ANNAMALAI UNIVERSITY

Faculty of Engineering and Technology

DEPARTMENT OF MECHANICAL ENGINEERING

M.E. ThErMa l PowEr EnginEEring

Choice Based Credit System

(Full Time & Part Time)

2019

DEPARTMENT OF MECHANICAL ENGINEERING

VISION

The Mechanical Engineering Department endeavors to be recognized globally for outstanding education and research leading to well qualified engineers, who are innovative, entrepreneurial and successful in advanced fields of mechanical engineering to cater the ever changing industrial demands and social needs.

MISSION

The Mechanical Engineering program makes available a high quality, relevant engineering education. The Program dedicates itself to providing students with a set of skills, knowledge and attitudes that will permit its graduates to succeed and thrive as engineers and leaders. The Program strives to:

- Prepare its graduates to pursue life-long learning, serve the profession and meet intellectual, ethical and career challenges.
- Maintain a vital, state-of-the-art research enterprise to provide its students and faculty with opportunities to create, interpret, apply and disseminate knowledge.

Programme Educational Objectives (PEO)

1. To equip the students with necessary foundation for effectively analyzing and solving the problems associated in thermal engineering field.
2. To deliver comprehensive education in Thermal Engineering to ensure that the students have core competency to be successful in industry/ research laboratory and motivate them to pursue higher studies and research in interrelated areas.
3. To encourage the students to take up real life and/or research related problems and to create innovative solutions of these problems through comprehensive analysis and designing.
4. Graduates will have inculcated the ability to maintain high professionalism and ethical standards, effective technical presentation and writing skill and to work as a part of team on research projects.

Program Outcomes (PO)

PO 1: An ability to acquire, apply and share in-depth knowledge in the area of thermal engineering.

PO 2: An ability to conduct independent research and generate new knowledge for the benefit of mankind.

PO 3: Graduates will demonstrate an ability to identify, formulate and solve thermal engineering problems.

PO 4: Graduates will demonstrate research skills to critically analyze complex thermal engineering problems for synthesizing new and existing information for their solutions.

PO 5: An ability to maintain a high level of professional and intellectual integrity, ethics of research and scholarly standards.

PO 6: Graduates will demonstrate skills to use modern engineering tools, software and equipment to analyze and solve complex engineering problems.

PO7: Graduates will demonstrate and ability to work on laboratory and multidisciplinary tasks.

PO 8: Students will be able to convey thoughts effectively on the basis of acquired soft skills and self confidence with peers, subordinates and higher authority for the consistent and effective knowledge sharing process.

PO 9: Graduates will be able to understand the need for, and an ability to engage in life-long learning and continual updating of professional skills

Mapping of POs with PEOs									
PEOs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**
PEO1	✓		✓	✓					
PEO2		✓				✓		✓	
PEO3	✓	✓			✓		✓		✓
PEO4				✓	✓			✓	

FACULTY OF ENGINEERING AND TECHNOLOGY
DEPARTMENT OF MECHANICAL ENGINEERING
Program : M.E **Specialization: Thermal Power Engineering**
CURRICULUM - 2019

SEMESTER I									
Course Code	**Category**	**Course**	**L**	**T**	**P**	**CA**	**FE**	**Total**	**Credits**
METPPC11	**PC**	Thermodynamics and Combustion	3	-	-	25	75	100	3
METPPC12	**PC**	Advanced Fluid Dynamics	3	-	-	25	75	100	3
METPPE13	**PE**	Program Elective-I	3	-	-	25	75	100	3
METPPE14	**PE**	Program Elective-II	3	-	-	25	75	100	3
METPMC15	**MC**	Research Methodology and IPR	2	-	-	25	75	100	2
METPCP16	**CP**	Thermodynamics and Combustion Laboratory	-	-	3	40	60	100	2
METPCP17	**CP**	Computer Laboratory	-	-	3	40	60	100	2
METPAC18	**AC**	Audit Course-I	2	-	-	-	-	-	0
			Total			205	495	700	**18**

SEMESTER II									
Course Code	**Category**	**Course**	**L**	**T**	**P**	**CA**	**FE**	**Total**	**Credits**
METPPC21	**PC**	Advanced Heat Transfer	3	-	-	25	75	100	3
METPPC22	**PC**	Steam Engineering	3	-	-	25	75	100	3
METPPE23	**PE**	Program Elective-III	3	-	-	25	75	100	3
METPPE24	**PE**	Program Elective-IV	3	-	-	25	75	100	3
METPCP25	**OE**	Open Elective	3	-	-	40	60	100	3
METPOE26	**CP**	Solar and Heat Transfer Laboratory	-	-	3	40	60	100	2
METPTS27	**TS**	Industrial Training and Seminar / Mini project		Tr 2	S 2	40	60	100	2
METPAC28	**AC**	Audit Course-II	2	-	-	-	-	-	0
			Total			205	495	700	**19**

PC	**Program Core**	**CP**	Core Practical	**AC**	Audit Course
PE	**Program Elective**	**TS**	Industrial Training and Seminar	**PV**	Project work & Viva-voce
OE	**Open Elective**	**MC**	Mandatory Learning Course	**XX**	Branch code
				yy	M.E Specialization Code

SEMESTER III									
Course Code	**Category**	**Course**	**L**	**T**	**P**	**CA**	**FE**	**Total**	**Credits**
METPOE31	**PE**	Program Elective-V	3	-	-	25	75	100	3
METPOE32	**OE**	Open Elective	3	-	-	25	75	100	3
METPPV33	**PV-I**	Project work & Viva-voce Phase-I	-	Pr 16	S 4	40	60	100	10
			Total			90	210	300	**16**

SEMESTER IV									
Course Code	**Category**	**Course**	**L**	**T**	**P**	**CA**	**FE**	**Total**	**Credits**
METPPV41	**PV-II**	Project work & Viva-voce Phase-II	-	Pr 24	S 6	40	60	100	15
			Total			40	60	100	**15**

DEPARTMENT OF MECHANICAL ENGINEERING
M.E. (Thermal Power) PART TIME - DEGREE PROGRAMME
Choice Based Credit System (CBCS)
REGULATION - 2019
Courses of Study and Scheme of Examination

S E M E S T E R – I											
Sl. No.	**Course Code**	**Category**	**Course**	**L**	**T**	**P**	**CA**	**FE**	**Total**	**Credits**	Equivalent Course Code in M.E. Full Time
1	PMETPPC11	**PC**	Thermodynamics and Combustion	3	-	-	25	75	100	3	METPPC11
2	PMETPPC12	**PC**	Advanced Fluid Dynamics	3	-	-	25	75	100	3	METPPC12
3	PMETPMC13	**MC**	Research Methodology and IPR	2	-	-	25	75	100	2	METPMC15
4	PMETPCP14	**CP**	Thermal Engineering Lab Practice-I	-	-	3	40	60	100	2	METPCP16
	Total						**115**	**285**	**400**	**10**	

S E M E S T E R – II											
Sl. No.	**Course Code**	**Category**	**Course**	**L**	**T**	**P**	**CA**	**FE**	**Total**	**Credits**	**Equivalent Course Code in M.E. Full Time**
1	PMETPPC21	**PC**	Advanced Heat Transfer	3	-	-	25	75	100	3	METPPC21
2	PMETPPC22	**PC**	Steam Engineering	3	-	-	25	75	100	3	METPPC22
3	PMETPOESCN	**OE**	Open Elective - I	2	-	-	25	75	100	2	
4	PXXYYCP24	**CP**	Thermal Engg. Lab Practice-II	-	-	3	40	60	100	2	METPCP17
	Total						**115**	**285**	**400**	**10**	

S E M E S T E R – III											
Sl. No.	**Course Code**	**Category**	**Course**	**L**	**T**	**P**	**CA**	**FE**	**Total**	**Credits**	**Equivalent Course Code in M.E. Full Time**
1	PMETPPESCN	**PE**	Program Elective-I	3	-	-	25	75	100	3	
2	PMETPPESCN	**PE**	Program Elective-II	3	-	-	25	75	100	3	
3	PXXYYCP33	**CP**	Program Core Lab-III	-	-	3	40	60	100	2	METPCP25
	Total						**90**	**210**	**300**	**8**	

P - Part-Time
XX – Department Branch Code
YY - PG Specialization
L: Lecture ,**P:** Practical,**T**: Thesis, **CA:** Continuous Assessment;**FE:** Final Examination

SEMESTER – IV											
Sl. No.	**Course Code**	**Category**	**Course**	**L**	**T**	**P**	**CA**	**FE**	**Total**	**Credits**	**Equivalent Course Code in M.E. Full Time**
1	PMETPPESCN	PE	Program Elective-III	3	-	-	25	75	100	3	
2	PMETPPESCN	PE	Program Elective-IV	3	-	-	25	75	100	3	
3	PMETPTS43	TS	Industrial Training and Seminar / Mini project		Tr	S	40	60	100	2	METPTS27
					2	2					
	Total						**90**	**210**	**300**	**8**	

SEMESTER – V											
Sl. No.	**Course Code**	**Category**	**Course**	**L**	**T**	**P**	**CA**	**FE**	**Total**	**Credits**	**Equivalent Course Code in M.E. Full Time**
1	PMETPPESCN	**PE**	Program Elective-V	3	-	-	25	75	100	3	
2	PMETPOESCN	**OE**	Open Elective - II (From the Dept)	3	-	-	25	75	100	3	
3	PMETPPV53	**PV-I**	Project work & Viva-voce Phase-I	-	Pr	S	40	60	100	10	METPPV33
					16	4					
	Total						**90**	**210**	**300**	**16**	

