SARVEPALLI RADHAKRISHNAN UNIVERSITY, BHOPAL

SCHEME OF EXAMINATION AS PER AICTE MODEL CURRICULUM w.e.f. JULY 2020

GRADING SYSTEM (FOR STUDENTS ADMITTED IN JULY 2020 ONWARDS)

Master of Technology (THERMAL ENGG.)

I Semester/ I Year

S.No.	Subject Code	Category	Name of Subject	MAXIMUM MARKS ALLOTED					Total Marks	Contact Hours per week			Total Credits
				Theory Slot			Practical Slot						
				End Sem	Mid Sem Test (Two Test Avg.)	Quiz & Assig.	End Sem	Term Work		L	T	P	
1	MTTHE 11	CORE	RESEARCH METHODOLOGY & IPR	100	30	30	-	-	160	3	1	0	4
2	MTTHE 12	CORE	HEAT & MASS TRANSFER	100	30	30	50	50	260	3	1	4	6
3	MTTHE 13	CORE	ADVANCE FLUID MECHANICS	100	30	30	50	50	260	3	1	4	6
4	MTTHE 14	MEPE	ELECTIVE -I	100	30	30	-	-	160	3	1	0	4
5	MTTHE 15	MEPE	ELECTIVE -II	100	30	30	-	-	160	3	1	0	4
6	MTTHE 16	AUDIT	AUDIT-I *	-	-	-	-	-	-	2	0	0	0
TOTAL				**500**	**150**	**150**	**100**	**100**	**1000**	**17**	**5**	**8**	**24**
L: LECTURE P: PRACTICAL T: TUTORIAL													

ELECTIVE-I

MTTHE 14 (A)	NUCLEAR ENGINEERING
MTTHE 14 (B)	ENERGY CONSERVATION & MANAGEMENT
MTTH E14 (C)	GAS FLOW THROUGH TURBO MACHINES

ELECTIVE-II

MTTHE 15 (A)	STEAM & GAS TURBINE
MTTH E15 (B)	AIR CONDITIONING SYSTEM DESIGN
MTTH E15 (C)	PUMP BLOWERS AND COMPRESSOR

*AUDIT COURSE-I : ENGLISH FOR RESEARCH PAPER WRITING

SARVEPALLI RADHAKRISHNAN UNIVERSITY, BHOPAL

SCHEME OF EXAMINATION AS PER AICTE MODEL CURRICULUM w.e.f. JULY 2020

GRADING SYSTEM (FOR STUDENTS ADMITTED IN JULY 2020 ONWARDS)

Master of Technology (THERMAL ENGG.)

II Semester/ I Year

S.No.	Subject Code	Category	Name of Subject	MAXIMUM MARKS ALLOTED					Total Marks	Contact Hours per week			Total Credits
				Theory Slot			Practical Slot						
				End Sem	Mid Sem Test (Two Test Avg.)	Quiz & Assig.	End Sem	Term Work		L	T	P	
1	MTTHE 21	CORE	MINI PROJECT	-	-	-	100	60	160	0	0	4	2
2	MTTHE 22	CORE	REFRIGERATION & CRYOGENICS	100	30	30	50	50	260	4	1	2	6
3	MTTHE 23	CORE	I.C. ENGINE AND ALTERNATE FUELS	100	30	30	50	50	260	4	1	2	6
4	MTTHE 24	MEPE	ELECTIVE -III	100	30	30	-	-	160	4	1	0	5
5	MTTHE 25	MEPE	ELECTIVE -IV	100	30	30	-	-	160	4	1	0	5
6	MTTHE 26	AUDIT	AUDIT-II **	-	-	-	-	-	-	2	0	0	0
TOTAL				**400**	**120**	**120**	**200**	**160**	**1000**	**18**	**4**	**8**	**24**

L: LECTURE P: PRACTICAL T: TUTORIAL

ELECTIVE-III

MTTHE 24 (A)	DESIGN OF HEAT EXCHANGER
MTTHE 24 (B)	MAINTENANCE OF THERMAL POWER PLANT
MTTHE 24 (C)	TOTAL QUALITY MANAGEMENT

ELECTIVE-IV

MTTHE 25 (A)	COMPUTATIONAL FLUID DYNAMICS
MTTH E25 (B)	MODELLING OF I.C.ENGINE
MTTHE 25 (C)	OPERATION RESEARCH

****AUDIT COURSE-II : CONSTITUTION OF INDIA**

SARVEPALLI RADHAKRISHNAN UNIVERSITY, BHOPAL

SCHEME OF EXAMINATION AS PER AICTE MODEL CURRICULUM w.e.f. JULY 2020

GRADING SYSTEM (FOR STUDENTS ADMITTED IN JULY 2020 ONWARDS)

Master of Technology (THERMAL ENGG.)

III Semester/ II Year

S.No.	Subject Code	Category	Name of Subject	MAXIMUM MARKS ALLOTED					Total Marks	Contact Hours per week			Total Credits
				Theory Slot			Practical Slot						
				End Sem	Mid Sem Test (Two Test Avg.)	Quiz & Assig.	End Sem	Term Work		L	T	P	
1	MTTHE 31	MEPE	ELECTIVE- V	100	30	30	-	-	160	4	1	-	5
2	MTTHE 32	MEOE	OPEN ELECTIVE	100	30	30	-	-	160	4	1	-	5
3	MTTHE 33	DIST	DISSERTATION -I	-	-	-	400	280	680	0	0	20	10
TOTAL				**200**	**60**	**60**	**400**	**280**	**1000**	**8**	**2**	**20**	**20**

L: LECTURE P: PRACTICAL T: TUTORIAL

ELECTIVE-V

MTTHE 31 (A)	NON CONVETIONALENERGY SOURCES
MTTHE 31 (B)	ADVANCE MATHEMATICAL METHODS IN ENGG.
MTTHE 31 (C)	DESIGN OF SOLAR AND WIND SYSTEM

OPEN ELECTIVE

MTTH E32 (A)	COMPOSITE MATERIAL
MTTH E32 (B)	INDUSTRIAL SAFETY
MTTHE 32 (C)	WASTE TO ENERGY

SARVEPALLI RADHAKRISHNAN UNIVERSITY, BHOPAL

SCHEME OF EXAMINATION AS PER AICTE MODEL CURRICULUM w.e.f. JULY 2020

GRADING SYSTEM (FOR STUDENTS ADMITTED IN JULY 2020 ONWARDS)

Master of Technology (THERMAL ENGG.)

IV Semester/ II Year

S.No.	Subject Code	Category	Name of Subject	MAXIMUM MARKS ALLOTED					Total Marks	Contact Hours per week			Total Credits
				Theory Slot			Practical Slot						
				End Sem	Mid Sem Test (Two Test Avg.)	Quiz & Assig.	End Sem	Term Work		L	T	P	
1	MTTHE 41	DIST	DISSERTATION -II	-	-	-	500	500	1000	0	0	30	15
TOTAL				**-**	**-**	**-**	**500**	**500**	**1000**	**0**	**0**	**30**	**15**

L: LECTURE P: PRACTICAL T: TUTORIAL

Ist -SEMESTER

CATEGORY -CORE

SUBJECT CODE -MTTHE 11

SUBJECT -RESEARCH METHODOLOGY & IPR

TOTAL HOURS – 60

OBJECTIVE :

- The student must understand meaning of research, literature survey, report writing.
- The students are to understand nature of intellectual property, patent rights and new development in IPR.

