instrumentation, 3rd Edition, Butterworth-Heinemann, 2001.

23MEE214

ENERGY SYSTEMS AND MANAGEMENT

(Programme Elective - V)

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 learn the present energy scenario and the need for energy conservation.
2. To learn the instruments suitable for energy auditing.
3. To study the various measures for energy conservation and financial implications for various thermal utilities.

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

1. Understand importance of energy for development of country
2. Know the importance of energy storage methods of thermal, electrical and mechanical
3. Understand the significance of various energy conservation methods
4. Evaluate energy demand estimation and pricing
5. Know the purpose, methodology of energy audit

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

Introduction:

Energy Scenario – world and India. Energy Resources Availability in India. Energy consumption pattern. Energy conservation potential in various Industries and commercial establishments. Energy intensive industries – an overview. Energy conservation and energy efficiency – needs and advantages. Energy auditing – types, methodologies, barriers. Role of energy manager – Energy audit questionnaire – energy Conservation Act 2003.

UNIT-II

Energy storage Methods and systems: Thermal, Electrical and Mechanical energy storage methods and systems, Energy saving in IC engines and Gas turbines.

Direct Energy Conversion methods: Magneto-hydrodynamic (MHO) power generation, Thermionic power generation, Thermoelectric power generation, Fuel cells, Hydrogen energy system

UNIT-III

Heat recovery systems: Incinerators, regenerators and boilers Energy Conservation: Methods of energy conservation and energy efficiency for buildings, air conditioning, heat recovery and thermal energy storage systems

UNIT-IV

Energy Management: Principles of Energy Management, Energy demand estimation, Organising and Managing Energy Management Programs, Energy pricing

UNIT-V

Energy Audit: Purpose, Methodology with respect to process Industries, Characteristic method employed in Certain Energy Intensive Industries, Economic Analysis: Scope, Characterization of an Investment Project and Case studies.

TEXT BOOKS:

1. Energy Management audit & Conservation, De, B. K., Vrinda Publication, 2010, 2nd Edition.
2. Energy Management, Murphy, W. R., Elsevier, 2007, 1st Edition.

SUGGESTED READING:

1. Energy Management Hand book, Doty, S. and Truner, W. C., Fairmont Press, 2009, 7th edition.

ONLINE RESOURCES:

1. International Energy Agency Website, (Link: https://www.iea.org/)
2. Indian Renewable Energy Development Agency Limited Website, (Link: https://www.ireda.in)
3. Ministry of Power, GoI, Website, (Link: https://powermin.gov.in/)

23MEE215

FLUID POWER SYSTEMS

(Programme Elective – V)

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 an insight into the capabilities of hydraulic and pneumatic fluid power.
2. To understand concepts and relationships surrounding force, pressure, energy and power in fluid power systems.
3. To examine concepts centering on sources of hydraulic power, rotary and linear actuators, distribution systems, hydraulic flow in pipes, and control components in fluid power systems.
4. Exposure to build and interpret hydraulic and pneumatic circuits related to industrial applications
5. To familiarize with logic controls and trouble shooting

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

1. Identify and analyse the functional requirements of a fluid power transmission system for a given application.
2. Visualize how a hydraulic/pneumatic circuit will work to accomplish the function.
3. Design an appropriate hydraulic or pneumatic circuit or combination circuit like electro-hydraulics, electro-pneumatics for a given application.
4. Select and size the different components of the circuit.
5. Develop a comprehensive circuit diagram by integrating the components selected for the given application.

CO-PO Articulation Matrix

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

UNIT – 1:

Introduction to fluid power systems

Fluid power system components, advantages and applications, transmission of power at static and dynamic states, Pascal's law and its applications, fluids for hydraulic system: types, properties, selection, additives, effect of temperature and pressure on hydraulic fluid, seals, sealing materials, compatibility of seal with fluids, types of pipes, hoses, quick acting couplings, fluid conditioning through filters, strainers, classification of filters, sources of contamination and contamination control, heat exchangers.

UNIT – II:

Pumps and actuators

Pumps: Classification of pumps, pumping theory of positive displacement pumps, construction and working of gear pumps, vane pumps, piston pumps, pump performance characteristics, pump selection factors

Accumulators: Types, working of various types of accumulators

Actuators: Classification, working of various types of hydraulic cylinders (actuators).

UNIT – III:

Components and hydraulic circuit design

Components: classification of control valves, directional control valves-symbolic representation, constructional features of poppet check valve, pilot operated dcv, shuttle valve, sliding spool valve, pressure control valves - types, pressure relief valve and pilot operated pressure control valve, flow control valves -compensated and non-compensated fcv

Hydraulic circuit design: Control of single and double -acting hydraulic cylinder, regenerative cylinder circuit, meter-in and meter-out circuits, pump unloading circuit, double pump hydraulic circuit, counter balance valve application circuit, hydraulic cylinder sequencing circuits

UNIT – IV:

Pneumatic power systems

Introduction to pneumatic systems, choice of working medium, advantages, limitations, applications, structure of a pneumatic power system, production of compressed air, working of various types of air compressors, fluid conditioners-air filters, air dryers, lubricators and air pressure regulator.

Pneumatic actuators: Linear cylinders–classification, working, seals, end position cushioning, rodless cylinders and advantages

Pneumatic control valves: classification, DCV such as poppet, suspended seat type slide valve, non-return valves, check valve, quick exhaust valve, and time delay valve

UNIT – V:

Pneumatic control circuits

Simple Pneumatic Control: Direct and indirect actuation of pneumatic cylinders, flow control valve, speed control of cylinders using fcv, supply air throttling and exhaust air throttling.

Signal Processing Elements: Use of Logic gates - OR and AND gates in pneumatic applications, practical examples involving the use of logic gates.

Multi-Cylinder Application: Motion and control diagrams, sequential motion control, signal elimination methods, cascade control action - principle, signal elimination techniques

Electro- Pneumatic Control: solenoid, relay and contactors, solenoid operated DC valve, solenoid controlled pilot operated of directional control valves, control circuit for single acting cylinder

TEXT BOOKS:

1. Anthony Esposito, “Fluid Power with applications”, Pearson edition, 2011.
2. John J Pippenger, Tyler G Hicks, “Industrial Hydraulics”, McGraw Hill International Edition, 1980.

Reference books:

1. Andrew Par, Hydraulics and pneumatics, Jaico Publishing House, 2005.
2. FESTO, Fundamentals of Pneumatics, Vol I,IIandIII.
3. Herbert E. Merritt, “Hydraulic Control Systems”, John Wiley and Sons, Inc

23CEO101

COST MANAGEMENT OF ENGINEERING PROJECTS

(Open Elective)

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

COURSE OBJECTIVES: This course aims to

1. To enable the students to understand the concepts of Project management.
2. To provide knowledge on concepts of Project Planning and scheduling.
3. To create an awareness on Project Monitoring and Cost Analysis
4. To provide adequate knowledge to the students on Recourse Management Costing-variance Analysis
5. To train the students with the concepts of Budgetary Control for cost management and to provide a basic platform on Quantitative techniques for cost management.

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

1. Acquire in-depth knowledge about the concepts of project management and understand the principles of project management.
2. Determine the critical path of a typical project using CPM and PERT techniques.
3. Prepare a work break down plan and perform linear scheduling using various methods.
4. Solve problems of resource scheduling and leveling using network diagrams.
5. Learn the concepts of budgetary control and apply quantitative techniques for optimizing project cost.