SEMESTER – VI											
Sl. No.	**Course Code**	**Category**	**Course**	**L**	**T**	**P**	**CA**	**FE**	**Total**	**Credits**	**Equivalent Course Code in M.E. Full Time**
1	PMETPPV61	**PV-II**	Project work & Viva-voce Phase-II	-	Pr	S	40	60	100	16	METPPV41
					26	6					
	Total						**40**	**60**	**100**	**16**	

List of Program Electives

1.METPPESCN Nuclear Engineering
2.METPPESCN Energy Conservation and management
3.METPPESCN Air conditioning system design
4.METPPESCN Gas Turbines
5.METPPESCN Refrigeration and cryogenics
6.METPPESCN Design of Heat exchangers
7.METPPESCN Computational fluid dynamics
8.METPPESCN Modelling of IC engines
9.METPPESCN Solar energy and wind energy
10.METPPESCN Advanced mathematical methods in Engineering

List of Open Electives

1.METPOESCN Industrial Safety
2.METPOESCN Waste To Energy
3.METPOESCN Nuclear Engineering
4.METPOESCN Fuels And Combustion
5.METPOESCN Energy Management In Buildings
6.METPOESCN Bio Energy Conversion
7.METPOESCN Advanced Power Plant Engineering

List of Program Electives

11.METPPESCN Nuclear Engineering
12.METPPESCN Energy Conservation and management
13.METPPESCN Air conditioning system design
14.METPPESCN Gas Turbines
15.METPPESCN Refrigeration and cryogenics
16.METPPESCN Design of Heat exchangers
17.METPPESCN Computational fluid dynamics
18.METPPESCN Modelling of IC engines
19.METPPESCN Solar energy and wind energy
20.METPPESCN Advanced mathematical methods in Engineering

List of Open Electives

8.METPOESCN Industrial Safety
9.METPOESCN Waste To Energy
10.METPOESCN Nuclear Engineering
11.METPOESCN Fuels And Combustion
12.METPOESCN Energy Management In Buildings
13.METPOESCN Bio Energy Conversion
14.METPOESCN Advanced Power Plant Engineering

List of Audit courses

1.METPACSCN English for Research Paper Writing
2.METPACSCN Disaster Management
3.METPACSCN Sanskrit for Technical Knowledge
4.METPACSCN Value Education
5.METPACSCN Constitution of India
6.METPACSCN Pedagogy Studies
7.METPACSCN Stress Management by Yoga
8.METPACSCN Personality Development through Life Enlightenment Skills

FIRST SEMESTER

METPPC11	THERMODYNAMICS AND COMBUSTION	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To learn the advanced concepts in Thermodynamics
- To provide knowledge of exergy, basic laws governing energy conversion
- To introduce statistical thermodynamics.
- To prepare the students to present theoretical, semi-theoretical and empirical models for the prediction of thermodynamic properties

Syllabus Contents:

First law and State postulates, Second law and Entropy, Availability and Irreversibility,

Transient flow analysis
Nonreactive Ideal-Gas Mixture, PvT Behavior of Real gases and Real Gas mixture

Generalized Thermodynamic Relationship, Combustion and Thermo-chemistry,
Second law analysis of reacting mixture, Availability, analysis of reacting mixture, Chemical equilibrium.

Statistical thermodynamics, statistical interpretations of first and second law and Entropy,

Third law of thermodynamics, Nerst heat theorem.

REFERENCES:

1. Cengel, “Thermodynamics”, Tata McGraw Hill Co., New Delhi, 1980.
2. Howell and Dedcius, “Fundamentals of Engineering Thermodynamics”, McGraw Hill Inc.,U.S.A.
3. Van Wylen & Sonntag, “Thermodynamics”, John Wiley and Sons Inc., U.S.A.
4. Jones and Hawkings, “Engineering Thermodynamics”, John Wiley and Sons Inc., U.S.A, 2004.
5. Holman, “Thermodynamics”, McGraw Hill Inc., New York, 2002.
6. Faires V.M. and Simmag, “Thermodynamics”, Macmillan Publishing Co. Inc., U.S.A.
7. Rao Y.V.C., “Postulational and Statistical Thermodynamics”, Allied Publishers Inc, 1994.

COURSE OUTCOMES:

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

1. Gain knowledge of exergy, basic laws governing energy conversion in multi component systems and application of chemical thermodynamics.
2. Aware of advanced concepts in thermodynamics.
3. Able to present theoretical, semi-theoretical and empirical models for the prediction of thermodynamic properties.
4. Apply fundamental principles of thermodynamics to non-ideal models of numerous engineering devices
5. Understand statistical thermodynamics

Mapping of COs with POs									
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**
CO1	✓			✓					✓
CO2	✓	✓		✓					
CO3			✓		✓				
CO4	✓					✓			
CO5	✓	✓							✓

METPPC12	**ADVANCED FLUID DYNAMICS**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES:

- To understand and define the fluid flow problems
- To solve fluid flow problems
- To explain the flow patterns and differentiate between the flow regimes and its effects

Syllabus Contents:

Governing equations in Fluid Dynamics: Derivation of Continuity and Momentum equations using integral and differential approach, dimensionless form of governing equations, special forms of governing equations, integral quantities

Exact Solutions of Navier-Stokes Equations: Fully developed flows, parallel flow in straight channel, Couette flow, Creeping flows Potential Flow: Kelvin's theorem, Irrotational flow, Stream function-vorticity approach.

Laminar Boundary layers: Boundary layer equations, flow over flat plate, Momentum integral equation for boundary layer, approximate solution methodology for boundary layer equations

Turbulent Flow: Characteristics of turbulent flow, laminar turbulent transition, time mean motion and fluctuations, derivation of governing equations for turbulent flow, shear stress models, universal velocity distribution

Experimental Techniques: Role of experiments in fluid, layout of fluid flow experiments, sources of error in experiments, data analysis, design of experiments, review of probes and transducers, Introduction to Hot wire Anemometry, Laser Doppler Velocimetry and Particle Image Velocimetry

REFERENCES:

1. Muralidhar and Biswas, Advanced Engineering Fluid Mechanics, , Alpha Science International, 2005
2. Irwin Shames, Mechanics of Fluids, , McGraw Hill, 2003
3. Fox R.W., McDonald A.T , Introduction to Fluid Mechanics, John Wiley and Sons Inc, 1985
4. Pijush K. Kundu, Ira M Kohen and David R. Dawaling, Fluid Mechanics, Fifth Edition, 2005

COURSE OUTCOMES:

At the end of the course, students will be able to

1. Understand and define the fluid flow problems along with range of governing parameters
2. Solve fluid flow problems of industrial base.
3. Devise the experiments in the field of fluid mechanics.
4. Understand the flow patterns
5. Differentiate the flow regimes and its effects.

Mapping of COs with POs									
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**
CO1	✓			✓	✓				
CO2	✓			✓	✓				
CO3		✓		✓		✓	✓		
CO4	✓								✓
CO5	✓	✓							

✓

METPMC15	**RESEARCH METHODOLOGY AND IPR**	**L**	**T**	**P**	**C**
		2	**0**	**0**	**2**

Course Objective:

- To formulate research problems
- To analyze the information related to results
- To introduce research ethics

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

Effective literature studies approaches, analysis Plagiarism, Research ethics, Effective technical writing, how to write report, Paper Developing a Research Proposal, Format of research proposal, a presentation and assessment by a review committee

Nature of Intellectual Property: Patents, Designs, Trade and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development.

International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, Patenting under PCT. Patent Rights: Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications.

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

REFERENCES:

1. Melville and Wayne Goddard, “Research methodology: an introduction for science & engineering students’”
2. Wayne Goddard and Stuart Melville, “Research Methodology: An Introduction”
3. Ranjit Kumar, 2nd Edition, “Research Methodology: A Step by Step Guide for beginners”
4. Halbert, “Resisting Intellectual Property”, Taylor & Francis Ltd ,2007.
5. Mayall , “Industrial Design”, McGraw Hill, 1992.

6. Niebel , “Product Design”, McGraw Hill, 1974.
7. Asimov, “Introduction to Design”, Prentice Hall, 1962.
8. Robert P. Merges, Peter S. Menell, Mark A. Lemley, “ Intellectual Property in New Technological Age”, 2016.
9. T. Ramappa, “Intellectual Property Rights Under WTO”, S. Chand, 2008

COURSE OUTCOMES:

At the end of this course, students will be able to

1. Understand research problem formulation.
2. Analyze research related information
3. Follow research ethics
4. Enhance their writing skills
5. Understand that today’s world is controlled by Computer, Information Technology, but tomorrow world will be ruled by ideas, concept, and creativity

Mapping of COs with POs									
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**
CO1	✓	✓	✓	✓		✓			
CO2	✓	✓	✓	✓		✓			
CO3	✓	✓	✓	✓		✓			
CO4	✓	✓	✓	✓		✓			
CO5	✓	✓	✓	✓		✓			

✓

MEEMCP16	**THERMODYNAMICS AND COMBUSTION LABORATORY**	**L**	**T**	**P**	**C**
		0	**0**	**3**	**2**

COURSE OBJECTIVES

- To conduct the load test, speed test and Heat Balance Test of a single and double cylinder diesel engine.
- To evaluate the performance of steam boiler, turbine and condenser.
- To make the students understand the working principle of various types of governors, balancing systems, Cam analyzer, Torsional vibration of single rotor system, whirling speed concept, action of forces in gyroscope.