SYLLABUS CONTENTS:

Unit 1:

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. **(10 HOURS)**

Unit 2:

Effective literature studies approaches, analysis Plagiarism, Research ethics. **(10 HOURS)**

Unit 3:

Effective technical writing, how to write report, Paper Developing a Research Proposal, Format of research proposal, a presentation and assessment by a review committee. **(10 HOURS)**

Unit 4:

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. **(10 HOURS)**

Unit 5:

Patent Rights: Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications. **(10 HOURS)**

Unit 6:

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. **(10 HOURS)**

COURSE OUTCOMES:

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

- Understand research problem formulation.
- Analyze research related information
- Follow research ethics
- Understand that today's world is controlled by Computer, Information Technology, but tomorrow world will be ruled by ideas, concept, and creativity.
- Understanding that when IPR would take such important place in growth of individuals & nation, it is needless to emphasis the need of information about Intellectual Property Right to be promoted among students in general & engineering in particular.
- Understand that IPR protection provides an incentive to inventors for further research work and investment in R & D, which leads to creation of new and better products, and in turn brings about, economic growth and social benefits.

References:

1. Stuart 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, 2 nd 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. Model Curriculum of Engineering & Technology PG Courses [Volume - II]125.
8. Asimov, “Introduction to Design”, Prentice Hall, 1962.
9. Robert P. Merges, Peter S. Menell, Mark A. Lemley, “ Intellectual Property in New Technological Age”, 2016.
10. T. Ramappa, “Intellectual Property Rights Under WTO”, S. Chand, 2008.

Ist -SEMESTER

CATEGORY -CORE

SUBJECT CODE -MTTHE 12

SUBJECT -HEAT & MASS TRANSFER

TOTAL HOURS – 60

OBJECTIVE:

- The student must understand modes of heat transfer namely conduction,convection and radiation.
- The student must understand mass transfer.

SYLLABUS CONTENTS:

UNIT 1

Introduction: Modes of heat flow, Basic laws of heat transfer. Combined heat transfer Mechanisms. Conduction: Steady state conduction, System with internal generation of heat, Transient Conduction, Extended surfaces (Fins), Multi-dimensional heat transfer problems, Phase change, Heat transfer with moving bodies. **(12 HOURS)**

UNIT 2

Convection: Governing Equations in Laminar & Turbulent Flow, Free and Forced Convection, Tubes, Ducts and exterior surfaces, tube bundles in cross flow, Correlations, Dimensional analysis. **(12 HOURS)**

UNIT 3

Boiling heat transfer, nature of vaporization, nucleate pool boiling and empirical correlations for pool boiling heat transfer, factors affecting pool boiling film coefficients, high heat flux boiling. Condensation: Physical Mechanisms, Laminar film condensation on a vertical plate, turbulent film condensation, drop wise condensation. **(12 HOURS)**

UNIT 4

Radiation: Radiation Properties & Law, Electrical analogy, Radiation exchange between surfaces, Applications to cavities & enclosures.

(10 HOURS)

UNIT 5

Mass transfer: equation for convective mass transfer, boundary layer mass transfer, empirical correlation for convective mass transfer. **(12 HOURS)**

COURSE OUTCOMES:

At the end of the course:

1. The students are expected to understand the subject of Heat Transfer in detail with capability to solve Industrial Problems. This will also create the base and interest among the students to carry out the Future Research

Reference Books:

1. Heat Transfer, Krieth, Cengage learn (Thomson)
2. Heat transfer by J.P. Holman.
3. Analysis of Heat transfer E.R.G.Eckerst and R.M. Drake Jr. McGraw Hills.
4. Heat mass and momentum transfer -W.M.Roshenow and P.Choi, Prentice Hall.
5. Heat transfer- B.Gebhart ,McGraw Hills .
6. Conduction Heat Transfer -V.S. Arpaci ,Addison Wesley .
7. Thermal radiation -H.C. Hotel .

Ist -SEMESTER

CATEGORY -CORE

SUBJECT CODE -MTTHE 13

SUBJECT - ADVANCED FLUID MECHANICS

TOTAL HOURS – 60

OBJECTIVE:

- The student to be refreshed with basic laws kinematics and ideal fluid flow.
- The student to understand the difference between incompressible & compressible flow.
- To understand theory & design of hydraulic machine

SYLLABUS CONTENTS

UNIT 1

Reviews of basic laws, concept of continuum, fluid flow in Integral & differential form. **(10 HOURS)**

UNIT 2

Kinematics of Fluid: Description of properties in a moving fluid, Local and material derivatives, Control mass and control volume analysis, Reynolds Transport theorem and its application. **(10 HOURS)**

UNIT 3

Ideal fluid flow: Introduction, Elementary flows in a 2-D plane, Flow nets, superposition of Elementary flows. **(10 HOURS)**

UNIT 4

Viscous Incompressible Flows: Introduction, Equations of motion, N-S equations and its application. Boundary Layer Theory: Prandtl's boundary layer equations, Flat plate boundary layer, approximate solution – Integral method, Laminar and turbulent boundary layer, Separation, Lift and Drag.

(10 HOURS)

UNIT 5

Fundamental of Compressible flows: Introduction, Thermodynamic relations of perfect gases, Speed of sound, pressure wave propagation, and Stagnation and Sonic properties, Shocks. **(10 HOURS)**

UNIT 6

Hydraulic machines: Theory and design of hydro-turbines and centrifugal pumps, their proto-type testing. **(10 HOURS)**

COURSE OUTCOME

At the end of the course:

1. The Students shall be able to understand and define the fluid flow problems along with range of governing parameters
2. The student shall be eligible to take up the fluid flow problems of industrial base.
3. The students shall be able to devise the experiments in the field of fluid mechanics.
4. The Students shall be able understand the flow patterns and differentiate between the flow regimes and its effects.

Reference Books:

1. Fluid Mechanics by Shames (McGraw Hill).
2. Mechanics of Fluid by Massey (EL-BS).
3. The Dynamics and Thermodynamics of Compressible Fluid flow A.H. Shapiro
4. Boundary Layer Theory H. Schlichting McGraw Hills.
5. Thermal Sciences, Potter, Cengage Learn (Thomson)

Ist -SEMESTER

CATEGORY -MEPE

SUBJECT CODE -MTTHE 14(A)

SUBJECT - NUCLEAR ENGINEERING

ELECTIVE –I

TOTAL HOURS - 60

OBJECTIVE:

The student to learn about production, use and control of nuclear energy with emphasis on reactor safety and radiation protection.

SYLLABUS CONTENTS:

UNIT-I

Basics of nuclear fission and power from fission

Radioactivity, nuclear reactions, cross sections, nuclear fission, power from fission,conversion and breeding. **(10 HOURS)**

UNIT-II

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. **(10 HOURS)**

UNIT-III

Multigroup, multiregion diffusion equation, concept of criticality

Solution of multigroup diffusion equations in one region and multiregion reactors, concept of criticality of thermal reactors. **(10 HOURS)**

UNIT-IV

Reactor kinetics and control

Derivation of point kinetics equations, inhour equation, solutions for simple cases ofreactivity additions, fission product poison, reactivity coefficients. **(10 HOURS)**

UNIT-V

Heat removal from reactor core

Solution of heat transfer equation in reactor core, temperature distribution, critical heat flux. **(10 HOURS)**

UNIT-VI

Reactor safety, radiation protection

Reactor safety philosophy, defence in depth, units of radioactivity exposure, radiation protection standar. **(10 HOURS)**

COURSE OUTCOMES:

At the end of the course:

1. Student will understand the basic concepts and processes taking place inside a nuclear reactor, such as nuclear fission, neutron production, scattering, diffusion, slowing down Model Curriculum of Engineering & Technology PG Courses [Volume -II] [120] and absorption.
2. The student will also be familiar with concepts of reactor criticality, the Relationship between the dimension and fissile material concentration in a critical geometry.
3. The student will also be familiar with Time dependent (transient) behavior of power reactor in non-steady state operation and the means to control the reactor.
4. The student will also be familiar with concepts of heat removal from reactor Core, reactor safety and radiation protection.