CO-PO Articulation Matrix

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

UNIT- I:

Project Management: Introduction to project managements, Stakeholders, Roles, Responsibilities and functional relationships, Principles of project management, Objectives and project management system, Project team, Organization, roles and responsibilities, Concepts of project planning, Monitoring, Staffing, Scheduling and controlling.

UNIT-II:

Project Planning and Scheduling: Introduction for project planning, defining activities and their interdependency, time and resource estimation. Work break down structure. Linear scheduling methods-bar charts, Line of Balance (LOB), their limitations. Principles, definitions of network-based scheduling methods: CPM, PERT. Network representation, network analysis-forward and backward passes.

UNIT-III:

Project Monitoring and Cost Analysis: introduction-Cost concepts in decision- making; Relevant cost, Differential cost, Incremental cost and Opportunity cost. Objectives of a Costing System; Inventory valuation; Creation of a Database for operational control; Provision of data for Decision-Making, Time cost tradeoff-Crashing project schedules, its impact on time on time, cost, Project direct and indirect costs.

UNIT- IV:

Resources Management and Costing-Variance Analysis: Planning, Enterprise Resource Planning, Resource scheduling and leveling, Total Quality Management and Theory of constraints. Activity-Based Cost Management, Bench Marking; Balanced Score Card and Value-Chain Analysis

Standard Costing and Variance Analysis: Pricing strategies: Pareto Analysis, Target costing, Life Cycle Costing, Costing of service sector. Just-in-time approach, Material Requirement

UNIT- V:

Budgetary Control: Flexible Budgets; Performance budgets; Zero-based budgets, Measurement of Divisional profitability pricing decisions including transfer pricing. **Quantitative techniques for cost management**: Linear Programming, PERT/CPM, Transportation Assignment problems, Simulation, Learning Curve Theory.

TEXT BOOKS:

1. Charles T Horngren., Cost Accounting A Managerial Emphasis, 14th edition, Pearson Education, 2012,
2. Charles T. Horngren and George Foster., Advanced Management Accounting, 6th revised edition, Prentice Hall, 1987.

SUGGESTED READING:

1. K. K Chitkara., Construction Project Management: Planning, scheduling and controlling, Tata McGraw Hill Education, 2004.
2. Kumar Neeraj Jha., Construction Project Management Theory and Practice, 2nd edition, Pearson Education India, 2015.
3. Robert S Kaplan and Anthony A. Atkinson, Management & Cost Accounting, 2nd edition, Pearson, 1996.

23EEO101

WASTE TO ENERGY

(Open Elective)

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 know the various forms of waste
2. To understand the processes of Biomass Pyrolysis.
3. To learn the technique of Biomass Combustion.

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

1. Understand the concept of conservation of waste
2. Identify the different forms ofwastage
3. Chose the best way for conservation to produce energy from waste
4. Explore the ways and means of combustion of biomass
5. Develop a healthy environment for the mankind

CO-PO Articulation Matrix

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

UNIT - I

Introduction to Energy from Waste: Classification of waste as fuel, Agro based, Forest residue, Industrial waste, MSW, Conversion devices, Incinerators, Gasifiers, Digestors

UNIT – II

Biomass Pyrolysis: Pyrolysis, Types, Slow, Fast, Manufacture of charcoal, Methods, Yields and application, Manufacture of pyrolytic oils and gases, Yields and applications.

UNIT – III

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

UNIT–IV

Biomass Combustion: Biomass stoves, Improved chullahs, Types, Some exotic designs, Fixed bed combustors, Types, Inclined grate combustors, Fluidizedbed combustors, Design, Construction and operation, Operation of all the above biomass combustors.

UNIT – V

Biogas: Properties of biogas (Calorific value and composition), Biogas plant technology and status, Bio energy system, Design and constructional features, Biomass resources and their classification, Biomass conversion processes, Thermo chemical conversion, Direct combustion, Biomass gasification, Pyrolysis and liquefaction, Biochemical conversion, Anaerobic digestion, Types of biogas plants, Applications, Alcohol production from biomass, Bio diesel production, Urban waste to energy conversion, Biomass energy programme in India.

TEXT BOOKS:

1. V.Ashok.,NonConventional Energy, Desai, Wiley Eastern Ltd., 1990.
2. K.C. Khandelwal and S.S. Mahdi., Biogas Technology – A Practical Hand Book, Vol. I & II, TataMcGraw Hill Publishing Co. Ltd., 1983.

.

SUGGESTED READING:

1. D.S. Challal., Food, Feed and Fuel from Biomass, IBH Publishing Co. Pvt. Ltd.,1991.
2. C. Y. WereKo-Brobby and E. B. Hagan, Biomass Conversion and Technology, John Wiley & Sons, 1996.

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 randomforest. 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.

23MEC211

INDUSTRIAL PROJECT / DISSERTATION PHASE - I

Instruction	20 Hours per week
Duration of SEE	--
SEE	--
CIE	100 Marks
Credits	10

Course Outcomes: This course aims to:

1. Students will be exposed to self-learning various topics.
2. Students will learn to survey the literature such as books, national/ international refereed journals and contact resource persons for the selected topic of research.
3. Students will learn to write technical reports.
4. Students will develop oral and written communication skills to present.
5. Student will defend their work in front of technically qualified audience.

Guidelines:

1. The Project work will preferably be a problem with research potential and should involve scientific research, design, generation/collection and analysis of data, determining solution and must preferably bring out the individual contribution.
2. Seminar should be based on the area in which the candidate has undertaken the dissertation work.
3. The CIE shall include reviews and the preparation of report consisting of a detailed problem statement and a literature review.
4. The preliminary results (if available) of the problem may also be discussed in the report.
5. The work has to be presented in front of the committee consists of Head, Chairperson-BoS, Supervisor and Project coordinator.
6. The candidate has to be in regular contact with his supervisor and the topic of dissertation must be mutually decided by the guide and student.

CO-PO Articulation Matrix

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

Guidelines for awarding marks in CIE (Continuous Internal Evaluation): Max. Marks: 100		
Evaluation by	**Max .Marks**	**Evaluation Criteria / Parameter**
Supervisor	30	Project Status / Review(s)
	20	Report
Department Committee	10	Relevance of the Topic
	10	PPT Preparation(s)
	10	Presentation(s)
	10	Question and Answers
	10	Report Preparation

Note: Department committee has to assess the progress of the student for every two weeks

23CEA101

DISASTER MITIGATION AND MANAGEMENT

Instruction	2 Hours per week
Duration of SEE	2 Hours
SEE	50 Marks
CIE	--
Credits	0

COURSE OBJECTIVES: This course aims to

1. To equip the students with the basic knowledge of hazards, disasters, risks and vulnerabilities including natural, climatic and human induced factors and associated impacts
2. To impart knowledge in students about the nature, causes, consequences and mitigation measures of the various natural disasters
3. To enable the students to understand risks, vulnerabilities and human errors associated with human induced disasters
4. To enable the students to understand and assimilate the impacts of any disaster on the affected area depending on its position/ location, environmental conditions, demographic, etc.
5. To equip the students with the knowledge of the chronological phases ina disaster management cycle and to create awareness about the disaster management framework and legislations in the context of national and global conventions

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

1. Analyze and critically examine existing programs in disaster management regarding vulnerability, risk and capacity at different levels
2. Understand and choose the appropriate activities and tools and set up priorities to build a coherent and adapted disaster management plan
3. Understand various mechanisms and consequences of human induced disasters for the participatory role of engineers in disaster management
4. Understand the impact on various elements affected by the disaster and to suggest and apply appropriate measures for the same
5. Develop an awareness of the chronological phases of disaster preparedness, response and relief operations for formulating effective disaster management plans and ability to understand various participatory approaches/strategies and their application in disaster management.