List of Experiments

1. Study and Performance test on Kaeser air compressor test rig.
2. Heat balance test and air fuel determination on a Diesel Engine
3. Effect of injection pressure on the performance and emission of Diesel Engine.
4. Determination of damping coefficient in damping torsional oscillation.
5. Experimentation of pressure processes station by PID control.
6. Demonstrate the gyroscopic effects and determination of gyroscopic couple.
7. Performance evaluation of loco type boiler.
8. Performance evaluation of Greenbat turbine with condenser.
9. Performance evaluation of reader vertical steam engine.

COURSE OUTCOMES

Upon completing this course, students should be able to:

1. Gain knowledge about the combustion principles.
2. Analyze the performance of internal combustion engines
3. Analyze the performance of steam boiler, turbine and condenser.
4. Supplement the principles learnt in kinematics and Dynamics of Machinery.
5. Work as a team to promote lifelong learning.

Mapping of COs with POs									
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**
CO1	✓				✓	✓	✓		
CO2	✓				✓	✓	✓		
CO3	✓				✓	✓	✓		
CO4	✓				✓	✓	✓		
CO5	✓				✓	✓	✓		

MEEMCP17	**COMPUTER LABORATORY**	**L**	**T**	**P**	**C**
		0	**0**	**3**	**2**

COURSE OBJECTIVES

- To understand the strength of OOPS using c++
- To impart programming skills in C++ programming.
- To introduce the basics of MAT LAB.

List of Experiment

Search, generate, manipulate data using MS office/ Open Office
Presentation and Visualization – graphs, charts, 2D, 3D
C++, Programming,
Simple MATLAB Exercises
Simple CATIA Exercises

COURSE OUTCOMES

Upon completing this course, students should be able to:

1. Able to prepare slides and graphs
2. Write and compile programmes in C++
3. Develop assembly drawings with different views using auto cad
4. Solve simple mathematical models using MATLAB.
5. Write simple exercises in CATIA

Mapping of COs with POs									
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**
CO1	✓				✓	✓	✓		
CO2	✓				✓	✓	✓		
CO3	✓				✓	✓	✓		
CO4	✓				✓	✓	✓		
CO5	✓				✓	✓	✓		

SECOND SEMESTER

METPPC21	ADVANCED HEAT TRANSFER	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To develop the ability to use the heat transfer concepts for various applications like finned systems, turbulence flows, high speed flows.
- To develop the numerical approach to solve the heat transfer problem
- To carry out the thermal analysis and design of heat exchangers.
- Review on mechanism of heat and mass transfer – balance laws and constitutive equations.

Conduction

Review of general heat conduction equations – 1-D heat conduction with variable heat generation – boundary and initial conditions – heat transfer from extended surfaces – use of transient temperature charts – lumped system analysis – periodic heat flow. Numerical heat transfer: Finite difference formulation of steady and transient heat conduction problems – solution procedures (Gaussian elimination and iterative procedures).

Convection

Review on the concept of boundary layer – N-S equations – Momentum and energy integral equations (Flat plate – fully developed tube flow). Turbulent heat transfer – introduction to turbulence model (k-ε model) – mixing length concept – Analogy between heat and momentum transfer (Reynolds, Colburn, Von-Karman analogy – Turbulent flow in a tube. Porous media heat transfer : Basic principles of flow and heat transfer.

Radiation

Review of radiation shape factor – thermal shields – concept of radiosity method – radiation by gases and flames.

Two phase flows and boiling and condensation heat transfer

Fundamentals of 2-phase flows: Homogenous, separated and drift flux models – Two phase flow pressure drop.

Heat Exchange Equipments

Review of LMTD - ε - NTU approach – Compact exchangers, packed and fluidized systems. Special topics of heat transfer: (Qualitative treatment only) Ablative cooling – Cooling of electronic components – Heat transfer analysis in I.C. engines – High speed flows – Heat pipes.

REFERENCES:

1. Incropera F.P. and DeWitt.D.P., Fundamentals of Heat & Mass Transfer, John Wiley & Sons, 1996.
2. Nag P.K., Heat transfer , Tata McGraw-Hill , 2002.
3. Ozisik.M.N., Heat Transfer - Basic Approach, McGraw-Hill Co., 1985.
4. Bejan.A., Convection Heat Transfer, John Wiley and Sons, 1984.
5. McAdams W.H., Heat transmission, McGraw-Hill Book Co., 1958
6. Wallis G.B., One-Dimensional two phase flow, McGraw-Hill Book Co., 1969.
7. Bird R.B., Stewart W.E. and Lightfoot E.N., Transport Phenomena, John Wiley & Sons, 1994.

COURSE OUTCOMES

Upon On successful completion of this course the student will be able to

1. Apply the law of thermodynamics and heat transfer to real life heat transfer problems.
2. Understand the significance of heat transfer in industrial applications
3. Learn advanced topics in heat transfer
4. Learn the fundamentals of two phase flows
5. Develop numerical approach to solve problems in heat transfer

Mapping of COs with POs									
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**
CO1	✓		✓	✓					✓
CO2			✓		✓		✓		
CO3	✓		✓	✓					
CO4	✓	✓							✓
CO5			✓					✓	

✓

METPPC22	**STEAM ENGINEERING**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES:

- To learn the fundamentals of steam generation
- To learn steam and piping design
- To learn about energy conservation and waste minimization

Introduction

Fundamentals of steam generation, Quality of steam, Use of steam table, Mollier Chart - Boilers, Types, Mountings and Accessories, Combustion in boilers, Determination of adiabatic flame temperature, quantity of flue gases, Feed Water and its quality, Blow down; IBR, Boiler standards

Piping & Insulation

Water Line, Steam line design and insulation; Insulation-types and application, Economic thickness of insulation, Heat savings and application criteria, Refractory-types, selection and application of refractory, Heat loss.

Steam Systems

Assessment of steam distribution losses, Steam leakages, Steam trapping, Condensate and flash steam recovery system, Steam Engineering Practices; Steam Based Equipments / Systems.

Boiler Performance Assessment

Performance Test codes and procedure, Boiler Efficiency, Analysis of losses; performance evaluation of accessories; factors affecting boiler performance.

Energy Conservation and Waste Minimization

Energy conservation options in Boiler; waste minimization, methodology; economical viability of waste minimization

Instrumentation & Control : Process instrumentation; control and monitoring. Flow,pressure and temperature measuring and controlling instruments, its selection.

REFERENCES

1. T. D. Estop, A. McConkey, Applied Thermodynamics, Parson Publication
2. Domkundwar; A Course in Power Plant Engineering; Dhanapat Rai and Sons
3. Yunus A. Cengel and Boles, "Engineering Thermodynamics ",Tata McGraw-Hill Publishing Co. Ltd
4. Book II - Energy Efficiency in Thermal Utilities; Bureau of Energy Efficiency
5. Book IV - Energy Performance Assessment for Equipment & Utility Systems; Bureau of Energy Efficiency
6. Edited by J. B. Kitto & S C Stultz; Steam: Its Generation and Use; The Babcock and Wilcox Company
7. P. Chatopadhyay; Boiler Operation Engineering: Questions and Answes; Tata McGrawHill Education Pvt Ltd, N Delhi

COURSE OUTCOMES

Upon completion of the course, students will be able to

1. Explain the working of different boilers and significance of mountings and accessories.
2. Able to use techniques, skills, and modern engineering tools necessary for boiler performance assessment
3. Able to design and develop controls and instrumentation for effective monitoring of the process
4. Enhance their ability in steam piping design
5. Understand the significance of waste minimization and energy conservation

Mapping of COs with POs									
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**
CO1	✓			✓			✓		
CO2			✓	✓				✓	✓
CO3	✓	✓	✓		✓		✓		
CO4		✓		✓		✓			
CO5	✓				✓			✓	✓

METPCP26	**SOLAR AND HEAT TRANSFER LABORATORY**	**L**	**T**	**P**	**C**
		0	**0**	**3**	**2**

COURSE OBJECTIVES

- To make the students understand the modes of heat transfer and to conduct the trails on various experiments to analyze the heat transfer parameters.
- To understand the working of refrigeration trainer and air conditioners.
- To study the basics of solar energy.

List of Experiments

1.Natural convection from vertical cylinder
2.Experiments on finned tube heat exchanger
3.Experiments on unsteady state heat transfer apparatus.
4.Determination of thermal conductivity of metal rod.
5.Experiments on composite wall apparatus
6.Performance test on central A/C plant
7.Performance test on vapor absorption refrigeration system
8.Performance test on Solar still
9.Performance test on Solar concentrator test rig.
10.Performance test on Solar cooker.

COURSE OUTCOMES

Upon completing this course, students should be able to:

1. Understand the behavior of a system at different operating conditions
2. Understand the various modes of heat transfer
3. Understand the working of refrigeration systems
4. Understand the usage of different refrigeration tools.
5. Learn the basics of solar energy, how to determine solar intensity, and how to estimate daily and annual solar energy potential at each location.

Mapping of COs with POs									
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**
CO1	✓				✓	✓	✓		
CO2	✓				✓	✓	✓		
CO3	✓				✓	✓	✓		
CO4	✓				✓	✓	✓		
CO5	✓				✓	✓	✓		

✓

METPTS27	**INDUSTRIAL TRAINING AND SEMINAR / MINI PROJECT**	**L**	**T**	**P**	**C**
		0	**2**	**2**	**2**

COURSE OBJECTIVES:

- To train the students in the field work related the Mechanical Engineering and to have a practical knowledge in carrying out Structural field related works.
- To train and develop skills in solving problems during execution of certain works related to Mechanical Engineering.