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)

Ist -SEMESTER

CATEGORY -MEPE

SUBJECT CODE -MTTHE 14(B)

SUBJECT - ENERGY CONSERVATION AND MANAGEMENT

ELECTIVE –I

TOTAL HOURS - 60

OBJECTIVE:

The student to be exposed to energy scenario & relevant international standards and laws.

SYLLABUS CONTENTS:

UNIT-I

The energy market, energy scenario, planning, utilization pattern and future strategy, Importance of energy management. **(12 HOURS)**

UNIT-II

Energy auditing- methodology and analysis, **(12 HOURS)**

UNIT-III

Energy economics, **(12 HOURS)**

UNIT-IV

Energy conservation in industries, Cogeneration, Combined heating and power systems. **(12 HOURS)**

UNIT-V

Relevant international standards and laws. (12 HOURS)

COURSE OUTCOMES:

At the end of the course:

Model Curriculum of Engineering & Technology PG Courses [Volume -II]121

1. The student should acquire insight about the importance of energy
2. The student should capable to analyze all scenarios from energy consumption
3. The student should generate scenarios of energy consumption and predict the future trend.
4. The student should Suggest and plan energy conservation solutions

REFERENCES:

1. L.C. Witte, P.S. Schmidt, D.R.Brown, “Industrial Energy Management and Utilization”,Hemispherical Publication, 1988.
2. Callaghan “Energy Conservation”.
3. D.A. Reeg, “Industrial Energy Conservation”, Pergamon Press, 1980.
4. T.L. Boyen, “Thermal Energy Recovery” Wiley, 1980.
5. L.J. Nagrath, “Systems Modeling and Analysis”, Tata McGraw Hill, 1982.
6. W.C. Turner, “Energy Management Handbook “, Wiley, New York, 1982.
7. I.G.C. Dryden, “The Efficient Use of Energy “, Butterworth, London, 1982.
8. R. Loftnen, Van Nostrarid Reinhold C. “Energy Handbook”, 1978.
9. TERI Publications

SARVEPALLI RADHAKRISHNAN UNIVERSITY, BHOPAL

M.Tech. (Thermal Engineering)

Ist -SEMESTER

CATEGORY -MEPE

SUBJECT CODE -MTTHE 14(C)

SUBJECT - GAS FLOW THROUGH TURBO MACHINES

ELECTIVE –I

TOTAL HOURS – 60

OBJECTIVE :

- To understanding the fundamental of compressible flows
- To understanding the basics of fluid mechanics
- To understanding the aspects of turbo machines.

SYLLABUS CONTENTS

Unit 1

Fundamental Equations of Steady Flow: Continuity equation, Equations of Motion, Euler's Equation, Bernoulli's equation, Energy, Stream Function and Velocity Potential, **(12 HOURS)**

Unit 2

Potential Flow: Elementary potential flow, Source, Sink, Vortex and Doublet, Superposition of flow patterns. Flow over immersed bodies. Development of the aerofoil-lift and drag, Kutta- Joukowski Profile, pressure distribution over aerofoil blading. **(12 HOURS)**

Unit 3

Viscous Flow: Incompressible Flow: Laminar Turbulent Flows: Navier's Strokes equation and exact solutions of steady flow problems. Flow through pipes, over flats plates. Laminar and turbulent boundary layers. Dimensional analysis. **(12 HOURS)**

Unit 4

Compressible Flow of Gases: Isentropic and adiabatic flow, Stagnation and critical properties Flow though ducts of constant area, Fanno line and Rayleigh line flows. Fundamental equations and variation in flow properties. Flow with normal shock waves governing equations, Prandtl Meyer and Rankine Hugoniot relations, Strength of a shock wave, Moving normal shock waves. **(12 HOURS)**

Unit 5

Cascade Tests: Fundamental equations of flow through turbo machinery. Radial equilibrium equation. Vortex flow through turbo machines. Losses in turbo machinery. Dimensional analysis of flow through turbo machines. Surging and chocking. **(12 HOURS)**

Course outcome;

C01- Understanding and define the fluid flow problem

C02- Understanding the aspects of potential flow.

C03- Understanding dimentional analysis of viscous flow.

C04- Understanding the phenomenon of shock wave in case of compressible flow of gases.

C05- Understanding cascade tests in connection with surging and chocking**.**

REFERENCE BOOKS:

1. Fundamental of Compressible Flows -Yahya
2. Compressible Fluid Flow -Michel A.Saad
3. Introduction of fluid mechanics -Fox and MC Donald
4. Turbo Machines -A.Valan Arasu
5. Applied Fluid Dynamics Handbook -Robert D.Blevins
6. Int J.of Heat and Mass Transfer -Elsevier Pub

Ist -SEMESTER

CATEGORY -MEPE

SUBJECT CODE -MTTHE 15(A)

SUBJECT - STEAM AND GAS TURBINES

ELECTIVE –II

TOTAL HOURS - 60

OBJECTIVE:

- The student to be exposed to steam turbines ,regeneration aspect,reheating aspect.
- To make student aware of mixed pressure turbine.
- Exposure to gas turbine.

SYLLABUS CONTENTS

Unit 1

Steam Turbines: Principle and working of steam turbines, type of turbines, impulse and reactions, compounding for pressure and velocity. Velocity triangles for various types, stage to blade, speed ratio for optimum efficiency, diagram efficiency, steam s performance. Energy losses in steam turbine, turbine performance at various loads and governing of steam turbines. Constructional details and description of steam turbine components in brief. **(12 HOURS)**

Unit 2

Regenerative feed heating cycles: Introduction : Most Ideal Regenerative feed heating cycle. Regenerative feed heating cycles and their represenation on T-s and h-s Diagram. Representation of actual process on T-s and h-s Diagram Regenerative cycles. Other types of feed heating arrangements. Optimum feed water temperature and saving in Heat Rate. Feed Heaters, Direct Contact Heaters, Surface Heaters, Deaerators . **(12 HOURS)**

Unit 3

Reheating – Regenerative and Regenerative water – Extraction Cycles. Reheating of steam, Practical reheating and Non- reheating cycles, advantage & disadvantages of reheating, regenerative water extraction cycles, practical feed heating arrangements. Feed heating system for 120MW, 200MW, 350MW, 500MW & 660 MW Units. **(12 HOURS)**

Unit 4

Mixed Pressure Turbines: Low- pressure Turbines, Mixed pressure Turbines, Heat Accumulators. **(12 HOURS)**

Unit 5

Gas Turbines: Open and closed cycles, constant pressure and constant volume cycles, cycles with inter cooling, reheating and heat exchanger, compressor and turbine efficiencies, pressure losses, performance characteristics of various cycles, practical problems. Jet Propulsion: Calculation of thrust, Power, speed and efficiency, turbo – jet and turbo propulsion systems. **(12 HOURS)**

COURSE OUTCOMES:

At the end of the course:

1. Student should understand construction and design features of gas turbines as used for Model Curriculum of Engineering & Technology PG Courses [Volume -II] 123 power generation.
2. Student should understand thermodynamics cycles a, and different sizes and layouts of gas turbine plant
3. Able to understand thermodynamics and fluid mechanics component for enhancing the efficiency and effectively of gas turbines

REFERENCE BOOKS:

1. Fluid dynamics and heat transfer of turbo-machinery, Budugur Lakshminarayana, Amazon.com
2. Cohen H Rogers, Sarvanmutto, Gas Turbine Theory, Longman Pub.
3. Mathur, Sharma, Gas turbine, Standard Pub And Distributors Delhi.