CO-PO Articulation Matrix

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

UNIT- I:

Introduction: Basic definitions- Hazard, Disaster, Vulnerability, Risk, Resilience, Mitigation, Management; classification of types of disaster- Natural and man- made; International Decade for natural disaster reduction (IDNDR); International strategy for disaster reduction (ISDR), National disaster management authority (NDMA).

UNIT-II:

Natural Disasters: Hydro meteorological disasters: Causes, Early warning systems- monitoring and management, structural and non-structural measures for floods, drought and Tropical cyclones; Geographical based disasters: Tsunami generation, causes, zoning, Early warning systems- monitoring and management, structural and non-structural mitigation measures for earthquakes, tsunami, landslides, avalanches and forest fires. Case studies related to various hydro meteorological and geographical based disasters.

UNIT-III:

Human induced hazards: Chemical disaster- Causes, impacts and mitigation measures for chemical accidents, Risks and control measures in a chemical industry, chemical disaster management; Case studies related to various chemical industrial hazards eg: Bhopal gas tragedy; Management of chemical terrorism disasters and biological disasters; Radiological Emergencies and case studies; Casestudies related to major power break downs, fire accidents, traffic accidents, oil spills and stampedes, disasters due to double cellar construction in multi- storeyed buildings.

UNIT- IV:

Disaster Impacts: Disasterimpacts- environmental, physical, social, ecological, economic, political, etc.; health, psycho-social issues; demographic aspects- gender, age, special needs; hazard locations; global and national disaster trends; climate change and urban disasters.

UNIT- V:

Concept of Disaster Management: Disaster management cycle – its phases; prevention, mitigation, preparedness, relief and recovery; risk analysis, vulnerability and capacity assessment; Post-disaster environmental response- water, sanitation, food safety, waste management, disease control; Roles and responsibilities of government, community, local institutions, NGOs and other stakeholders; Policies and legislation for disaster risk reduction, DRR programmes in India and the activities of National Disaster Management Authority.

TEXT BOOKS:

1. Pradeep Sahni, “Disaster Risk Reduction in South Asia”, Prentice Hall, 2003.
2. B. K. Singh,”Handbook of Disaster Management: techniques & Guidelines”, Rajat Publication, 2008.

SUGGESTED READING:

1. Ministry of Home Affairs, “Government of India, “National disaster management plan, Part I and II”
2. K. K. Ghosh,”Disaster Management”, APH Publishing Corporation, 2006.
3. “Hazards, Disasters and your community: Abooklet for students and the community”, Ministry of home affairs.

Online Resources:

1. http : / /www.ind iaen viron men tp ortal.org . in / f i l es/file/ disaster_management_india1.pdf
2. http://www.ndmindia.nic.in/(National Disaster management in India, Ministry of Home Affairs)

23EEA101

SANSKRIT FOR TECHNICAL KNOWLEDGE

Instruction	2Hours per week
Duration of SEE	2 Hours
SEE	50 Marks
CIE	--
Credits	0

COURSE OBJECTIVES: This course aims to

1. To get a working knowledge in illustrious Sanskrit, the scientific language in the world
2. To make the novice Learn the Sanskrit to develop the logic in mathematics, science & other subjects
3. To explore the huge knowledge from ancient Indian literature

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

1. Develop passion towards Sanskrit language
2. Decipher the latent engineering principles from Sanskrit literature
3. Correlates the technological concepts with the ancient Sanskrit history.
4. Develop knowledge for the technological progress
5. Explore the avenue for research in engineering with aid of Sanskrit

CO-PO Articulation Matrix

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

UNIT-I

Introduction to Sanskrit Language: Sanskrit Alphabets-vowels-consonants- significance of Amarakosa-parts of speech-Morphology-creation of new words- significance of synonyms-sandhi-samasa-sutras-active and passive voice-Past/ Present/Future Tense-syntax-Simple Sentences (elementary treatment only)

UNIT-II

Role of Sanskrit in Basic Sciences: Brahmagupthas lemmas (second degree indeterminate equations), sum of squares of n-terms of AP- sulba_sutram or baudhayana theorem (origination of pythogorous theorem)-value of pie- Madhava's sine and cosine theory (origination of Taylor's series).
Themeasurementsystem-time-mass-length-temp,Matterelasticity-optics-speed of light (origination of michealson and morley theory).

UNIT-III

Role of Sanskrit in Engineering-I (Civil, Mechanical, Electrical and Electronics Engineering):
Building construction-soil testing-mortar-town planning-Machine definition-crucible-furnace-air blower-Generation of electricity in a cell-magnetism-Solar system-Sun: The source of energy, the earth-Pingala chandasutram (origination of digital logic system)

UNIT-IV

Role of Sanskrit in Engineering-II (Computer Science Engineering & Information Technology): Computer languages and the Sanskrit languages- computer command words and the vedic command words-analogy of pramana in memamsa with operators in computer language-sanskrit analogy of physical sequence and logical sequence, programming.

UNIT-V

Role of Sanskrit in Engineering-III (Bio-technology and Chemical Engineering): Classification of plants-plants, the living-plants have senses-classification of living creatures, Chemical laboratory location and layout-equipment-distillation vessel-kosthi yanthram

TEXT BOOKS:

1. M Krishnamachariar, "History of Classical Sanskrit Literature", TTD Press, 1937.
2. M.R. Kale, "A Higher Sanskrit Grammar: For the Use of School and College Students", Motilal Banarsidass Publishers, ISBN-13: 978- 8120801783, 2015

SUGGESTED READING:

1. Kapail Kapoor, "Language, Linguistics and Literature: The Indian Perspective", ISBN- 10: 8171880649, 1994.
2. "Pride of India", Samskrita Bharati Publisher, ISBN: 81-87276-27-4, 2007.
3. Shri RamaVerma, "Vedas the source of ultimate science", Nag publishers, ISBN:81-7081-618-1,2005

23ECA101

VALUE EDUCATION

Instruction	2 Hours per week
Duration of SEE	2 Hours
SEE	50 Marks
CIE	--
Credits	0

COURSE OBJECTIVES: This course aims to

1. Understand the need and importance of Values for self-development and for National development.
2. Imbibe good human values and Morals
3. Cultivate individual and National character.

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

1. Summarize classification of values and values for self-development.
2. Identify the importance of values in personal and professional life.
3. Apply the importance of social values for better career and relationships.
4. Compile the values from holy books for personal and social responsibility.
5. Discuss concept of soul and reincarnation, values Dharma, Karma and Guna.

CO-PO Articulation Matrix

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

UNIT - I

Human Values, Ethics and Morals: Concept of Values, Human Values, Indian concept of humanism, Values for self-development, Social values, Individual attitudes, Work ethics, Moral and non- moral behavior, Standards and Principles based on religion, Culture and Tradition.

UNIT - II

Value Cultivation, and Self-Management: Need and Importance of cultivation of values such as Sense-of Duty, Devotion to work, Self-reliance, Confidence, Concentration, Integrity & discipline, and Truthfulness.

UNIT - III

Spiritual Outlook and Social Values: Personality and Behaviour Development, Scientific attitude and Spiritual (soul) outlook, Cultivation of Social Values Such as Positive Thinking, Punctuality, Love & Kindness, Avoiding fault finding in others, Reduction of anger, Forgiveness, Dignity of labour, True friendship, Universal brotherhood and religious tolerance., Happiness Vs Suffering, Love for truth, Aware of self-destructive habits, Appreciation and co-operation.