The students individually undergo a training program in reputed concerns in the field of Mechanical Engineering during the summer vacation (at the end of second semester for full - time / * fourth semester for part - time) for a minimum stipulated period of four weeks. At the end of the training, the student has to submit a detailed report on the training he had. Within ten days from the commencement of the third semester for Full-time / fifth semester for part-time. The students will be evaluated by a team of staff members nominated by head of the department through a viva-voce examination.

* - *Four weeks during the summer vacation at the end of II Semester.*

COURSE OUTCOMES:

1. The students can face the challenges in the practice with confidence.
2. The student will be benefited by the training with managing the situation arises during the execution of works related to Mechanical Engineering.

Mapping of COs with POs									
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**
CO1	✓				✓	✓	✓		
CO2	✓				✓	✓	✓		

THIRD SEMESTER

METPPV33	PROJECT WORK & VIVA-VOCE PHASE-I	L	T	P	C
		0	16	4	10

COURSE OBJECTIVES

- To enhance the research and development activities of the students
- To enhance the writing skills

COURSE OUTCOMES

Upon completing this course, students should be able to:

1. Understand the significance of research
2. Gain hands on experience in collection of literature
3. Improve their presentation skills
4. Enhance their thesis writing skills
5. Apply the knowledge gained from theoretical and practical courses in solving problems, so as to give confidence to be creative, well planned, organized, coordinated in their project work phase – II.

Mapping of COs with POs									
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**
CO1	✓				✓	✓	✓		
CO2	✓				✓	✓	✓		
CO3	✓				✓	✓	✓		
CO4	✓				✓	✓	✓		
CO5	✓				✓	✓	✓		

✓

FOURTH SEMESTER

METPPV41	PROJECT WORK & VIVA-VOCE PHASE-II	L	T	P	C
		0	24	6	15

COURSE OBJECTIVES

- To improve the student research and development activities.
- To improve presentation and report preparation skills.

COURSE OUTCOMES

Upon completing this course, students should be able to:

1. Understand the significance of research
2. Gain hands on experience in collection of literature
3. Improve their presentation skills
4. Enhance their thesis writing skills
5. Apply the knowledge in solving problems, so as to give confidence to be creative, well planned, organized, coordinated project outcome of the aimed work.

Mapping of COs with POs									
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**
CO1	✓				✓	✓	✓		
CO2	✓				✓	✓	✓		
CO3	✓				✓	✓	✓		
CO4	✓				✓	✓	✓		
CO5	✓				✓	✓	✓		

✓

PROGRAM ELECTIVES

METPPESCN	NUCLEAR ENGINEERING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To learn the basics of nuclear engineering
- To know the reactor kinetics
- To prepare the students to exhibit a high level of professionalism, integrity, environmental and social responsibility, and life-long independent learning ability

Basics of nuclear fission and power from fission
Radioactivity, nuclear reactions, cross sections, nuclear fission, power from fission, conversion and breeding

Neutron transport and diffusion
Neutron transport equation, diffusion theory approximation, Fick's law, solutions to diffusion equation for point source, planar source, etc., energy loss in elastic collisions,neutron slowing down

Multigroup, multiregion diffusion equation, concept of criticality
Solution of multigroup diffusion equations in one region and multiregion reactors, concept of criticality of thermal reactors

Reactor kinetics and control
Derivation of point kinetics equations, inhour equation, solutions for simple cases of reactivity additions, fission product poison, reactivity coefficients

Heat removal from reactor core
Solution of heat transfer equation in reactor core, temperature distribution, critical heat flux

Reactor safety, radiation protection
Reactor safety philosophy, defence in depth, units of radioactivity exposure, radiation protection standards

REFERENCES:

1. Introduction to Nuclear Engineering (3rd Edition) by John R. Lamarsh, Anthony J.Barrata, Prentice Hall, (2001)
2. Introduction to Nuclear Reactor Theory, by John R. Lamarsh, Addison-Wesley, 1966)
3. Nuclear Reactor Analysis, by James J. Duderstadt and Lewis J. Hamilton, John Wiley(1976)

COURSE OUTCOMES:

At the end of the course, students will be able to

1. Understand the basic concepts and processes taking place inside a nuclear reactor.
2. Know the procedure for slowing down and absorption.
3. Familiar with concepts of reactor criticality, the relationship between the dimension and fissile material concentration in a critical geometry.
4. Familiar with transient behaviour of power reactor in non-steady state operation and the means to control the reactor.
5. Familiar with concepts of heat removal from reactor core, reactor safety and radiation protection.

Mapping of COs with POs									
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**
CO1	✓		✓						
CO2	✓			✓					✓
CO3	✓	✓						✓	
CO4	✓				✓	✓			
CO5	✓						✓		✓

✓

METPPESCN	**ENERGY CONSERVATION AND MANAGEMENT**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES:

- To understand the energy data from industries
- To carry out energy audit in machines for energy savings
- To learn the components of EB billing

Introduction to energy & power scenario of world, National Energy consumption data, environmental aspects associated with energy utilization; Energy Auditing- need, types, methodology and barriers, role of energy managers, instruments of energy auditing.

Components of EB billing, HT and LT supply, transformers, cable sizing; Concept of capacitors, power factor improvement, harmonics; Electric motors- motor efficiency computation, energy efficient motors; Illumination- Lux, Lumens, types of lighting, efficacy, LED lighting and scope of energy conservation in lighting.

Thermal systems, Boilers, Furnaces and Thermic Fluid heaters- efficiency computation and energy conservation measures; Steam distribution and usage, steam traps, condensate recovery, flash steam utilization; Insulation & Refractories.

Energy conservation in major utilities; pumps, fans, blowers, compressed air systems, Refrigeration& Air Conditioning systems, Cooling Towers, DG sets.

Energy Economics- discount period, payback period, internal rate of return, net present value; Life Cycle costing- ESCO concept.

REFERENCES

1. Witte L.C., Schmidt P.S. and Brown D.R., Industrial Energy Management and Utilization, Hemisphere Publ., Washington, 1988..
2. Callaghn P.W., Design and Management for Energy Conservation, Pergamon Press, Oxford, 1981.
3. Murphy W.R. and McKay G., Energy Management, Butterworths, London, 1987.
4. Energy Manager Training Manual, Bureau of Energy Efficiency (BEE) under Ministry of Power, GOI, 2004 (available at www.energymanager training.com).

COURSE OUTCOMES:

Upon completion of this course, the students will be able to

1. Perform energy auditing for the energy consumption in industries.
2. Know the different types of lightings
3. Understand the energy conservation measures
4. Understand the significance of energy conservation in major utilities
5. Learn the concept of energy economics

Mapping of COs with POs									
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**
CO1		✓		✓				✓	
CO2	✓					✓			✓
CO3			✓	✓					✓
CO4			✓	✓	✓				
CO5	✓			✓		✓		✓	✓

✓

METPPESCN	**AIR CONDITIONING SYSTEM DESIGN**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES

- To introduce the construction and design of air conditioning system
- To design seasonal energy efficient systems
- To understand the performance of air-conditioning system

Syllabus Contents:

Air conditioning systems

Various air-conditioning processes

Enthalpy deviation curve, psychrometry, SHF, dehumidified air quantity, human comfort, indoor air quality.

Design conditions and load calculations, air distribution, pressure drop, duct design, fans &, blowers.

Performance & selection, noise control.

REFERENCES:

1.ASHRAE Handbook.

2."Handbook of air-conditioning system design", Carrier Incorporation, McGraw Hill Book Co., U.S.A, 1965.

3."Refrigeration and air-conditioning", ARI, Prentice Hall, New Delhi, 1993.

4.Norman C. Harris, "Modern Air Conditioning", New York, McGraw-Hill,1974.

5.Jones W.P., "Air Conditioning Engineering", Edward Arnold Publishers Ltd., London, 1984.

6.Hainer R.W., "Control Systems for Heating, Ventilation and Air-Conditioning", Van Nostrand Reinhold Co., New York, 1984.

7. Arora C.P., "Refrigeration & Air Conditioning", Tata Mc Graw Hill, 1985.

8.Manohar Prasad, "Refrigeration & Air Conditioning", New Age Publishers.

9.Stoecker, "Refrigeration & Air Conditioning", Mc Graw Hill, 1992.

10.Stoecker, "Design of Thermal Systems", Mc Graw Hill, 1992.

COURSE OUTCOMES:

At the end of the course, students should be able to

1. Understand the construction and design features of Air-conditioning system.
2. Know the various air conditioning processes
3. Understand various types and its adoptability to various environment.
4. Understand the various health issues
5. Able to design seasonal energy efficient system

Mapping of COs with POs									
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**
CO1	✓			✓					✓
CO2	✓				✓			✓	
CO3		✓		✓	✓				
CO4			✓			✓	✓		
CO5		✓	✓						✓

✓

METPPESCN	**GAS TURBINES**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES

- To introduce the components and working of gas turbines
- To learn about gas cycles
- To learn the operation of jet propulsion

Syllabus Contents:

Introduction, Cycles, Performance characteristics and improvement

Gas dynamics, Centrifugal, axial and mixed flow compressor, principles and characteristics

Turbine construction, Blade materials, manufacturing techniques, blade fixing

Problems of high temperature operation, blade cooling, practical air cooled blades Combustion Systems, various fuels and fuel systems

Jet propulsion cycles and their analysis, parameters affecting performance, thrust augmentation, environmental considerations and applications.