Ist -SEMESTER

CATEGORY -MEPE

SUBJECT CODE -MTTHE 15(B)

SUBJECT - AIR CONDITIONING SYSTEM DESIGN

ELECTIVE –II

TOTAL HOURS - 60

OBJECTIVE :

- The student should to be exposed to air conditioning system,process,performance and design.

SYLLABUS CONTENTS:

UNIT-I

Air conditioning systems, **(12 HOURS)**

UNIT -II Various air-conditioning processes, **(12 HOURS)**

UNIT -III

Enthalpy deviation curve, psychometric, SHF, dehumidified air quantity, human comfort, indoor air quality, **(12 HOURS)**

UNIT -IV

Design conditions and load calculations, air distribution, pressure drop, duct design, fans&, blowers, **(12 HOURS)**

UNIT -V

Performance & selection, noise control. **(12 HOURS)**

COURSE OUTCOMES:

At the end of the course:

1. Student should understand construction and design features Air-conditioning system.Model Curriculum of Engineering & Technology PG Courses [Volume - II] [122]
2. Student should understand various types and its adoptability in the various environment and application areas.
3. Student should understand various health issues

4. Student should design seasonal energy efficient system

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", Vann strand
7. 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.

Ist -SEMESTER

CATEGORY -MEPE

SUBJECT CODE -MTTHE 15(C)

SUBJECT - PUMPS, BLOWERS AND COMPRESSORS

ELECTIVE –II

TOTAL HOURS – 60

OBJECTIVE:

- To revise law of momentum
- To be able to designpump,blower,compressor and fans.

SYLLABUS CONTENTS:

Law of momentum .Vortex theory of Euler's head. Hydraulic performance of pumps, Capitation. Jet Pumps: Turbo blowers and their characteristics, cooling tower fan, Surging .Design of pumps, blowers, compressors and fans. **(60 HOURS)**

COURSE OUTCOME

C01- Understanding theory of euler's head.

C02- Evaluating hydraulic performance of pumps.

C03- Understanding jet pump usage in turbo blower.

C04-Designing of pumps, blowers, compressors and fans**.**

REFERENCE BOOKS :

1. Centrifugal and Axial flow pumps A.J. Stepanoff, Wiley.
2. Design and performance of centrifugal and Axial flow pumps and compressors , A.Kovats

Ist -SEMESTER

CATEGORY -AUDIT

SUBJECT CODE -MTTHE 16

SUBJECT - AUDIT-I (ENGLISH FOR RESEARCH PAPER WRITING)

TOTAL HOURS - 60

COURSE OBJECTIVES:

Students will be able to:

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

SYLLABUS CONTENTS

UNIT-I

Planning and Preparation, Word Order, Breaking up long sentences, Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness. **(10 HOURS)**

UNIT-II

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

(10 HOURS)

UNIT-III

Review of the Literature, Methods, Results, Discussion,Conclusions, The Final Check. **(10 HOURS)**

UNIT-IV

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, **(10 HOURS)**

UNIT-V

Skills 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. **(10 HOURS)**

UNIT-VI

useful phrases, how to ensure paper is as good as it could possibly be the first-time submission. **(10 HOURS)**

COURSE OUTCOME:

C01-Brush up basics in English

C02- Brush up of explanation on paraphrasing and plagiarism, also inclusion of Writing skill for Abstract& introduction.

C03- Aware of the format i.e chapter to be included in the dissertation.

C04- Understanding the key skills of writing the chapters on Abstract, Introduction and review of Literature

C05- Understanding the key skills of writing the chapter on Methodology, Result, Discussion and conclusion.

C06- Capable of ensuring quality of paper.

Suggested Studies:

1. Goldbort R (2006) Writing for Science, Yale University Press (available on Google Books)
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

IInd -SEMESTER

CATEGORY -CORE

SUBJECT CODE -MTTHE 21

SUBJECT - MINI PROJECT

TOTAL HOURS - 60

OBJECTIVE:

The student to be exposed to practical life problem.

SYLLABUS CONTENTS:

- Students can take up small problems in the field of design engineering as mini project. It can be related to solution to an engineering problem, verification and analysis of experimental data available, conducting experiments on various engineering subjects, material characterization, studying a software tool for the solution of an engineering problem etc

(60 HOURS)

COURSE OUTCOMES:

At the end of the course:

1. Students will get an opportunity to work in actual industrial environment if they opt for internship.
2. In case of mini project, they will solve a live problem using software/analytical/computational tools.
3. Students will learn to write technical reports.
4. Students will develop skills to present and defend their work in front of technically

IInd -SEMESTER

CATEGORY -CORE

SUBJECT CODE -MTTHE 22

SUBJECT - REFRIGERATION AND CRYOGENICS

TOTAL HOURS - 60

OBJECTIVE :

- The students should be made aware to components of a refrigerator & their design.
- The student should be made aware of refrigerator.
- The students to be made aware to vapour compression refrigeration & vapour absorption refrigeration.

SYLLABUS CONTENTS:

UNIT-I

Vapour compression refrigeration, actual cycle, second law efficiency, Multistage compression with inter-cooling, Multi-evaporator systems, Cascade systems, **(10 HOURS)**

UNIT-II

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

(10 HOURS)

UNIT-III

Design, selection of evaporators, condensers, control systems, motor selection, **(10 HOURS)**

UNIT-IV

Refrigerants, alternative refrigerants, CFC/HCFC phase-out regulations, Refrigeration applications, food preservation, transport, **(10 HOURS)**

UNIT-V

Introduction to Vapor absorption refrigeration, single effect and double effect systems, **(10 HOURS)**

UNIT-VI

Gas liquefaction systems - Linde-Hampson, Linde dual pressure, Claude cycle. **(10 HOURS)**

COURSE OUTCOMES:

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

1. To learn the basics of refrigeration and cryogenics and its application area.
2. To design the refrigeration systems for domestic and industrial applications like cold storages
3. To learn about ODP, GWP and related environment issues

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

IInd -SEMESTER

CATEGORY -CORE

SUBJECT CODE -MTTHE 23

SUBJECT - I.C ENGINE & ALTERNATE FUELS

TOTAL HOURS - 60

OBJECTIVE:

- The students should understand construction, working & testing of S.I. engine & C.I. engine.
- The students should be aware of non conventional engine.
- The student should be made aware of future fuels for I.C. engine.