UNIT - IV

Values in Holy Books : Self-management, Good health and internal & external cleanliness, Holy books versus Blind faith, Character and Competence, Equality, Nonviolence, Humility, Role of Women.

UNIT – V

All religions and same message: Mind your mind, Self-control, Concept of soul, Science of Reincarnation, Character and Conduct, Concept of Dharma, Cause and Effect based Karma Theory, The qualities of Devine and Devilish, Satwic, Rajasic and Tamasicgunas.

TEXT BOOKS:

1. Chakraborty, S.K. “Values & Ethics for organizations Theory and practice”, Oxford University Press, New Delhi, 1998.
2. Jaya Dayal Goyandaka, “Srimad Bhagavad Gita with SanskritText, Word Meaning and Prose Meaning”, Gita Press, Gorakhpur, 2017

23ADA101

PEDAGOGY STUDIES

Instruction	2 Hours per week
Duration of SEE	2 Hours
SEE	50 Marks
CIE	---
Credits	0

COURSE OBJECTIVES: This course aims to

1. To present the basic concepts of design and policies of pedagogy studies.
2. To provide understanding of the abilities and dispositions with regard to teaching techniques, curriculum design and assessment practices.
3. To familiarize various theories of learning and their connection to teaching practice.
4. To create awareness about the practices followed by DFID, other agencies and other researchers.
5. To provide understanding of critical evidence gaps that guides the professional development.

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

1. Illustrate the pedagogical practices followed by teachers in developing countries both in formal and informal classrooms.
2. Examine the effectiveness of pedagogical practices.
3. Understand the concept, characteristics and types of educational research and perspectives of research.
4. Describe the role of classroom practices, curriculum and barriers to learning.
5. Understand Research gaps and learn the future directions.

CO-PO Articulation Matrix

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

UNIT-I

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

UNIT-II

Thematic Overview: Pedagogical practices followed by teachers in formal and informal classrooms in developing countries - Curriculum, Teacher education.

UNIT-III

Evidence on the Effectiveness of Pedagogical Practices: Methodology for the in depth stage: quality assessment of included studies - How can teacher education (curriculum and Practicum) and the school curriculum and guidance material best support effective pedagogy? - Theory of change - Strength and nature of the body of evidence for effective pedagogical practices - Pedagogic theory and pedagogical approaches - Teachers' attitudes and beliefs and pedagogic strategies.

UNIT-IV

Professional Development: Alignment with classroom practices and follow up support - Support from the head teacher and the community – Curriculum and assessment - Barriers to learning: Limited resources and large class sizes.

UNIT-V

Research Gaps and Future Directions: Research design – Contexts – Pedagogy- Teacher education - Curriculum and assessment – Dissemination and research impact.

TEXT BOOKS:

1. Ackers J, Hardman F, "Classroom Interaction in Kenyan Primary Schools, Compare", 31 (2): 245 – 261, 2001.
2. Agarwal M, "Curricular Reform in Schools: The importance of evaluation", Journal of Curriculum Studies, 36 (3): 361 – 379, 2004.

SUGGESTED READING:

1. Akyeampong K, "Teacher Training in Ghana – does it count? Multisite teacher education research project (MUSTER)", Country Report 1.London: DFID, 2003.
2. Akyeampong K, Lussier K, Pryor J, Westbrook J, "Improving teaching and learning of Basic Maths and Reading in Africa: Does teacher Preparation count?, International Journal Educational Development, 33 (3): 272- 282, 2013.
3. Alexander R J, "Culture and Pedagogy: International Comparisons in Primary Education", Oxford and Boston: Blackwell, 2001.

4. Chavan M, "Read India: A mass scale, rapid, 'learning to read' campaign", 2003.

WEB RESOURCES:

1. https://onlinecourses.nptel.ac.in/noc17_ge03/preview
2. www.pratham.org/images/resources%20working%20paper%202.pdf.

23EGA101

ENGLISH FOR RESEARCH PAPER WRITING

Instruction	2 L Hours per Week
Duration of SEE	2 Hours
SEE	50 Marks
CIE	-
Credits	0

Prerequisite: Writing to express on science and technological concepts with good taste for research and development.

COURSE OBJECTIVES: This course aims to

1. Motivate learners for academic writing and thus encourage them for continuous professional updating and up-gradation.
2. Facilitate a practical understanding of the multiple purposes of Writing Research Papers and help them infer the benefits and limitations of research in science and technology.
3. Brainstorm and develop the content, formulating a structure and illustrating the format of writing a research paper.
4. Survey and select a theme/topic for a thorough reading and to writing a research paper.
5. Understand to implement the intricacies of writing and publishing a research paper.

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

1. Improve work performance and efficiency, illustrate the nuances of research paper writing and draw conclusions on professional usefulness.
2. Classify different types of research papers and organize the format and citation of sources.
3. Explore various formats of APA, MLA and IEEE and set up for writing a research paper.
4. Draft paragraphs and write theme based thesis statements in a scientific manner.
5. Develop an original research paper while acquiring the knowledge of how and where to publish their papers.

CO-PO-PSO Articulation Matrix

PO/PSO/CO	PO1	PO2	PO3	PO4	PO5	PO6
CO 1	1	2	1	-	3	2
CO 2	1	1	1	-	1	2
CO 3	2	2	2	1	1	1
CO 4	2	2	1	1	2	2
CO 5	3	3	1	2	3	2

UNIT - I

Academic Writing: Meaning & Definition of a research paper; Purpose of a research paper - Scope, Benefits, Limitations and outcomes for professional development, An introduction to methods and Approaches of Research.

UNIT - II

Research Paper Format: Title - Abstract - Introduction - Discussion - Findings - Conclusion - Style of Indentation - Font size/Font types - Indexing - Citation of sources.

UNIT - III

Process of Writing a Research Paper, Writing to Draft a Format, Develop Content, Adapting, Reviewing, Paraphrasing& Plagiarism Checks.

UNIT - IV

Choosing a topic - Thesis Statement - Outline - Organizing notes - Language of Research - Word order, Paragraphs - Writing first draft-Revising/Editing - The final draft and proof reading. Understanding APA, MLA, IEEE formats.

UNIT - V

Research Paper Publication, Reputed Journals –Paid, Free and peer reviewed journals, National/International - ISSN No, No. of volumes, Scopus Index/UGC Journals. Getting Papers Published.

TEXT BOOKS:

1. Kothari, C. R. and Gaurav, Garg, "Research Methodology Methods and Techniques", 4thEdition, New Age International Publishers, New Delhi, 2019.
2. Ellison, Carroll. "Writing Research Papers", McGraw Hill's Concise Guide, 2010.
3. Lipson, Charles. "Cite Right: A Quick Guide to Citation Styles-- MLA, APA, Chicago, the Sciences, Professions, and More", 2nd Edition,. University of Chicago Press. Chicago, 2018.

SUGGESTED READING:

1. Day, Robert A. "How to Write and Publish a Scientific Paper", Cambridge University Press, 2006
2. Girden, E. R. "MLA Handbook for Writers of Research Papers", 7th Edition, East West Press Pvt. Ltd, New Delhi, 2009
3. Bailey, Stephen. "Academic Writing: A Handbook for International Students", Routledge, 2018

Online Resources:

1. https://onlin://onlinecourses.nptel.ac.in/noc 18_mg13/preview
2. https://nptel.ac.in/courses/121/106/121106007/
3. https://www.classcentral.com/course/swayam-introduction-to-research-5221

Writing Tools:

1. https://owl.purdue.edu/owl_exercises/index.html - The Owl writing lab
2. https://www.turnitin.com/login_page.asp?lang=en_us – Turn tin software

23EGA102

CONSTITUTION OF INDIA

Instruction	2 L Hours per Week
Duration of SEE	2 Hours
SEE	50 Marks
CIE	-
Credits	0

Prerequisite: Knowledge on basics of the Constitution and the Government.