REFERENCES:

1. H Cohen, GFC Rogers and HIH Saravanamuttoo, "Gas Turbine Theory", Pearson Education, 2000.
2. V. Ganesan, "Gas Turbines", Tata McGraw Hill, 2003.
3. S.M.Yahya "Turbines, Compressors and Fans", Tata McGraw Hill, 1992.
4. Vincent "The theory and design of Gas Turbine and Jet Engines", McGraw Hill, 1950.
5. W W Bathic, "Fundamentals of Gas Turbines", John Wiley and Sons.

COURSE OUTCOMES:

At the end of the course, students will be able to

1. Understand the construction and design features of gas turbines
2. Understand the thermodynamic cycles
3. Understand the different layouts of a gas turbine plant
4. Able to understand thermodynamics and fluid mechanics component for enhancing the efficiency and effectively of gas turbines
5. Learn the operation of jet propulsion

Mapping of COs with POs									
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**
CO1	✓								✓
CO2	✓		✓		✓				✓
CO3		✓			✓		✓		
CO4		✓		✓					✓
CO5	✓					✓			✓

✓

METPPESCN	**REFRIGERATION AND CRYOGENICS**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES:

- To learn the various types of refrigeration systems and refrigerants
- To analyze the performance of refrigerator
- To learn design procedure for various components of refrigeration system

Syllabus Contents:

Vapour compression refrigeration, actual cycle, second law efficiency,
Multistage compression with inter-cooling, Multi-evaporator systems, Cascade systems

Performance characteristics and capacity control of reciprocating and centrifugal compressors, screw compressor and scroll compressor

Design, selection of evaporators, condensers, control systems, motor selection

Refrigerants, alternative refrigerants, CFC/HCFC phase-out regulations,
Refrigeration applications, food preservation, transport

Introduction to Vapor absorption refrigeration, single effect and double effect systems, Gas liquefaction systems - Linde-Hampson, Linde dual pressure, Claude cycle.

REFERENCES:

1. R.J.Dossat, "Principles of Refrigeration", Pearson Education Asia, 2001.
2. C.P.Arora, "Refrigeration and Air-conditioning", Tata McGraw-Hill, 2000.
3. Stoecker & Jones, "Refrigeration and Air-conditioning", McGraw Hill Book Company,
4. New York, 1982.
5. Jordan & Priester, "Refrigeration and Air-conditioning".
6. A.R.Trott, "Refrigeration and Air-conditioning", Butterworths, 2000.
7. J.L.Threlkeld, "Thermal Environmental Engineering", Prentice Hall, 1970.
8. R.Barron, "Cryogenic systems", McGraw–Hill Company, New Yourk, 1985.
9. G.G.Hasseldon. "Cryogenic Fundamentals", Academic Press.
10. Bailey, "Advanced Cryogenics", Plenum Press, London, 1971.
11. W.F.Stoecker, "Industrial Refrigeration Handbook", McGraw-Hill, 1998.
12. John A.Corinchock, "Technician's Guide to Refrigeration systems", McGrawHill.
13. P.C.Koelet, "Industrial Refrigeration: Principles, Design and Applications", Macmillan,1992.
14. ASHRAE HANDBOOKS (i) Fundamentals (ii) Refrigeration.
15. Graham Walker, "Miniature Refrigerators for Cryogenic Sensors and Cold Electronics",Clarendon Press, 1989

COURSE OUTCOMES:

At the end of the course, students will demonstrate the ability to:

1. Learn the basics of refrigeration and cryogenics and its application area.
2. Design the refrigeration systems for domestic and industrial applications like cold storages
3. Learn the various refrigerants and their properties
4. Design heat exchangers
5. Learn about ODP, GWP and related environment issues.

Mapping of COs with POs									
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**
CO1	✓		✓	✓					
CO2		✓		✓	✓				
CO3			✓			✓			✓
CO4		✓	✓				✓	✓	✓
CO5	✓				✓				✓

✓

METPPESCN	**DESIGN OF HEAT EXCHANGERS**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES

- To design and analyze a heat exchanger
- To introduce the effect of fouling on the performance of heat exchanger
- To introduce different types of heat exchangers

Syllabus Contents:

Heat Exchangers – Classification according to transfer process, number of fluids, surface compactness, and construction features. Tubular heat exchanger, plate type heat exchangers, extended surface heat exchangers, heat pipe, Regenerators. Classification according to flow arrangement: counter flow, parallel flow, cross flow exchanger.

Heat exchanger design methodology, assumption for heat transfer analysis, problem formulation, e-NTU method, *P*-NTU method, Mean temperature difference method, fouling of heat exchanger, effects of fouling, categories of fouling, fundamental processes of fouling.

Double Pipe Heat Exchangers: Thermal and Hydraulic design of inner tube, Thermal and hydraulic analysis of Annulus, Total pressure drop

Compact Heat Exchangers: Thermal and Hydraulic design of compact heat exchanger-Shell and Tube heat exchangers – Tinker's, kern's, and Bell Delaware's methods, for thermal and hydraulic design of Shell and Tube heat exchangers

Mechanical Design of Heat Exchangers – design standards and codes, key terms in heat exchanger design, material selection, and thickness calculation for major components such as tube sheet, shell, tubes, flanges and nozzles. Introduction to simulation and optimization of heat exchangers, flow induced vibrations.

REFERENCES:

1. Ramesh K. Shah and Dusan P. Sekulic, "Fundamentals of Heat Exchanger Design" John Wiley & sons Inc., 2003.
2. D.C. Kern, "Process Heat Transfer", McGraw Hill, 1950.
3. Sadik Kakac and Hongton Liu, "Heat Exchangers: Selection, Rating and Thermal Design" CRC Press, 1998.
4. A .P. Frass and M.N. Ozisik, "Heat Exchanger Design", McGraw Hill, 1984
5. Afgan N. and Schlinder E.V. "Heat Exchanger Design and Theory Source Book".
6. T. Kuppan, "Hand Book of Heat Exchanger Design".
7. "T.E.M.A. Standard", New York, 1999.
8. G. Walkers, "Industrial Heat Exchangers-A Basic Guide", McGraw Hill, 1982.

COURSE OUTCOMES:

At the end of the course, students will be able to

1. Understand the need for the design of heat exchangers
2. Demonstrate a basic understanding of several types of heat exchangers
3. Explain the working of heat pipes
4. Design and analyses of shell-and-tube double pipe, compact, plate heat exchangers.
5. Demonstrate the performance degradation of heat exchangers subjected to fouling.

Mapping of COs with POs									
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**
CO1	✓		✓	✓	✓				
CO2	✓				✓			✓	✓
CO3	✓	✓				✓			
CO4	✓	✓				✓			
CO5		✓		✓				✓	

✓

METPPESCN	COMPUTATIONAL FLUID DYNAMICS	L	T	P	c
		3	0	0	3

COURSE OBJECTIVES

- To use CFD as a tool for solving heat transfer problems
- To understand the various governing equations in CFD
- To encourage students to take up further research

Syllabus Contents:

Introduction to CFD: Computational approach to Fluid Dynamics and its comparison with experimental and analytical methods, Basics of PDE: Elliptic, Parabolic and Hyperbolic Equations.

Governing Equations: Review of Navier-Stokes Equation and simplified forms, Solution Methodology: FDM and FVM with special emphasis on FVM, Stability, Convergence and Accuracy.

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

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

Methodology of CFDHT: Objectives and importance of CFDHT, CFDHT for Diffusion Equation, Convection Equation and Convection-Diffusion Equation

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

REFERENCES:

1. Computational Fluid Dynamics, The Basic with applications by John A. Anderson, Jr.,McGraw Hill International editions, Mechanical Engineering series.
2. Numerical Methods in Fluid Flow & Heat Transfer by Dr. Suhas Patankar.
3. An Introduction to Computational Fluid Flow (Finite Volume Method), by H.K. Versteeg, W.Malalasekera, Printice Hall
4. Computational Methods for Fluid Dynamics by Ferziger and Peric, Springer Publication.
5. An Introduction to Computational Fluid Mechanics by Chuen-Yen Chow, Wiley Publication.
6. Computational Fluid Flow & Heat Transfer by Murlidhar and Sundarrajan, Narosa Publication.

COURSE OUTCOMES:

At the end of the course students will be able to

1. Understand the concepts of Computational Fluid Dynamics
2. Know how to use CFD it as tool to solve the Heat Transfer and Fluid Mechanics related Industrial Problems.
3. Generate various types of meshes
4. Understand the methodology of CFDHT

5. Promote interest to carry out the Future Research.

Mapping of COs with POs									
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**
CO1	✓	✓							✓
CO2		✓	✓	✓					
CO3		✓	✓	✓					
CO4		✓	✓	✓					✓
CO5		✓			✓	✓		✓	

✓

METPPESCN	**MODELLING OF IC ENGINES**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES

- To understand the fundamentals of IC engines modelling
- To simulate diesel, petrol engine and gas engines
- To learn the thermodynamics of engines

Fundamentals: Governing equations, Equilibrium charts of combustion chemistry, chemical reaction rates, and approaches of modeling, model building and integration methods, gas exchange through valves, engine and porting geometry, exhaust gas recirculation, valve lift curves.

Thermodynamic Combustion Models of CI Engines: Single zone models, premixed and diffusive combustion models, combustion heat release using wiebe function, wall heat transfer correlations, ignition delay, internal energy estimations, two zone model, application of heat release analysis.

Fuel spray behavior: Fuel injection, spray structure, fuel atomization, droplet turbulence interactions, droplet impingement on walls.

Modeling of charging system: Constant pressure and pulse turbo charging, compressor and turbine maps, charge air cooler.

Mathematical models of SI Engines: Simulation of Otto cycle at full throttle, part throttle and supercharged conditions. Progressive combustion, Autoignition modeling, single zone models, mass burning rate estimation, SI Engine with stratified charge. Friction in pumping, piston assembly, bearings and valve train etc. friction estimation for warm and warm up engines.