SYLLABUS CONTENTS

UNIT 1

SI Engines: Fuels for use in S.I. Engines; Rating of S.I. Engines fuels, carburetors and carburetion, fuel injection systems; Combustion in S.I. Engines-normal and abnormal, detonation, stratification and lean mixture operations. Carburetor replacement by MPFI, Elements of MPFI System like control unit, sensors, switches, Effect on engine performance & Engine Emission. **(15 HOURS)**

UNIT 2

Performance & testing of I.C. Engine: Introduction, breathing capacity, pumping losses, friction losses, super charging, performance parameters & their measurements for S.I.E. & C.I.E. Engine, performance maps. Air and sound pollution by engines, remedial measures; **(15 HOURS)**

UNIT 3

Non Conventional I.C. Engines : Dual Fuel, Multi Fuel, Stratified charge lean burn variable compression ratio, Rotary Engines, Description, Working and comparison with conventional I.C. Engines. **(15 HOURS)**

UNIT 4

Future Fuels for Ignition Engines : Introduction, Necessity for substitute Fuels. Substitute future fuels like Ethanol, Methnol, Bio gas, Hydrogen, Production, Transportation, storage of substitute fuel, performance of engines using these fuels. **(15 HOURS)**

COURSE OUTCOMES:

At the end of the course:

1. Students will demonstrate a basic understanding of several types of engine models that will include zero dimensional thermodynamic model, one dimensional and multi-dimensional, single zone, two zone etc models.
2. Students will develop models and simulate them for diesel engine petrol engine, gas engine.
3. Students will demonstrate the performance evaluation and emission standards for such modeled engines

Reference Books:

1. A.S. Khatchiian ;Theory of C.I. Engines Vol.1 and 2 IIT Bombay .
2. C.F. Taylor and E.S. Taylor; Internal Combustion Engines ,Stanton
3. P.G. Burman and B.Luca Fuel injection and Engines, Technical Press
4. L.C. Litchy ,Combustion Engines Processes, McGraw-Hill
5. E.F. Obert ,Internal Combustion Engines and Air Pollution , Intext Educational Publishers
6. H.R. Ricardo , The High Speed I.C. Engine, Blackie, LondON

IInd -SEMESTER

CATEGORY -MEPE

SUBJECT CODE -MTTHE 24(A)

SUBJECT - DESIGN OF HEAT EXCHANGERS

ELECTIVE-III

TOTAL HOURS - 60

OBJECTIVE:

- To become aware of types of heat exchanger.
- To learn design methodology

SYLLABUS CONTENTS:

UNIT-I

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. **(10 HOURS)**

UNIT-II

Heat exchanger design methodology, assumption for heat transfer analysis, problem Model Curriculum of Engineering & Technology PG Courses [Volume -II][130] 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. **(10 HOURS)**

UNIT-III

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

UNIT-IV

Compact Heat Exchangers: Thermal and Hydraulic design of compact heat exchanger**(10 HOURS)**

UNIT-V

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. **(10 HOURS)**

UNIT-VI

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. **(10 HOURS)**

COURSE OUTCOMES:

At the end of the course:

1. Students will demonstrate a basic understanding of several types of heat exchangers that will include shell-and-tube, double pipe, plate-and-frame, finned tube, and plate-fin heat exchangers, Heat pipes.
2. Students will design and analyses of shell-and-tube double pipe, compact, plate heat exchangers.
3. Students will demonstrate the performance degradation of heat exchangers subject to fouling.

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.

IInd -SEMESTER

CATEGORY -MEPE

SUBJECT CODE -MTTH 24(B)

SUBJECT - MAINTENANCE OF THERMAL POWER PLANT

TOTAL HOURS – 60

OBJECTIVE:

Students will be able to –

- Learn organizing maintenance department
- Understand diagnostic maintenance and machine health monitoring
- Understand mechanism of lubrication & failure
- Understand maintenance of power plant machinery

SYLLABUS CONTENTS

UNIT 1

Maintenance Management: emergency maintenance procedure Maintenance strategies, maintenance sch spare part management, inventory control purchase procedure and storage, Warning systems, organization of maintenance department, human consideration. **(12 HOURS)**

UNIT 2

Diagnostic Maintenance and Machine Health Monitoring: Introduction to maintenance techniques, preventive and predictive maintenance, signature analysis, observational and estimation techniques, online techniques specially dealing with instrumentation system, off-line techniques, non-destructive testing, practical application of diagnostic maintenance to specific industrial machinery and plants. Various techniques of condition monitoring wear analysis, vibration and noise signature, thermography etc.

(12 HOURS)

Unit 3

Mechanism of Lubrication & Lubricants: Lubrication regimes, analysis and modes of lubrication in different bearings, squeeze films, fluid film, elasto-hydrodynamic and boundary lubrications theories and applications,

environmental effects on lubrications, types of lubricant and properties, non-conventional lubricants and applications. **(12 HOURS)**

Unit 4

Failure Mechanisms and Analysis: Material failure due to environmental effects, Introduction; Importance of failure analysis, common causes of failure in metals & alloys. Failure due to faulty heat treatment, embrittlement of metals, Residual stresses in metals, and their effects. Defects in production and manufacture. Design faults, analysis of engineering failures, failure due to abuse of machinery, failure of seals & packing, failure of bearings, failure of gears, fatigue failure, failure due to time-temperature effects(creep) corrosion etc. **(12 HOURS)**

UNIT 5

Maintenance of Power Plant Machinery; Predictive and preventive maintenance of steam turbine and its components, Erosion of blades and its prevention. Lubrication of bearings, valves, Maintenance scheduling, methods of detection of leaking and its prevention in the condensers. Condenser fault systems and its cases. On load and off load cleaning of condenser tubes, Maintenance scheduling of cooling water plants, cooling towers, Life enhancement techniques, case studies. **(12 HOURS)**

OUTCOME;

C01- Understanding procedure, strategies, consideration of maintenance management.

C02- Understanding techniques of condition monitoring wear analysis, vibration and noise signature, thermography etc.

C03- Understanding types of lubricants & properties, non conventional lubricants and Applications.

C04- Understanding causes, analysis and failure mechanisms.

C05- Understanding predictive and preventive maintenance of steam turbine, cooling water Plants, cooling towers etc.

REFERENCE BOOKS:

1. Maintenance & Spare Parts & Management -P. Gopal Krishnan & Bannergee
2. Maintenance Engg. Handbook - by Lindley & Higgins
3. Industrial Maintenance Management - by Neibel
4. Reliability Centered Maintenance - by Moubray
5. Maintenance Engg. & Management - By R.C. Mishra
6. Modern Poewr plant Practice -10 Volumes British Electricity Int. Ltd.
7. Power Generation Handbook -Philip Kaimeh.Mc Graw HCourse

IInd -SEMESTER

CATEGORY -MEPE

SUBJECT CODE -MTTH 24(C)

SUBJECT - TOTAL QUALITY MANAGEMENT

TOTAL HOURS – 60

OBJECTIVE:

Student will be able to-

- Evolve total quality management.
- Understand control charts for statistical quality control.
- Understand improvement in process after diagnostics.

SYLLABUS CONTENTS

Unit 1

Evolution of total quality management, historical perspective, teamwork, TQM and ISO 9000; information technology and Business Process Re-engineering (BPR); TPM and quality awards; aids and barriers to quality mgt, creating vision and initiating transformation, establishing programs for education and self coordination, policy setting and review, flowchart of policy mgt and relation with daily mgt. improvements, measurement of key indicators; quality mgt leader; cross functional teams. **(12 HOURS)**

Unit 2

Process- definition, variation and feedback, funnel-marble experiment-rules of adjustment and its effects, quality- definition, goalpost and kaizen view, quality of design, conformance and performance; Taguchi loss function, cost of quality, chain action of improving quality to productivity to motivation and low cost; Deming's theory of mgt, fourteen points and variance reduction; attributes enumerative and variables analytic studies.