COURSE OBJECTIVES: This course aims to

1. The history of Indian Constitution and its role in the Indian democracy.
2. Address the growth of Indian opinion regarding modern Indian intellectuals' constitutional role and entitlement to civil and economic rights as well as the emergence of nationhood in the early years of Indian nationalism.
3. Have knowledge of the various Organs of Governance and Local Administration.

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

1. Understand the making of the Indian Constitution and its features.
2. Understand the Rights of equality, the Right of freedom and the Right to constitutional remedies.
3. Have an insight into various Organs of Governance - composition and functions.
4. Understand powers and functions of Municipalities, Panchayats and Co-operative Societies.
5. Understand Electoral Process, special provisions.

CO-PO-PSO Articulation Matrix

PO/PSO/CO	PO1	PO2	PO3	PO4	PO5	PO6
CO 1	2	1	-	1	1	1
CO 2	2	1	-	1	1	1
CO 3	2	1	-	1	1	1
CO 4	2	1	-	1	1	1
CO 5	2	-	-	1	1	1

UNIT-I

History of making of the Indian constitutions - History, Drafting Committee (Composition & Working). **Philosophy of the Indian Constitution**: Preamble, Salient Features.

UNIT-II

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

UNIT-III

Organs of Governance - Parliament: Composition, Qualifications, Powers and Functions.

Union executives : President, Governor, Council of Ministers, Judiciary, appointment and transfer of judges, qualifications, powers and functions.

UNIT-IV

Local Administration - District's Administration head: Role and importance. Municipalities: Introduction, Mayor and role of Elected Representative, CEO of Municipal Corporation. Panchayati Raj: Introduction, PRI: Zilla Panchayat, Elected Officials and their roles, CEO Zilla Panchayat: positions and role.

Block level: Organizational Hierarchy(Different departments) Village level: role of elected and appointed officials. Importance of grass root democracy.

UNIT-V

Election commission: Election Commission: Role and functioning, Chief Election Commissioner and Election Commissioners, State Election Commission :Role and functioning. Institute and Bodies for the welfare of

SC/ST/OBC and women**.**

TEXT BOOKS:

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

SUGGESTED READING:

1. Bhargava, Rajeev. (ed), "Politics and Ethics of the Indian Constitution", OUP, 2008.
2. NCERT, Indian Constitution at Work, 1st Edition, Government of India, New Delhi 2006, reprinted in 2022.
3. Ravindra Sastry, V. (ed.), Indian Government & Politics, 2nd edition, Telugu Akademy, 2018.

Online Resources:

1. http://www.nptel.ac.in/courses/103107084/Script.pdf

23EGA103

STRESS MANAGEMENT BY YOGA

Instruction	2Hours per week
Duration of SEE	2 Hours
SEE	50 Marks
CIE	--
Credits	0

COURSE OBJECTIVES: This course aims to

1. Creating awareness about different types of stress and the role of yoga in the management of stress.
2. Promotion of positive health and overall wellbeing (Physical, mental, emotional, social and spiritual).
3. Prevention of stress related health problems by yoga practice.

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

1. Understand yoga and its benefits.
2. Enhance Physical strength and flexibility.
3. Learn to relax and focus.
4. Relieve physical and mental tension through asanas
5. Improve work performance and efficiency.

CO-PO Articulation Matrix

PO/CO	PO1	PO2	PO3	PO4	PO5	PO6
CO 1	1	1	-	1	1	1
CO 2	1	-	-	1	1	1
CO 3	1	-	-	1	1	1
CO 4	1	1	-	1	1	1
CO 5	1	1	-	1	1	1

Unit I

Meaning and definition of Yoga - Historical perspective of Yoga - Principles of Astanga Yoga by Patanjali.

Unit II

Meaning and definition of Stress - Types of stress - Eustress and Distress. Anticipatory Anxiety and Intense Anxiety and depression. Meaning of Management- Stress Management.

Unit III

Concept of Stress according to Yoga - Stress assessment methods - Role of Asana, Pranayama and Meditation in the management of stress.

Unit IV

Asanas- (5 Asanas in each posture) - Warm up - Standing Asanas - Sitting Asanas - Prone Asanas - Supine asanas - Surya Namaskar

Unit V

Pranayama- Anulom and Vilom Pranayama - Nadishudhi Pranayama - Kapalabhati Pranayama - Bhramari Pranayama - Nadanusandhana Pranayama.

Meditation techniques: Om Meditation - Cyclic meditation : Instant Relaxation technique (QRT), Quick Relaxation Technique (QRT), Deep Relaxation Technique (DRT)

SUGGESTED READING:

1. **Yogic Asanas for Group Training - Part-I,** Janardhan Swami Yogabhyasi Mandal, Nagpur.
2. **Rajayoga or Conquering the Internal Nature,** Swami Vivekananda, Advaita Ashrama (Publication Department),Kolkata.
3. **Yoga Perspective in Stress Management Nagendra** ,H.R and Nagaratna R, , Bangalore, Swami Vivekananda YogaPrakashan

Online Resources:

1. https://onlinecourses.nptel.ac.in/noc16_ge04/preview
2. https://freevideolectures.com/course/3539/indian-philosophy/11

23EGA104

PERSONALITY DEVELOPMENT THROUGH LIFE'S ENLIGHTENMENT SKILLS

Instruction	2 L Hours per Week
Duration of SEE	2 Hours
SEE	50 Marks
CIE	-
Credits	0

Prerequisite: Awareness on Personality Development.

COURSE OBJECTIVES: This course aims to

1. Learn to achieve the highest goal happily.
2. Become a person with stable mind, pleasing personality and determination.
3. Awake wisdom among themselves.

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

1. Develop their personality and achieve their highest goal of life.
2. Lead the nation and mankind to peace and prosperity.
3. Practice emotional self-regulation.
4. Develop a positive approach to work and duties.
5. Develop a versatile personality.

CO-PO-PSO Articulation Matrix

PO/PSO/CO	PO1	PO2	PO3	PO4	PO5	PO6
CO 1	2	1	1	-	1	2
CO 2	2	1	1	-	1	2
CO 3	2	1	1	-	1	2
CO 4	2	1	1	-	1	2
CO 5	2	1	1	-	1	2

UNIT - I

Neetisatakam – Holistic development of personality - Verses 19, 20, 21, 22 (Wisdom) - Verses 29, 31, 32 (Pride and Heroism) - Verses 26,28,63,65 (Virtue)

UNIT – II

Neetisatakam – Holistic development of personality (cont'd) - Verses 52, 53, 59 (dont's) - Verses 71,73,75& 78 (do's) - Approach to day to day works and duties.

UNIT - III

Introduction to Bhagavad geetha for Personality Development – Shrimad Bhagawad Geeta: Chapter 2–Verses 41, 47, 48 - Chapter 3 – Verses 13,21,27,35 - Chapter 6 – Verses 5,13,17,23,35 - Chapter 18 –Verses 45, 46, 48 Chapter – 6: Verses 5, 13, 17, 23, 35; Chapter – 18: Verses 45, 46, 48

UNIT - IV

Statements of basic knowledge – Shrimad Bhagawad Geeta: Chapter 2- Verses 56, 62, 68 - Chapter 12 – Verses 13, 14, 15, 16, 17, 18 - Personality of Role model from Shrimad Bhagawat Geeta.