REFERENCES:

1. Haywood, “I.C. Engines”, Mc Graw Hill.
2. Ramos J (1989) Internal Combustion Engine Modeling. Hemisphere Publishing Company
3. C. D. Rakopoulos and E. G. Giakoumis, “Diesel Engine Transient
4. Operation Principles of Operation and Simulation Analysis”, Springer, 2009.
5. V. Ganeshan, “Internal Combustion Engines”, Tata McGraw Hill, New Delhi, 1996.
6. P.A. Lakshminarayanan and Y. V. Aghav, “ Modelling Diesel Combustion” Springer, 2010
7. Bernard Challen and Rodica Baranescu, “Diesel Engine Reference Book” Butterworth-Heinemann, 1999.

COURSE OUTCOMES:

At the end of the course, students will be able to

1. Demonstrate a basic understanding of several types of engine models
2. Generate different types of IC engine models
3. Simulate the spray behavior of engine.
4. Demonstrate the performance evaluation and emission standards for the modeled engines
5. Estimate friction for warm and warm up engines

Mapping of COs with POs									
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**
CO1	✓								
CO2	✓								
CO3	✓								
CO4	✓								
CO5	✓								

✓

METPPESCN	**SOLAR ENERGY AND WIND ENERGY**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES:

- To understand and analyze the present and future energy demand of world and nation
- To learn the techniques to exploit the available renewable energy resources such as solar, bio-fuels, wind power, tidal and geothermal effectively
- To introduce renewable energy simulation

Solar Radiation

Availability - Measurement and Estimation - Isotropic and an Isotropic Models - Introduction to Solar Collectors (Liquid Flat - Plate Collector, Air Heater and Concentrating Collector) and Thermal Storage - Steady State and Transient Analysis - Solar Pond - Solar Refrigeration.

Modeling of Solar Thermal Systems and Simulations in Process Design

Design of Active Systems by f-chart and Utilizability Methods - Water Heating Systems - Active and Passive - Passive Heating and Cooling of Buildings - Solar Distillation - Solar Drying.

Photovoltaic Solar Cell

P-N Junction - Metal - Schottky Junction, Electrolyte - Semiconductor Junction, Types of Solar Cells - their Applications - Experimental Techniques to determine the Characteristics of Solar Cells - Photovoltaic Hybrid Systems Photovoltaic Thermal Systems - Storage Battery - Solar Array and their Characteristics Evaluation - Solar Chargeable Battery.

Wind Energy

Structure - Statistics - Measurements and Data Presentation - Wind Turbine Aerodynamics - Momentum Theories - Basic Aerodynamics - Airfoils and their Characteristics - HAWT-Blade Element Theory - Prandtl's Lifting Line Theory (prescribed wake analysis) - VAWT Aerodynamics - Wind Turbine Loads - Aerodynamic Loads in Steady Operation - Wind Turbulence - Yawed Operation and Tower Shadow.

Wind Energy Conversion System (WECS)

Siting - Rotor Selection - Annual Energy Output - Horizontal Axis Wind Turbine (HAWT) - Vertical Axis Wind Turbine (VAWT) - Rotor Design Considerations - Number of Blades - Blade Profile - 2/3 Blades and Teetering - Coning - Upwind/Downwind - Power Regulation - Yaw System - Tower - Synchronous and Asynchronous Generators and Loads - Integration of Wind Energy Converters to Electrical Networks - Inverters - Testing of WECS - WECS Control System - Requirements and Strategies - Miscellaneous Topics - Noise etc - Other Applications.

REFERENCES

1. L.L.Freris, Wind Energy Conversion Systems, Prentice Hall, 1990.
2. D.A.Spera, Wind Turbine Technology: Fundanental concepts of Wind Turbine Engineering, ASME Press (1994).
3. S.P.Sukhatme-Solar Energy: principles of Thermal Collection and Storage, Tata McGraw-Hill (1984).
4. J.A.Duffie and W.A.Beckman-Solar Engineering of Thermal Processes-John Wiley (1991).
5. J.F.Kreider and F.Kreith-Solar Energy Handbook McGraw-Hill (1981).
6. htTP ://www.ises.ors
7. htTP :/www.windpower-monthly.com
8. www.solarpv.com

COURSE OUTCOMES

Upon completion of the course, the students will be able to

1. Know about the exploration of nonconventional energy resources and their effective tapping technologies.
2. Model solar thermal system
3. Determine the characteristics of solar thermal system
4. Understand wind turbine aerodynamics
5. Demonstrate the working of wind energy conversion system.

Mapping of COs with POs									
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**
CO1	✓		✓			✓			
CO2		✓	✓	✓					
CO3		✓			✓	✓			
CO4	✓		✓				✓	✓	
CO5		✓			✓	✓			✓

✓

METPPESCN	ADVANCED MATHEMATICAL METHODS IN ENGINEERING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To impart knowledge on mathematical methods that will come in handy to solve numerical problems that arise in engineering and technology.
- To apply discrete and continuous distributions in engineering problems
- To learn the principles of design of experiments

Syllabus Contents:

Ordinary Differential Equations: First-order equations (Linear, Equidimensional, Separable Exact, Homogeneous,); Second-order linear differential equations (homegeneous and nonhomogeneous); Solution methods such as undertermined coefficients and variation o parameters.

Partial Differential Equations: First order partial differential equations; Second order linea partial differential equations; Canonical forms; Fourier series, Second order equation (Parabolic, Elliptic and Hyperbolic) in rectangular, cylindrical polar and spherical coordinate systems; Solution techniques such as separation of variables, eigen function expansions, integral transforms (Fourier and Laplace transforms); D'Alembert's solution for the Wave equation; Maximum principle for Elliptic equations; Variational methods for approximate solutions of differential equations.

Standard discrete and continuous distributions like Binomial, Poisson, Normal, Exponential etc. Central Limit Theorem and its significance. Some sampling distributions like c2, t, F.

ANOVA: One – way, Two–way with/without interactions, Latin Squares ANOVA technique, Principles of Design of Experiments, some standard designs such as CRD, RBD, LSD.

Some of the relevant topics required for ANOVA (sample estimates and test hypothesis) may also be included.

REFERENCES:

1. J.B. Doshi, “Differential Equations for Scientists and Engineers”, Narosa, 2010.
2. Peter O'Neil, “Advanced Engineering Mathematics”, Seventh Edition, Cengage Learning, 2012 (Indian Edition).
3. Michael Greenberg, “Advanced Engineering Mathematics”, Second Edition, Pearson Education, 2002 (Indian Edition).
4. Jennings. A., Matrix Computation for Engineers and Scientists. John Wiley and Sons, 1992.
5. Prem.K.Kythe, Pratap Puri, Michael R.Schaferkotter, Introduction to Partial Differential Equations and Boundary Value problems with Mathematics, CRC Press, 2002.
6. Kreyszig, Erwin, I.S., Advanced Engineering Mathematics, Wiley, 1999.
7. Ramamurthy. V., Computer Aided Design in Mechanical Engineering., Tata McGraw Hill Publishing Co., 1987
8. Fundamental Concepts in the Design of Experiments, 5th Ed., by Hicks and Turner
9. Devore, Jay L., Probability and Statistics for Engineering and the Sciences, 5th edition, Brooks- Cole (1999)

COURSE OUTCOMES:

At the end of the course, students will demonstrate the ability to:

1. Analyze and develop mathematical model for the thermal system.
2. Analyze the reliability and maintainability of the series and parallel thermal system.
3. Solve differential equations using numerical techniques.
4. Perform experimental design
5. Motivate himself for a lifelong learning

Mapping of COs with POs									
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**
CO1	✓		✓	✓					
CO2			✓			✓			✓
CO3	✓	✓	✓						✓
CO4		✓		✓		✓		✓	
CO5	✓				✓		✓		✓

✓

OPEN ELECTIVES

METPOESCN	INDUSTRIAL SAFETY	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To learn the significance of industrial safety
- To learn the importance of maintenance
- To learn the need for wear and corrosion prevention

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

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.

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

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

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

REFERENCES:

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

COURSE OUTCOMES

Upon completion of the course, students will be able to

1. Know the significance of industrial safety
2. Learn the fundamentals of maintenance
3. Able to trace the fault in machines

4. Learn about wear and corrosion
5. Understand the significance of periodic maintenance

METPOESCN	WASTE TO ENERGY	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To learn the various resources from waste
- To introduce bio mass processing
- To study the properties of biogas

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

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

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.

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

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.