12 HOURS)

Unit 3

SQC-Control charts: basic discrete and continuous distributions, measures of central tendency, variability and shapes, sampling, size and central value theorem, control chart structure, process plotting and stability, study of out-of-control evidences, defect detection and prevention, use of control charts in evaluating past, present and future trends; attribute control charts, count and classification charts, construction and interpretation of p , np , c and u charts, PDSA cycle(plan, do, study, act), and R charts, and s charts, individual and moving range chart, trial control limits and out of control points. **(12 HOURS)**

Unit 4

Process diagnostics: Between and Within Group variations, periodic and persistent disturbances, control chart patterns-natural, level-shift, cycle, wild, multi-universe, relationship and other out of control patterns; diagnosing a process, brainstorming; cause-effect, Ishikava, interrelationship, systematic and matrix diagrams; change concepts and waste elimination **(12 HOURS)**

Unit 5

Process improvement: Performance and technical specifications, attribute-process and variable-process capability studies; unstable and stable process capability studies and examples; attribute and variable improvement studies; Inspection: acceptance sampling(AS)- lot formation, single, double and multiple/sequential sampling plans, operating characteristic (OC) curve, producer and consumer risk, theoretical invalidation of AS, kp rule for stable and chaotic processes. **(12 HOURS)**

COURSE OUTCOME

C01- Understanding aids and barriers to quality management.

C02- Understanding Taguchi loss function and Deming's theory of Management.

C03-Understanding p,np,c and u chart

C04- Diagnostic of process for quality management

C05- understanding ways of improving the process involved.

REFERENCES:

1. Gitlow HS, Oppenheim et al; Quality Management; TMH
2. Gryna FM; Jurans Quality Planning and Analysis; TMH
3. Crosby Philips; Quality is still free; New Amer Library
4. Kulkarni VA and Bewoor AK; Quality Control; Wiley
5. Jankiraman B and Gopal RK; Total Quality Management- Text and Cases; PHI Learning
6. Sugandhi L and Samual A; Total Quality Management; PHI Learning
7. Subburaj R; Total Qality Management; TMH
8. Naidu Babu and Rajendran; TQM; New age International pub;
9. Chase Richard B et al; Operations management; SIE-TMH
10. Chary SN; Production and Operations Management; TMH

IInd -SEMESTER

CATEGORY -MEPE

SUBJECT CODE -MTTHE 25(A)

SUBJECT - COMPUTATIONAL FLUID DYNAMICS

ELECTIVE-IV

TOTAL HOURS – 60

OBJECTIVES

Students will be able to:

- Understand the basics of CFD and CFDHT
- Become aware of Governing equations, Finite volume method
- Learn the geometric modeling and grid generation.
- Come to solving problems of incompressible flows.

SYLLABUS CONTENTS:

UNIT-I

Introduction to CFD:

Computational approach to Fluid Dynamics and its comparison with experimental and analytical methods, Basics of PDE: Elliptic, Parabolic and Hyperbolic Equations. **(10 HOURS)**

UNIT-II

Governing Equations:

Review of Navier-Stokes Equation and simplified forms, Solution Methodology: FDM and FVM with special emphasis on FVM, Stability, Convergence and Accuracy. **(10 HOURS)**

UNIT-III

Finite Volume Method:

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

(10 HOURS)

UNIT-IV

Geometry Modeling and Grid Generation:

Practical aspects of computational modeling of flow domains, Grid Generation, Types of mesh and selection criteria, Mesh quality, Key parameters and their importance. **(10 HOURS)**

UNIT-V

Methodology of CFDHT:

Objectives and importance of CFDHT, CFDHT for Diffusion Equation, Convection Equation and Convection-Diffusion Equation. **(10 HOURS)**

UNIT-VI

Solution of N-S Equations for Incompressible Flows:

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

(10 HOURS)

COURSE OUTCOMES:

At the end of the course:

1. The students are expected to understand the subject of Computational Fluid Dynamics and know how to use it as tool to solve the Heat Transfer and Fluid Mechanics related Industrial Problems. This will also create the base and interest among the students to carry out the Future Research.

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

IInd -SEMESTER

CATEGORY -MEPE

SUBJECT CODE -MTTHE 25(B)

SUBJECT - MODELING OF IC ENGINE

ELECTIVE-IV

TOTAL HOURS – 60

Objective

The students will be able to learn combustion and mathematical models of I.C. and S.I. engine the students will be able to model fuel spray behavior and charging system.

SYLLABUS CONTENTS:

UNIT-I

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. **(12 HOURS)**

UNIT-II

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.

Application of heat release analysis. **(12 HOURS)**

UNIT-III

Fuel spray behavior: Fuel injection, spray structure, fuel atomization, droplet turbulence Interactions, droplet impingement on walls. **(12 HOURS)**

UNIT-IV

Modeling of charging system: Constant pressure and pulse turbo charging, compressor and Turbine maps, charge air cooler. **(12 HOURS)**

UNIT-V

Mathematical models of SI Engines: Simulation of Otto cycle at full throttle, part throttles and supercharged conditions. Progressive combustion, Auto

ignition 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. **(12 HOURS)**

OUTCOMES:

At the end of the course:

1. Students will demonstrate a basic understanding of several types of engine Models that will include zero dimensional thermodynamic model, one Dimensional and multi-dimensional, single zone, two zone etc models.
2. Students will develop models and simulate them for diesel engine petrol Engine, gas engine.
3. Students will demonstrate the performance evaluation and emission standards for such modeled 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.

IInd -SEMESTER

CATEGORY -MEPE

SUBJECT CODE -MTTHE 25(C)

SUBJECT - OPERATION RESEARCH

ELECTIVE-IV

TOTAL HOURS - 60

OBJECTIVE:

The student must understand optimization techniques formulations of a LPP, scheduling & sequencing as well as simulation of game theory.

SYLLABUS CONTENTS:

Unit 1:

Optimization Techniques, Model Formulation, models, General L.R Formulation, Simplex Techniques, Sensitivity Analysis, Inventory Control Models. **(12 HOURS)**

Unit 2

Formulation of a LPP - Graphical solution revised simplex method - duality theory - dual simplex method - sensitivity analysis - parametric programming. **(12 HOURS)**

Unit 3:

Nonlinear programming problem - Kuhn-Tucker conditions min cost flow problem - max flow problem - CPM/PERT. **(12 HOURS)**

Unit 4

Scheduling and sequencing - single server and multiple server models - deterministic inventory models - Probabilistic inventory control models - Geometric Programming. **(12 HOURS)**

Unit 5

Competitive Models, Single and Multi-channel Problems, Sequencing Models, Dynamic Programming, Flow in Networks, Elementary Graph Theory, Game Theory Simulation. **(12 HOURS)**

COURSE OUTCOMES:

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

1. Students should able to apply the dynamic programming to solve problems of discreet and continuous variables.
2. Students should able to apply the concept of non-linear programming
3. Students should able to carry out sensitivity analysis
4. Student should able to model the real world problem and simulate it.

References:

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 Optimization: Operations Research, Jain Brothers, Delhi, 2008
4. Hitler Liebermann Operations Research: McGraw Hill Pub. 2009
5. Pannerselvam, Operations Research: Prentice Hall of India 2010
6. Harvey M Wagner, Principles of Operations Research: Prentice Hall of India 2010

II nd -SEMESTER

CATEGORY-AUDIT

SUBJECT CODE-MTTHE-26

SUBJECT NAME-CONSTITUTION OF INDIA

Basic features and fundamental principles

TOTAL HOURS - 60

COURSE OBJECTIVES:

Students will be able to:

1. Understand the premises informing the twin themes of liberty and freedom from a civil rights perspective.
2. 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.
3. 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.