UNIT - V

Role of Bahgavad geeta in the present scenario - Chapter 2 – Verses 17 - Chapter 3 – Verses 36, 37, 42 - Chapter 4 – Verses 18, 38, 39 - Chapter 18 – Verses 37, 38, 63.

TEXT BOOKS:

1. Gopinath, P., "Bhartrihari's Three Satakam(Niti-sringar-vairagya)", Rashtriya Sanskrit Sansthanam, New Delhi, 2018.

2. Swarupananda, Swami, “Srimad Bhagavad Geeta”, Advaita Ashram (Publication Dept), Kolkata, 2017.

Online Resources:

1. http://nptel.ac.in/downloads/109104115/

CHAITANYA BHARATHI INSTITUTE OF TECHNOLOGY

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

M.E. (Thermal Engineering)

SEMESTER – IV

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 C212	Industrial Project / Dissertation Phase - II	--	--	32	Viva	100	100	16
TOTAL			**--**	**--**	**32**		**100**	**100**	**16**
Clock Hours Per Week = 32									

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

Service Courses Offered by Mechanical Engineering Department

Open Elective (5/5)		
SNO	**Subj. Code**	**Name of the Subject**
1	23MEO 101	Industrial Safety
2	23MEO 102	Introduction to Optimization Techniques
3	23MEO 103	Composite Materials
4	23MEO 104	Alternative energy sources
5	23MEO 105	Computational methods

23MEC212

INDUSTRIAL PROJECT / DISSERTATION PHASE - II

Instruction	32 Hours per week
Duration of SEE	Viva-Voce
SEE	100 Marks
CIE	100 Marks
Credits	16

Course Objectives: This course aims to

1. Orient the students towards scientific research, problem solving, design, generation/collection and analysis of data.
2. Make the student to realize the objectives and fulfil the aim of the project.
3. Enhance the technical writing skills and encourage to publish the findings.

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

1. Students will be able to use different experimental techniques and will be able to use different software/ computational/analytical tools.
2. Students will be able to design and develop an experimental set up/ equipment/test rig.
3. Students will be able to conduct tests on existing set ups/equipments and draw logical conclusions from the results after analyzing them.
4. Students will be able to either work in a research environment or in an industrial environment.
5. Students will be conversant with technical report writing and will be able to present and convince their topic of study to the engineering community.

Guidelines:

1. It is a continuation of Project work started in semester III.
2. The student has to submit the report in prescribed format and also present a seminar.
3. The dissertation should be presented in standard format as provided by the department.
4. The candidate has to prepare a detailed project report consisting of introduction of the problem, problem statement, literature review, objectives of the work, methodology (experimental set up or numerical details as the case may be) of solution and results and discussion.
5. The report must bring out the conclusions of the work and future scope for the study. The work has to be presented in front of the examiners panel consisting of an approved external examiner, an internal examiner (HoD and BoS Chair Person) guide/co-guide.
6. The candidate has to be in regular contact with his/her guide/co- guide.

CO-PO Articulation Matrix

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

Guidelines for awarding marks in CIE (Continuous Internal Evaluation): Max. Marks: 100		
Evaluation by	**Max. Marks**	**Evaluation Criteria / Parameter**
Department Review Committee	05	Review 1
	10	Review 2
	10	Review 3
	15	Final presentation with the draft copy of the report standard format
	10	Submission of the report in a standard format
Supervisor	10	Regularity and Punctuality
	10	Work Progress
	10	Quality of the work which may lead to publications
	10	Analytical / Programming / Experimental Skills Preparation
	10	Report preparation in a standard format

Guidelines for awarding marks in SEE (Semester End Examination): Max. Marks: 100		
Evaluation by	**Max. Marks**	**Evaluation Criteria / Parameter**
External and Internal Examiner(s) together	20	Power Point Presentation
	40	Quality of thesis and evaluation
	20	Quality of the project 1. Innovations 2. Applications 3. Live Research Projects 4. Scope for future study 5. Application to society
	20	Viva-Voce

CHAITANYA BHARATHI INSTITUTE OF TECHNOLOGY
(AICTE Model Curriculum with Effect from the AY 2023 – 2024)
M.E. (Thermal Engineering)

Service Courses Offered by Mechanical Engineering Department

Open Elective (5/5)		
SNO	**Subj. Code**	**Name of the Subject**
1	23MEO101	Industrial Safety
2	23MEO102	Introduction to Optimization Techniques
3	23MEO103	Composite Materials
4	23MEO104	Alternative energy sources
5	23MEO105	Computational methods

23MEO101

INDUSTRIAL SAFETY

(Open Elective)

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. Causes for industrial accidents and preventive steps to be taken.
2. Fundamental concepts of Maintenance Engineering.
3. About wear and corrosion along with preventive steps to be taken
4. The basic concepts and importance of fault tracing.
5. The steps involved in carrying out periodic and preventive maintenance of various equipments used in industry

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

1. Identify the causes for industrial accidents and suggest preventive measures.
2. Identify the basic tools and requirements of different maintenance procedures.
3. Apply different techniques to reduce and prevent Wear and corrosion in Industry.
4. Identify different types of faults present in various equipments like machine tools, IC Engines, boilers etc.
5. Apply periodic and preventive maintenance techniques as required for industrial equipments like motors, pumps and air compressors and machine tools etc

CO-PO Articulation Matrix

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

UNIT - I

Industrial Safety: Accident, Causes, Types, Results and control, Mechanical and electrical hazards, Types, Causes and preventive steps/procedure, Describe salient points of factories act 1948 for health and safety, Wash rooms, Drinking water layouts, Light, Cleanliness, Fire, Guarding, Pressure vessels, Safety color codes, Fire prevention and firefighting, Equipment and methods.

UNIT – II

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

UNIT – III

Wear and Corrosion and their Prevention: Wear, Types, Causes, Effects, Wear reduction methods, Lubricants, Types and applications, Lubrication methods, General sketch, Working and applications of Screw down grease cup, Pressure grease gun, Splash lubrication, Gravity lubrication, Wick feed lubrication, Side feed lubrication, Ring lubrication, Definition of corrosion, principle and factors affecting the corrosion, Types of corrosion, Corrosion prevention methods.

UNIT–IV

Fault Tracing: Fault tracing, Concept and importance, Decision tree concept, Need and applications, Sequence of fault finding activities, Show as decision tree, Draw decision tree for problems in machine tools, Hydraulic, Pneumatic, Automotive, Thermal and electrical equipment's like any one machine tool, Pump, Air compressor, Internal combustion engine, Boiler, Electrical motors, Types of faults in machine tools and their general causes.