REFERENCES:

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

COURSE OUTCOMES

Upon completion of the course, students will be able to

1. Understand the energy potential from waste
2. Learn the various resources from waste
3. Implement bio mass processing techniques
4. Learn the properties of biogas
5. Attempt energy generation from waste

METPOESCN	NUCLEAR ENGINEERING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To learn the basics of nuclear engineering
- To know the reactor kinetics
- To prepare the students to exhibit a high level of professionalism, integrity, environmental and social responsibility, and life-long independent learning ability

Basics of nuclear fission and power from fission
Radioactivity, nuclear reactions, cross sections, nuclear fission, power from fission, conversion and breeding

Neutron transport and diffusion
Neutron transport equation, diffusion theory approximation, Fick's law, solutions to diffusion equation for point source, planar source, etc., energy loss in elastic collisions,neutron slowing down

Multigroup, multiregion diffusion equation, concept of criticality
Solution of multigroup diffusion equations in one region and multiregion reactors, concept of criticality of thermal reactors

Reactor kinetics and control
Derivation of point kinetics equations, inhour equation, solutions for simple cases of reactivity additions, fission product poison, reactivity coefficients

Heat removal from reactor core
Solution of heat transfer equation in reactor core, temperature distribution, critical heat flux
Reactor safety, radiation protection
Reactor safety philosophy, defence in depth, units of radioactivity exposure, radiation protection standards

REFERENCES:

1. Introduction to Nuclear Engineering (3rd Edition) by John R. Lamarsh, Anthony J.Barrata, Prentice Hall, (2001)
2. Introduction to Nuclear Reactor Theory, by John R. Lamarsh, Addison-Wesley, 1966)
3. Nuclear Reactor Analysis, by James J. Duderstadt and Lewis J. Hamilton, John Wiley(1976)

COURSE OUTCOMES:

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

1. Understand the basic concepts and processes taking place inside a nuclear reactor
2. Know the concepts of nuclear fission, neutron production, scattering, diffusion, slowing down and absorption.
3. Familiar with concepts of reactor criticality, the relationship between the dimension and fissile material concentration in a critical geometry.
4. Familiar with time dependent (transient) behaviour of power reactor in non-steady state operation and the means to control the reactor.

5. Familiar with concepts of heat removal from reactor core, reactor safety and radiation protection.

METPOESCN	FUELS AND COMBUSTION	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To learn different type of conventional and non conventional fuel with their properties, methods to analysis of fuel, Energy conversion techniques in detail.
- To learn the combustion process of conventional and non conventional fuels, able to calculate the necessary air requirement for combustion process.
- To acquire knowledge in the areas of ignition, Flame study and details of burners to develop combustion process.

Introduction

General, Conventional Energy Sources, Solar Energy, Nuclear Power, Energy from Biomass, Wind Power, Tidal Power, Geothermal Energy, Energy Survey of India, Rocket Fuels,

Solid & Liquid Fuels

General, Family of Coal, Origin of Coal, Gasification of Coal, Analysis and Properties of Coal, Classification of Coal, Oxidation of Coal, Hydrogenation of Coal, Efficient use of Solid Fuel. Renewable Solid (biomass) Fuel, Solid Fuel Handling and Storage. Origin and Classification of Petroleum, Refining and Other Conversion Processes, Composition of Petroleum with respect to Combustion, Property & Testing of Petroleum Products, Various Petroleum Products, Liquid Fuels from Other Sources, Storage and Handling of Liquid Fuels, Liquid Fuels Combustion Equipment

Gaseous Fuels

Types of Gaseous Fuels, Natural Gases, Methane from Coal Mines, Manufactured Gases, Producer Gas, Water Gas, Carburetted Water Gas, Blast Furnace Gas, Biogas, Refinery Gas, LPG, Cleaning and Purification of Gaseous Fuels.

Theory of Combustion Process and Stoichiometry

Combustion Thermodynamics, Stoichiometry Relations, Rapid Methods of Combustion Stoichiometry, Theoretical Air Required for Complete Combustion, Mass Basis and Volume Basis Calculation of Minimum Amount of Air Required for a Fuel of known Composition, Calculation of Dry Flue Gases if Fuel Composition is Known, Calculation of the Composition of Fuel, Excess Air Supplied and Amount of Exhaust gases.

Burner Design

Ignition, Concept of Ignition, Auto Ignition, Ignition Temperature, Flame, Flame Propagation, Flame Front, Various Methods of Flame Stabilization, Concepts of Burner, Basic Features and Types of Solid, Liquid and Gaseous Fuel Burners - Different Types of Coal - Oil and Gas Burners, Recuperative & Regenerative Burners.

REFERENCES

1. Samir Sarkar, Fuels & Combustion, 2nd Edition, Orient Longman, 1990
2. Bhatt ,vora Stoichiometry, 2nd Edition, Tata Mcgraw Hill, 1984
3. Blokh AG, Heat Transfer in Steam Boiler Furnace, Hemisphere Publishing Corpn, 1988

4. Civil Davies, Calculations in Furnace Technology, Pergamon Press, Oxford, 1966
5. Sharma SP, Mohan Chander, Fuels & Combustion, Tata Mcgraw Hill, 1984 EIA

COURSE OUTCOMES

Upon completion of the course, students will be able to

1. Evaluate the properties of conventional and non conventional fuel, and to describe, compare, cost and availability.
2. Learn the various advantages and disadvantages of each fuel.
3. Understand the complete combustion process of each fuel,
4. Able to calculate the stoichiometry, theoretical and actual air requirement for the combustion process.
5. Understand the concepts of ignition characteristics, Flame, Flame propagation and Flame front in detail.

METPOESCN	ENERGY MANAGEMENT IN BUILDINGS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To learn the green buildings concepts applicable to modern buildings.
- Acquaint students with the principle theories materials, construction techniques and to create energy efficient buildings.
- To learn the methodology of heat transmission in buildings

Introduction

Conventional versus Energy Efficient buildings – Historical perspective - Water – Energy – IAQ requirement analysis – Future building design aspects – Criticality of resources and needs of modern living

Landscape and Building Envelopes

Energy efficient Landscape design - Micro-climates – various methods – Shading, water bodies- Building envelope: Building materials, Envelope heat loss and heat gain and its evaluation, paints, Insulation, Design methods and tools.

Heat Transmission in Buildings

Surface co-efficient- air cavity, internal and external surfaces, overall thermal transmittance, wall and windows; Heat transfer due to ventilation/infiltration, internal heat transfer; Solar temperature; Decrement factor; Phase lag. Design of daylighting; Estimation of building loads: Steady state method, network method, numerical method, correlations; Computer packages for carrying out thermal design of buildings and predicting performance.

Passive Cooling

Passive cooling concepts- Evaporative cooling, radiative cooling; Application of wind, water and earth for cooling; Shading, paints and cavity walls for cooling; Roof radiation traps; Earth airtunnel. Hybrid methods.

Renewable Energy in Buildings

Introduction of renewable sources in buildings, Solar water heating, small wind turbines, stand-alone PV systems, Hybrid system – Economics.

REFERENCES

1. Krieder, J and Rabi, A., Heating and Cooling of buildings : Design for Efficiency, Mc Graw Hill, 1994.
2. Ursala Eicker, "Solar Technologies for buildings", Wiley publications, 2003.
3. Guide book for National Certification Examination for Energy Managers and Energy Auditors
4. Smith, CB Energy Management Principles, Pergamon Press, NewYork, 1981.

COURSE OUTCOMES

Upon completion of the course, the student will be able to

1. Learn the critical resources required for a modern living
2. Perform energy audit in any type for buildings and suggest the conservation measures.
3. Implement passive cooling techniques in buildings
4. Provide the renewable energy systems for the buildings
5. Enhance their standard of living

METPOESCN	BIO ENERGY CONVERSION	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To pursue the various technologies for utilizing the bio-energy and its availability and conversion of bio-energy in the useful forms.
- Analyze elaborately the technologies available for conversion of biomass to energy in the technical update.
- Analyze the bio-energy conversion with respect to economical aspect and also in the environmental aspect.

Introduction of Biomass

Availability merits and demerits-Indian scenario-conversion mechanism- utilization of photo synthesis comparison with other energy.

Thermal Biomass Conversion

Combustion, pyrolysis, Gasification and Liquefaction-Biological Conversion-Methanol, Ethanol Production -Fermentation-Anaerobic Digestion Biodegradation and Biodegradability of Substrate.

Combustion

Perfect, complete and incomplete combustion-stoichiometric air requirement for biofuels -equivalence ratio-fixed bed and fluid Bed combustion-fuel and ash handling systems-steam cost comparison with conventional fuels.

Power Generation Techniques

Through Fermentation and Gasification-Biomass Production from different Organic Wastes-Effect of Additives on Biogas Yield-Biogas production from Dry Dung Cakes-Industrial Application-Viability of Energy Production-Wood Gasifier System, Operation of Spark Ignition and Compression Ignition with Wood Gas Operation and Wood Gas Operation and Maintenance.

Economics and Environmental Aspects

Energy Effectives and Cost Effectiveness-History of Energy Consumption and Cost – Environmental Aspects of Bio-energy Conversion.

REFERENCES

1. David Boyles, Bio Energy Technologies Thermodynamics and Costs, Ellis Hoknood,Chichester,1984.
2. Khandelwal KC, Mahdi SS, Biogas Technology-A Practical Handbook, Tata McGraw Hil,1986.
3. R.C. Maheswari, Bio Energy for Rural Energisation ,Concept Publication,1987.
4. Anthony San Pietro, Biochemical and Photosynthetic aspects of Energy Production, Academic Press, New York,1980.
5. EL-Halwagi MM, Biogas Technology: Transfer & Diffusion, Elsevier Applied SC, London 1986.
6. Tom B Reed ,Biomass Gasification-Principles and Technology, Noyce Data Corporation,1981.
7. Iyer PVR et al, Thermochemical Characterization of Biomass, M N E S.

COURSE OUTCOMES

Upon completion of the course, the students will be able to

1. Gain vast idea of the various form of biomass availability in the earth.
2. Get complete understanding of the various biomass energy conversion technologies,
3. Understand the importance of bio mass
4. Learn the chemistry behind the combustion process.
5. Learn the economical and environmental aspects of biomass energy conversion

METPOESCN	ADVANCED POWER PLANT ENGINEERING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To understand and analyze the present and future energy demand of world and nation and techniques to exploit the available renewable energy resources such as, solar, bio-fuels, wind power, tidal and geothermal effectively

Direct Energy Conversion

Principles and operation of MHD – Design length of channel – Hall effect – Types of MHD generators – Applications of MHD – Principles of EHD and operation – Fuel cells – Principles of Hydrogen – Oxygen fuel cell – Hydro-carbon fuel cells – Redox fuel cell – Lithium Hydrogen fuel cells.