The Constitution of India is the supreme law of India. Parliament of India cannot make any law which violates the Fundamental Rights enumerated under the Part III of the Constitution. The Parliament of India has been empowered to amend the Constitution under Article 368, however, it cannot use this power to change the "basic structure" of the constitution, which has been ruled and explained by the Supreme Court of India in its historical judgments. The Constitution of India reflects the idea of "Constitutionalism" – a modern and progressive concept historically developed by the thinkers of "liberalism" – an ideology which has been recognized as one of the most popular political ideology and result of historical struggles against arbitrary use of sovereign power by state. The historic revolutions in France, England, America and particularly European Renaissance and Reformation movement have resulted into progressive legal reforms in the form of "constitutionalism" in many countries. The Constitution of India was

made by borrowing models and principles from many countries including United Kingdom and America. **(15 HOURS)**

The Constitution of India is not only a legal document but it also reflects social, political and economic perspectives of the Indian Society. It reflects India's legacy of "diversity". It has been said that Indian constitution reflects ideals of its freedom movement; however, few critics have argued that it does not truly incorporate our own ancient legal heritage and cultural values. No law can be "static" and therefore the Constitution of India has also been amended more than one hundred times. These amendments reflect political, social and economic developments since the year 1950. The Indian judiciary and particularly the Supreme Court of India have played an historic role as the guardian of people. It has been protecting not only basic ideals of the Constitution but also strengthened the same through progressive interpretations of the text of the Constitution. The judicial activism of the Supreme Court of India and its historic contributions has been recognized throughout the world and it gradually made it "as one of the strongest court in the world". **(15 HOURS)**

Historic revolutions in france england america and particularly european renaissance and india and its historic contributions has been recognized throughout the world and it gradually made it "as one of the strongest court in the world". reformation movement have resuleted into progressive legal reform in the form of "constitutionalism" in many countries. the constitution of india was made by borrowing models and principles from many countries including united kingdom and america. **(15 HOURS)**

The Constitution of India is not only a legal document but it also reflects social, political and economic perspectives of the Indian Society. It reflects India's legacy of "diversity". It has been said that Indian constitution reflects ideals of its freedom movement, however, few critics have argued that it does not truly incorporate our own ancient legal heritage and cultural values. No law can be

"static" and therefore the Constitution of India has also been amended more than one hundred times. These amendments reflect political, social and economic developments since the year 1950. The Indian judiciary and particularly the Supreme Court of India has played an historic role as the guardian of people. It has been protecting not only basic ideals of the Constitution but also strengthened the same through progressive interpretations of the text of the Constitution. The judicial activism of the Supreme Court of Course content

Meaning of the constitution law and constitutionalism Historical perspective of the Constitution of India Salient features and characteristics of the Constitution of India Scheme of the fundamental rights The scheme of the Fundamental Duties and its legal status The Directive Principles of State Policy – Its importance and implementation Federal structure and distribution of legislative and financial powers betwee the Union and the States Parliamentary Form of Government in India – The constitution powers and status of the President of India Amendment of the Constitutional Powers and Procedure The historical perspectives of the constitutional amendments in India Emergency Provisions : National Emergency, President Rule, Financial Emergency Local Self Government – Constitutional Scheme in India Scheme of the Fundamental Right to Equality Scheme of the Fundamental Right to certain Freedom under Article 19 Scope of the Right to Life and Personal Liberty under Article 21. **(15 HOURS)**

Course Outcomes:

Students will be 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.

SARVEPALLI RADHAKRISHNAN UNIVERSITY, BHOPAL

M.Tech. (Thermal Engineering)

IIIrd -SEMESTER

CATEGORY -MEPE

SUBJECT CODE -MTTHE 31(A)

SUBJECT - NON CONVENTIONAL ENERGY SOURCES

ELECTIVE-V

TOTAL HOURS – 60

OBJECTIVE:

The students must understand sources of energy such as Solar energy, Biomass energy, Geothermal energy and Biochemical engineering.

SYLLABUS CONTENTS:

UNIT 1

Introduction: Conventional sources of commercial energy ,estimation of time for which conventional sources will last alternate energy sources .

(10 HOURS)

UNIT 2

The Solar Option: Direct and Indirect applications. Availability of solar radiation energy collection and concentration for photo-thermal application, thermal storage. Introduction to photo-voltaic and thermoelectric conversion .Wind energy .Types of wind mills. Elementary design principles .Ocean thermal energy conversion. **(10 HOURS)**

UNIT 3

Biomass Energy : Bio mass as a source of energy .Energy plantation . Production of fuel from wood agricultural and animal waste . Bioconversion process .Bio –gas ,its generation and utilization . UNIT 4 The nuclear option: Fission and fusion technology fundamentals .Thermal and fast reactor .State of art .Breeder reactor .Prospects and limitations .Economics.

10 HOURS)

UNIT 5

Geothermal Energy System: Extent of available resources .Heat Transport in geothermal system .Introduction to tidal and wave energy .M.H.D. Power Fuel cells. **(10 HOURS)**

UNIT 6

Biochemical Engineering: Introduction to chemicals of life enzymes, kinetics and michaelis–Menten equation .Introduction to microorganisms growth requirements, growth Kinetics, Monod equation. **(10 HOURS)**

OUTCOME

C01- Understanding the need for non conventional energy sources

C02- Understanding aspect of solar energy and wind energy.

C03- Understanding production of bio gas and utilization

C04- Understanding prospects, limitation, economics of nuclear energy.

C05- Understanding tidal and wave energies, fuel cell.

REFERENCE BOOKS:

1. Solar Engineering of Thermal Processes , J.A. Duffie and W.A. Beckman John Wiley.
2. Principles of Solar Engineering, F.Kreith and J.F. Kreider McGraw –Hill .
3. Alternative Energy Sources T.N. Veziroglu McGraw –Hill .
4. Biochemical Engineering Fundamentals J.E. Bailey and D.F. Olis, TMH
5. Biochemical Engineering Academic press S.Aiba ,A.E. Humphrey ,N.F. Mills.

IIIrd -SEMESTER

CATEGORY -MEPE

SUBJECT CODE -MTTHE 31(B)

SUBJECT - ADVANCED MATHEMATICAL METHODS IN ENGINEERING

ELECTIVE-V

TOTAL HOURS – 60

OBJECTIVE:

The students should be able to solve ordinary differential equations, partial differential equations, standard discrete and continuous distributions, NOVA Details.

SYLLABUS CONTENTS:

UNIT I

Ordinary Differential Equations: First-order equations (Linear, Equidimensional, Separable Exact, Homogeneous,); Second-order linear differential equations (homogeneous and no homogeneous); Solution methods such as undetermined coefficients and variation of parameters.