UNIT – V

Periodic and Preventive Maintenance: Periodic inspection, Concept and need, Degreasing, Cleaning and repairing schemes, Overhauling of mechanical components, Overhauling of electrical motor, Common troubles and remedies of electric motor, Repair complexities and its use, Definition, Need, Steps and advantages of preventive maintenance. Steps/procedure for periodic and preventive maintenance of Machine tools, Pumps, Air compressors, Diesel generating sets, Program and schedule of preventive maintenance of mechanical and electrical equipment, Advantages of preventive maintenance, Repair cycle concept and importance

TEXT BOOKS:

1. H. P. Garg, Maintenance Engineering, S. Chand and Company
2. Audels, Pump-hydraulic Compressors, McGraw Hill Publication

SUGGESTED READING:

1. Higgins & Morrow, Maintenance Engineering Handbook, Da Information Services.
2. Winterkorn, Hans, Foundation Engineering Handbook, Chapman & Hall London

23MEO102

INTRODUCTION TO OPTIMIZATION TECHNIQUES

(Open Elective)

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. Come to know the formulation of LPP models
2. Understand the Transportation and Assignment techniques
3. Come to know the procedure of Project Management along with CPM and PERT techniques
4. Understand the concepts of queuing theory and inventory models
5. Understand sequencing techniques

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

1. Formulate a linear programming problems (LPP)
2. Build and solve Transportation Models and Assignment Models.
3. Apply project management techniques like CPM and PERT to plan and execute project successfully
4. Apply queing and inventory concepts in industrial applications
5. Apply sequencing models in industries

CO-PO Articulation Matrix

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

UNIT - I

Operations Research: Definition, Scope, Models, Linear programming problems (LPP), Formulation, Graphical Method, and Simplex Method

UNIT - II

Transportation Models: Finding an initial feasible solution, North West corner method, Least cost method, Vogel's approximation method, Finding the optimal solution, Special cases in transportation problems, Unbalanced transportation problem, Degeneracy in transportation, Profit maximization in transportation.

UNIT- III

Project Management: Definition, Procedure and objectives of project management, Differences between PERT and CPM, Rules for drawing network diagram, Scheduling the activities, Fulkerson's rule, Earliest and latest times, Determination of ES and EF times in forward path, LS & LF times in backward path, Determination of critical path, Duration of the project, Free float, Independent float and total float

UNIT - IV

Queuing Theory and Inventory:: Kendols notation, Single server models, Inventory control, Deterministic inventory models, Probabilistic inventory control models.

UNIT - V

Sequencing Models: Introduction, Objectives, General assumptions, Processing 'n' jobs through two machines, Processing 'n' jobs through three machines

TEXT BOOKS:

1. H.A. Taha, Operations Research, An Introduction, PHI, 2008
2. H.M. Wagner, Principles of Operations Research, PHI, Delhi, 1982
3. J.C. Pant, Introduction to Optimisation: Operations Research, Jain Brothers, Delhi, 2008

SUGGESTED READING:

1. Hitler Libermann, Operations Research, McGraw Hill Pub, 2009
2. Pannerselvam, Operations Research, Prentice Hall of India, 2010
3. Harvey M Wagner, Principles of Operations Research, Prentice Hall of India, 2010

23MEO103

COMPOSITE MATERIALS

(Open Elective)

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. Composite materials and their constituents.
2. Classification of the reinforcements and evaluate the behavior of composites.
3. Fabrication methods of metal matrix composites.
4. Manufacturing of Polymer matrix composites.
5. Failure mechanisms in composite materials.

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

1. Classify and characterize the composite materials.
2. Describe types of reinforcements and their properties.
3. Understand different fabrication methods of metal matrix composites.
4. Understand different fabrication methods of polymer matrix composites.
5. Decide the failure of composite materials.

CO-PO Articulation Matrix

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

UNIT - I

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

UNIT – II

Reinforcements: Preparation, Layup, Curing, Properties and applications of glass fibers, Carbon fibers, Kevlar fibers and boron fibers, Properties and applications of whiskers, Particle reinforcements, Mechanical behavior of composites, Rule of mixtures, Inverse rule of mixtures, Isostrain and isostress conditions.

UNIT – III

Manufacturing of Metal Matrix Composites: Casting, Solid state diffusion technique, Cladding, Hot isostatic pressing, Properties and applications, Manufacturing of ceramic matrix composites, Liquid metal infiltration, Liquid phase sintering, Manufacturing of Carbon, Carbon composites, Knitting, Braiding, Weaving. Properties and applications.

UNIT–IV

Manufacturing of Polymer Matrix Composites: Preparation of moulding compounds and prepegs, Hand layup method, Autoclave method, Filament winding method, Compression moulding, Reaction injection moulding, Properties and applications.

UNIT – V

Strength: Lamina failure criteria, Strength ratio, Maximum stress criteria, Maximum strain criteria, Interacting failure criteria, Hygrothermal failure, Laminate first play failure, Insight strength

TEXT BOOKS:

1. K.K.Chawla, "Composite Materials- Science and Engineering", 4th edition, Springer Verlag, 2019.
2. WD Callister, Jr., Adapted by R. Balasubramaniam , "Materials Science and Engineering, An introduction".

SUGGESTED READING:

1. Deborah D.L. Chung, "Composite Materials Science and Applications" 2nd edition, Springer Verlag, 2010.
2. Sanjay K. Mazumdar, "Composites Manufacturing- materials, product and process engineering", 1st edition, CRC press, 2002.
3. Daniel Gay, "Composite Materials Design and Applications" 3rd edition, CRC press, 2015.

23MEO104

ALTERNATIVE ENERGY SOURCES

(Open Elective)

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

Course Objectives: This Course aims to

1. Elucidate need and importance of non-conventional energy resources
2. Explain extent of solar energy which can be utilized as energy resource
3. Explain concept of wind energy and its merits and demerits
4. Provide operating principles of geothermal energy and bio-energy
5. Explain merits and demerits of tidal energy, wave energy and OTEC

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

1. Understand the need for renewable energy sources in the context of environmental issues.
2. Apply the principles of solar energy for domestic and industrial usages.
3. Understand the working principle of wind power plants along with merits and demerits.
4. Describe the concepts of geothermal energy sources and biomass as a source of energy.
5. Explain the principles and impact of wave, tidal and OTEC plants on the environment.

CO-PO Articulation Matrix

PO/CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
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

Energy Sources: Energy characteristics, forms of energy, energy chain (route), energy sectors, Indian energy scenario, energy pricing in India, energy and environment, energy security, energy conservation and its importance, energy strategy for future, classification of energy sources, availability of conventional and non-conventional (renewable) energy sources, classification of RES - solar, wind, geothermal, bio-mass, ocean tidal, ocean wave and ocean thermal energy conversion (OTEC), advantages and limitations of conventional and renewable energy sources.

UNIT-II

Solar Energy: Solar radiation, solar thermal collectors, working of flat plate and concentrating (focusing) solar collectors and their limitations, comparison of flat plate and focusing collectors, applications of solar collectors - water heating, space heating, low temperature power generation, solar cookers, water pumping, SODIS, solar thermal power plant, advantages and limitations of solar energy systems, PV materials, PV cells and their manufacturing, space based solar power (SBSP), solar satellite system, advantages and disadvantages of SBSP.

UNIT-III

Wind Energy: Sources of wind, merits and demerits of wind energy, site selection for wind energy conversion system, wind turbine (wind mill), classification of wind mills, working principle horizontal axis and vertical axis windmills, horizontal vs vertical axis windmills, power extracted from the wind, effect of velocity on power generation, new developments and problems in operating large wind power generators.

UNIT-IV

Geothermal Energy: Layers in earth, resources of geothermal energy, hydrothermal, petrothermal and geopressure resources, advantages, disadvantages, applications and environmental effects of geothermal energy sources.

Biomass Energy: Resources, biogas and its composition, process of biogas generation, wet process and dry process, raw materials available for biogas fermentation, economical, social, environmental and health benefits of biogas utilization, selection of site and constructional techniques of a biogas plant, working of KVIC, Pragathi design, Janata and Deenbandu biogas plants, common operational problems, causes and remedies relating to a biogas plant.

UNIT V

Tidal power: Tidal systems, site selection for tidal power plant, schematic layout of tidal power house, principle of operation of single basin and double basin tidal plants, advantages and disadvantages of tidal power.

Wave energy - Differences between tides and waves, advantages and disadvantages of wave power, problems associated with wave energy collection, working principle of wave energy conversion devices.