Power Plants

Design of coal bunkers – Co-generation – combined gas and steam power plants – Advantages of Combined cycles – Binary Vapour cycles.

Solar Energy

Storage – Stratified storage – Well mixed storage – Comparison – Solar ponds – types – Description of Non-Convective solar pond – Extraction of Thermal energy – Application of solar pond. Solar Electric Power Generation – Tower concept – Photovoltaic cells – Design of swimming pool heaters & Power generation systems – Utilisation of bio-mass – Combustion – Pyrolysis- Gasification – Design of Gasifier – Heat and power generation applying bio-mass.

Other Non-Conventional Energy Systems

Geo-thermal energy – Different types of geothermal energy systems – Economic justification – OTEC power plants – Types & working principle.

Tidal Power Plants

Types – Working principle – Advantages & Disadvantages – Bio-gas generation and uses. Wind energy – Different types of wind power plants – problems on wind turbines – Advantages and disadvantages.

REFERENCES

1. Soo S.L., Direct Energy Conversion, 1965.
2. Rai G.D., Solar Energy Utilisation, Khanna Publishers, New Delhi, 1998.
3. Suhatme S.P., Solar Energy – Principles of Thermal Collection & Storage, Tata McGraw Hill
4. Elwakil M, Power Plant Technology, McGraw Hill, New York, 1964.
5. Archie W. Culp. Jr., Principles of Energy Conversion, McGraw Hill, 1968.
6. Kreider J.M. and Krieth J.F., Principles of Solar Engineering, McGraw Hill, New York, 1972.
7. Peter J.Lunde, Solar Thermal Engineering, John Wiley & Sons, New York, 1978.

COURSE OUTCOMES

Upon the completion of the course, the students will be able to

1. Acquire fundamental knowledge in energy generation, heat transfer and to utilization
2. Gain basic knowledge in renewable energy conversion technology
3. Learn the various cycles employed in power plants
4. Ability to use modern engineering tools, software and equipment to analyze and solve complex engineering problems.
5. Solve real world problems and reduce the impact global warming for betterment of living things to serve healthy life.

AUDIT COURSES

METPACSCN	ENGLISH FOR RESEARCH PAPER WRITING	L	T	P	C
		2	0	0	0

COURSE OBJECTIVES

Students will be able to:

- Understand that how to improve your writing skills and level of readability
- Learn about what to write in each section
- Understand the skills needed when writing a title
- Ensure the good quality of paper at very first-time submission

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

Clarifying Who Did What, Highlighting Your Findings, Hedging and Criticising, Paraphrasing and Plagiarism, Sections of a Paper, Abstracts. Introduction

Review of the Literature, Methods, Results, Discussion, Conclusions, The Final Check.

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

Kkills are needed when writing the Methods, skills needed when writing the Results, skills are needed when writing the Discussion, skills are needed when writing the Conclusions

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

REFERENCES

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

METPACSCN	DISASTER MANAGEMENT	L	T	P	C
		2	0	0	0

COURSE OBJECTIVES

Students will be able to:

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

Introduction Disaster: Definition, Factors And Significance; Difference Between Hazard And Disaster; Natural And Manmade Disasters: Difference, Nature, Types And Magnitude.

Repercussions of Disasters And Hazards: Economic Damage, Loss of Human And Animal Life, Destruction Of Ecosystem. Natural Disasters: Earthquakes, Volcanisms, Cyclones, Tsunamis, Floods, Droughts And Famines, Landslides And Avalanches, Man-made disaster:
Nuclear Reactor Meltdown, Industrial Accidents, Oil Slicks And Spills, Outbreaks of Disease And Epidemics, War And Conflicts.

Disaster Prone Areas In India: Study Of Seismic Zones; Areas Prone To Floods And Droughts, Landslides And Avalanches; Areas Prone To Cyclonic And Coastal Hazards With Special Reference To Tsunami; Post-Disaster Diseases And Epidemics

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

Risk Assessment: Disaster Risk: Concept And Elements, Disaster Risk Reduction, Global and National Disaster Risk Situation. Techniques of Risk Assessment, Global Co-Operation In Risk Assessment And Warning, People's Participation in Risk Assessment. Strategies for Survival.

Disaster Mitigation: Meaning, Concept And Strategies Of Disaster Mitigation, Emerging Trends In Mitigation. Structural Mitigation And Non-Structural Mitigation, Programs Of
Disaster Mitigation in India.

REFERENCES

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

METPACSCN	SANSKRIT FOR TECHNICAL KNOWLEDGE	L	T	P	C
		2	0	0	0

COURSE OBJECTIVES

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

Alphabets in Sanskrit, Past/Present/Future Tense, Simple Sentences, Order, Introduction of roots, Technical information about Sanskrit Literature, Technical concepts of Engineering - Electrical, Mechanical, Architecture, Mathematics

REFERENCES

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

COURSE OUTCOMES

Upon successful completion of the course, the students are able to:

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

METPACSCN	VALUE EDUCATION	L	T	P	C
		2	0	0	0

COURSE OBJECTIVES

Students will be able to

- Understand value of education and self- development
- Imbibe good values in students
- Let the should know about the importance of character

Values and self-development –Social values and individual attitudes. Work ethics, Indian vision of humanism. Moral and non- moral valuation. Standards and principles. Value judgements

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

Personality and Behavior Development - Soul and Scientific attitude. Positive Thinking. Integrity and discipline. Punctuality, Love and Kindness. Avoid fault Thinking. Free from anger, Dignity of labour. Universal brotherhood and religious tolerance. True friendship. Happiness Vs suffering, love for truth. Aware of self-destructive habits. Association and Cooperation. Doing best for saving nature

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

REFERENCES

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

COURSE OUTCOMES

Upon successful completion of the course, the students are able to:

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

METPACSCN	CONSTITUTION OF INDIA	L	T	P	C
		2	0	0	0

COURSE OBJECTIVES

Students will be able to:

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

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

Philosophy of the Indian Constitution: Preamble Salient Features

Contours of Constitutional Rights & 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.

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

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

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.

REFERENCES

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

COURSE OUTCOMES

Upon successful completion of the course, the students are able to:

1. Discuss the growth of the demand for civil rights in India for the bulk of Indians before the arrival of Gandhi in Indian politics.
2. Discuss the intellectual origins of the framework of argument that informed the conceptualization of social reforms leading to revolution in India.

3. Discuss the circumstances surrounding the foundation of the Congress Socialist Party [CSP]under the leadership of Jawaharlal Nehru and the eventual failure of the proposal of direct elections through adult suffrage in the Indian Constitution.
4. Discuss the passage of the Hindu Code Bill of 1956.

METPACSCN	PEDAGOGY STUDIES	L	T	P	C
		2	0	0	0

COURSE OBJECTIVES

Students will be able to:

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

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.

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

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 materials 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.

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

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

REFERENCES

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

COURSE OUTCOMES

Upon successful completion of the course, the students are able to:

1. What pedagogical practices are being used by teachers in formal and informal classrooms in developing countries?
2. What is the evidence on the effectiveness of these pedagogical practices, in what conditions, and with what population of learners?
3. How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy?

METPACSCN	STRESS MANAGEMENT BY YOGA	L	T	P	C
		2	0	0	0

COURSE OBJECTIVES

- To achieve overall health of body and mind
- To overcome stress

Definitions of Eight parts of yog. (Ashtanga) Yam and Niyam.
Do`s and Don't's in life.

(i) Ahinsa, satya, astheya, bramhacharya and aparigraha
(ii) Shaucha, santosh, tapa, swadhyay, ishwarpranidhan

Asan and Pranayam

(i) Various yog poses and their benefits for mind & body
(ii) Regularization of breathing techniques and its effects-Types of pranayama

REFERENCES

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

COURSE OUTCOMES

Upon successful completion of the course, the students are able to:

1. Develop healthy mind in a healthy body thus improving social health also
2. Improve efficiency

METPACSCN	PERSONALITY DEVELOPMENT THROUGH LIFE ENLIGHTENMENT SKILLS	L	T	P	C
		2	0	0	0

COURSE OBJECTIVES

- To learn to achieve the highest goal happily
- To become a person with stable mind, pleasing personality and determination
- To awaken wisdom in students

Neetisatakam-Holistic development of personality

- Verses- 19,20,21,22 (wisdom)
- Verses- 29,31,32 (pride & heroism)
- Verses- 26,28,63,65 (virtue)
- Verses- 52,53,59 (dont's)
- Verses- 71,73,75,78 (do's)

Approach to day to day work and duties.
Shrimad Bhagwad 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.

Statements of basic knowledge.
Shrimad Bhagwad Geeta:

- Chapter2-Verses 56, 62, 68
- Chapter 12 -Verses 13, 14, 15, 16,17, 18

Personality of Role model.
Shrimad Bhagwad Geeta:

- Chapter2-Verses 17,
- Chapter 3-Verses 36,37,42,
- Chapter 4-Verses 18, 38,39
- Chapter18 – Verses 37,38,63

REFERENCES

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

COURSE OUTCOMES

Upon successful completion of the course, the students are able to:

1. Study of Shrimad-Bhagwad-Geeta will help the student in developing his personality and achieve the highest goal in life
2. The person who has studied Geeta will lead the nation and mankind to peace and prosperity
3. Study of Neetishatakam will help in developing versatile personality of students.