(10 HOURS)

UNIT II

Partial Differential Equations: First order partial differential equations; Second order linea partial differential equations; Canonical forms; Fourier series, Second order equation Model Curriculum of Engineering & Technology PG Courses [Volume -II][134]

(Parabolic, Elliptic and Hyperbolic) in rectangular, cylindrical polar and spherical coordinate systems; Solution techniques such as separation of variables, eigenfunction 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. **(10 HOURS)**

UNIT III

Standard discrete and continuous distributions like Binomial, Poisson, Normal, Exponential etc. Central Limit Theorem and its significance. Some sampling distributions like c2, t, F. **(10 HOURS)**

UNIT IV

ANOVA: One – way, Two – way with/without interactions, Latin. **(10 HOURS)**

UNIT V

Squares ANOVA technique, Principles of Design Of Experiments, some standard designs such as CRD, RBD, LSD. **(10 HOURS)**

UNIT VI

Some of the relevant topics required for ANOVA (sample estimates and test hypothesis) may also be included. **(10 HOURS)**

COURSE OUTCOMES:

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

1. Students will be able to analyze and develop the mathematical model of Thermal system.
2. Student should able analyze the reliability and maintainability of the series and parallel thermal system.
3. Students will be able to solve differential equations using numerical Techniques.

REFERENCES:

1. J.B. Doshi, “Differential Equations for Scientists and Engineers”, Narosa, 2010.
2. Peter O'Neil, “Advanced Engineering Mathematics”, Seventh Edition, C engage 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)

IIIrd -SEMESTER

CATEGORY -MEPE

SUBJECT CODE -MTTH 31(C)

SUBJECT - DESIGN OF SOLAR AND WIND SYSTEMS

ELECTIVE-V

TOTAL HOURS – 60

OBJECTIVE:

The student should be exposed to alternative sources of energy such as Solar, Wind, Nuclear, Fuel cells, Biomass, Biogas, Hydrogen, Geothermal.

SYLLABUS CONTENTS:

UNIT I

Conventional sources of energy, Nuclear, Alternative energy sources,

(12 HOURS)

UNIT II

Solar Radiation-estimation, prediction & measurement, Solar energy utilization, **(12 HOURS)**

UNIT III

Performance of Solar flat plate collectors, concentrating collectors, thermal storage, **(10 HOURS)**

UNIT IV

Wind energy, Direct Energy conversion- PV, MHD, **(12 HOURS)**

UNIT V

Fuel cells, thermionic, thermoelectric, Biomass, biogas, hydrogen, Geothermal.

(12 HOURS)

COURSE OUTCOMES:

At the end of the course:

1. Student should update about the technological status of implementation of NCES in India.
2. Student should capable to analyze various techno economical obstacles in the commercial development of NCES in India.

3. Student should capable to conceptually model and design general NCES systems and predict the long term performance.
4. Student should suggest and plan hybrid NCES solutions to conventional energy systems

REFERENCES:

1. D.Y. Goswami, F. Kreith and J.F. Kreider, “Principle of Solar Engineering”, Taylor and Francis, 2000.
2. Sukhatme S.P., “Solar Energy”, Tata McGraw Hill Publishing Co. Ltd., New Delhi, 1994.
3. Bansal and othes, “Non-Conventional Energy Sources”.
4. J.F. Kreider, F. Kreith, “Solar Energy Handbook”, McGraw Hill, 1981
5. J.A. Duffie and W.A. Beckman, “Solar Engineering of Thermal Processes”, John Wiley,1991.

IIIrd -SEMESTER

CATEGORY -MEOE

SUBJECT CODE -MTTHE 32(A)

SUBJECT - COMPOSITE MATERIALS

OPEN ELECTIVE

TOTAL HOURS - 60

OBJECTIVE;

- To introduced to composite materials
- To understand the role of reinforcements
- To understand manufacturing metal matrix composites
- To understand manufacturing of polymer matrix composites
- To understand the critical criterion of strength of composite materials

SYLLABUS CONTENTS:

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.

(12 HOURS)

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 is stress conditions. **(12 HOURS)**

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.

(12 HOURS)

UNIT–IV:

Manufacturing of Polymer Matrix Composites: Preparation of Moulding compounds and prepregs – hand layup method – Autoclave method – Filament winding method – Compression moulding – Reaction injection moulding. Properties and applications.

(12 HOURS)

UNIT – V:

Strength: Laminar Failure Criteria-strength ratio, maximum stress criteria, maximum strain criteria, interacting failure criteria, hygrothermal failure. Laminate first play failure-insight strength; Laminate strength-ply discount truncated maximum strain criterion; strength design using caplet plots; stress concentrations.

(12 HOURS)

OUTCOME

C01- The student understood the basics of composite material.

C02-Tthe student understood the preperation, properties and application of Composite materials.

C03-The student understood the manufacture of composite involving kuitting braiding, wearing.

C04-Understood manufacture properties and applications of polymer Matrix composite

C05- Understood stress contraction, stress criteria & STRAIN criteria affecting failure.

TEXT BOOKS:

1. Material Science and Technology – Vol 13 – Composites by R.W.Cahn – VCH, West Germany.

2. Materials Science and Engineering, An introduction. WD Callister, Jr., Adapted by R.Balasubramaniam, John Wiley & Sons, NY, Indian edition, 2007.

REFERENCES:

1. Hand Book of Composite Materials-ed-Lubin.
2. Composite Materials – K.K.Chawla.
3. Composite Materials Science and Applications – Deborah D.L. Chung.
4. Composite Materials Design and Applications – Danial Gay, Suong V. Hoa, and Stephen W.TASI

IIIrd -SEMESTER

CATEGORY -MEOE

SUBJECT CODE -MTTHE 32(B)

SUBJECT - INDUSTRIAL SAFETY

OPEN ELECTIVE

TOTAL HOURS - 60

OBJECTIVE

The students to be exposed to aspects of industrial safety

The student will understand the phenomenon of maintenance engineering

The student will be exposed to wear and corrosion characteristics

The student to understand tracing of occurrence of faults.

To become aware of periodic and preventive maintenance.

SYLLABUS CONTENTS:

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, etc, Safety color codes. Fire prevention and firefighting, equipment and methods. **(12 HOURS)**

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. **(12 HOURS)**

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, 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. **(12 HOURS)**

Unit-IV:

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. **(12 HOURS)**

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: 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. **(12 HOURS)**

OUTCOME

C01-Students understood fire prevention and fire fighting

C02- Students understand types function and equipment used for Maintenance engineering.

C03- Students types & prevention methods of of wear & corrosion.

C04- Students types of faults in machine tools & their general causes.

C05- understand steps for periodic & preventive maintenance.

REFERENCE:

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

IIIrd -SEMESTER

CATEGORY -MEOE

SUBJECT CODE -MTTHE 32(C)

SUBJECT - WASTE TO ENERGY

OPEN ELECTIVE

TOTAL HOURS – 60

Objective :

The students will be exposed to obtaining energy from biomass waste

SYLLABUS CONTENTS:

Unit-I:

Introduction to Energy from Waste: Classification of waste as fuel – Agro based, Forest residue, Industrial waste - MSW – Conversion devices – Incinerators, gasifiers, digestors. **(12 HOURS)**

Unit-II:

Biomass Pyrolysis: Pyrolysis – Types, slow fast – Manufacture of charcoal – Methods - Yields and application – Manufacture of pyrolytic oils and gases, yields and applications. **(12 HOURS)**

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. **(12 HOURS)**

Unit-IV:

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. **(12 HOURS)**

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. **(12 HOURS)**

OUTCOME:

C01- Understand the basics regarding utilization of waste to produce Energy.

C02- Understand biomass pyrolysis

C03- Understand types of biomass gasification

C04- Understand the construction and operation of biomass

C05- Understand the procedure of biomass production.

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 & II, 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 & SINCE 1996