Ocean thermal energy conversion (OTEC) - OTEC power plants, location, open cycle and closed cycle OTEC plants, advantages, limitations and applications of OTEC, environmental impact of OTEC plants.

TEXT BOOKS:

1. S. Hasan Saeed and D.K. Sharma, ―Non Conventional Energy Resources‖, S.K. Kataria & Sons, New Delhi, 2017.
2. Dr. R.K. Singal, ―Non Conventional Energy Resources‖, S.K. Kataria & Sons, New Delhi, 2005.

Reference books:

1. K. M. Mittal, ―Non-Conventional Energy Systems‖, Wheeler Publishing Co. Ltd, New Delhi, 2003.
2. Shali Habibulla, ―Non-Conventional Energy Sources‖, State Institute of Vocational Education, Hyderabad, 2005.
3. G.D. Rai, ―Non Conventional Energy Sources‖, Khanna Publishers, New Delhi, 2011.

23MEO105

COMPUTATIONAL METHODS

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

Course Objectives: This Course aims to
1. Teach basic equations and concept of CFD.
2. Explain concept of PDEs and finite difference methods.
3. Explain Crank-Nihcolson, Implicit and Explicit methods & Jacobi, Gauss Seidel and ADI methods.
4. Provide various types of grid generation and errors in numerical solution.
5. Elucidate importance of FVM.

COURSE OUTCOMES: After the completion of this course, the student will be able to
1. Derive CFD governing equations and turbulence models.
2. Apply different PDEs and know the importance of Taylor series of expansion.
3. Solve simultaneous linear equations with various methods.
4. Understand errors, stability, consistency and develop O,H and C grid generated models.
5. Utilize FVM for heat transfer problems.

CO-PO Articulation Matrix

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

UNIT - I

Governing Equations: Continuity, Momentum and Energy equations, Navier Stokes equations, Reynolds and Favre averaged N – S equations. Introduction to turbulence, Turbulence models-mixing length model, K-å turbulence Model.

UNIT - II

Classification of PDEs: Elliptic, parabolic and hyperbolic equations, Initial and boundary conditions. Concepts of Finite difference methods – forward, backward and central difference, explicit, Implicit and Crank Nicholson.

UNIT- III

Finite Difference Solutions: Solution of simultaneous linear equations: Jacobi, Gauss Seidel, TDMA, ADI, solution for viscous incompressible flow using Vorticity Stream function method, MAC method.

UNIT - IV

Grid Generation: Grid Generation- Types of grid O,H,C. Coordinate transformation, Unstructured grid generation, Errors, Consistency, Stability analysis by von Neumann. Convergence criteria

UNIT - V

Finite Volume Method: Introduction to Finite volume method, Finite volume formulations for diffusion equation, convection diffusion equation, Staggered grids SIMPLE and SIMPLE R algorithms.

TEXT BOOKS:

1. P.S. Ghoshdastidar, Computational Fluid Dynamics and Heat Transfer, Cengage, 2017.
2. John D. Anderson, “Computational Fluid Dynamics”, Mc Graw Hill Inc., 2018.
3. H. K. Versteeg and Malala Shekara, “Introduction to Finite Volume Method”, Pearson, 2015.

SUGGESTED READING:

1. K. Muralidhar and T. Sundararajan T., “Computational Fluid flow and Heat transfer”, Narosa Publishing House, 2003.
2. S.V. Patankar, “Numerical Heat transfer and Fluid flow”, Hemisphere Publishing Company, New York, 1980.

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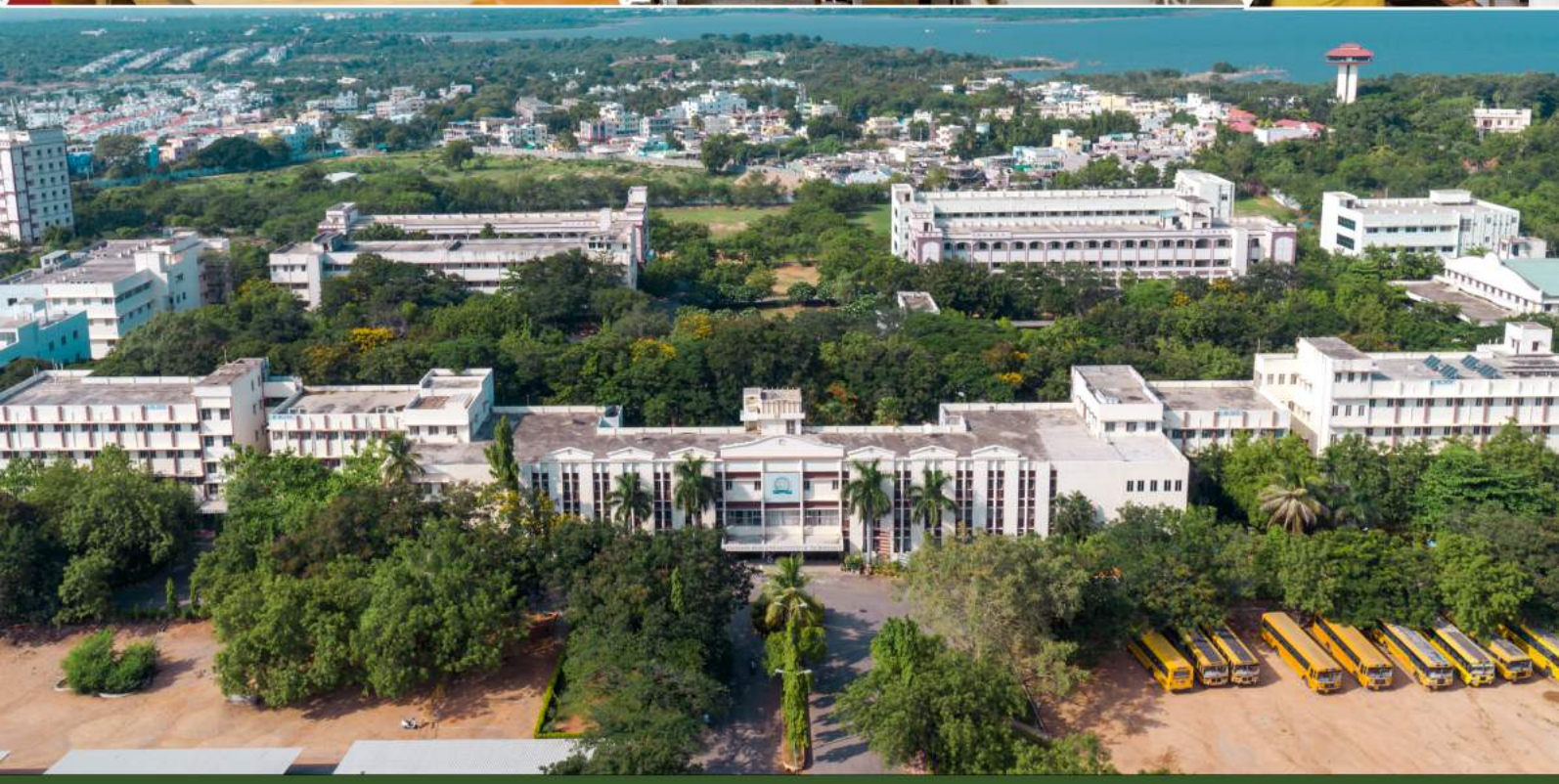

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Accreditated by NBA & NAAC (A++)

Kokapet Village, Gandipet Mandal, Hyderabad -500075, Telanagana.

E-mail: principal@cbit.ac.in, Website: www.cbit.ac.in

Phone No. : 040-24193276 / 277 / 279