Curriculum Structure for M. Tech. Thermal Engineering

(In light of NEP2020)

NCrF Level 7

For students admitted in 2023-24 onwards

Govt. College of Engineering, Amravati
(*An Autonomous Institute of Govt. of Maharashtra*)
Near Kathora Naka, Amravati, Maharashtra

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Specialization: THERMAL ENGINEERING

PROGRAM OBJECTIVES:

I. To enhance professional skills to meet global standards with ethical responsibility

II. To develop ability among the students to design, develop, analyze, test and implement Industrial system.

III. To inculcate the student lifelong learning, skill development and leadership qualities.

IV. To develop ability of research and innovations.

PROGRAM OUTCOMES (POs):

PO1: Ability to independently carry out research investigation and development work to solve practical problems

PO2: Ability to write and present a substantial technical report/document

PO3: Students should be able to demonstrate a degree of mastery over the area as per the specialization of the program. The mastery should be at a level higher than the requirements in the appropriate bachelor program

PO4: Ability to identify and provide feasible solution to the problems in product Development and manufacturing sector

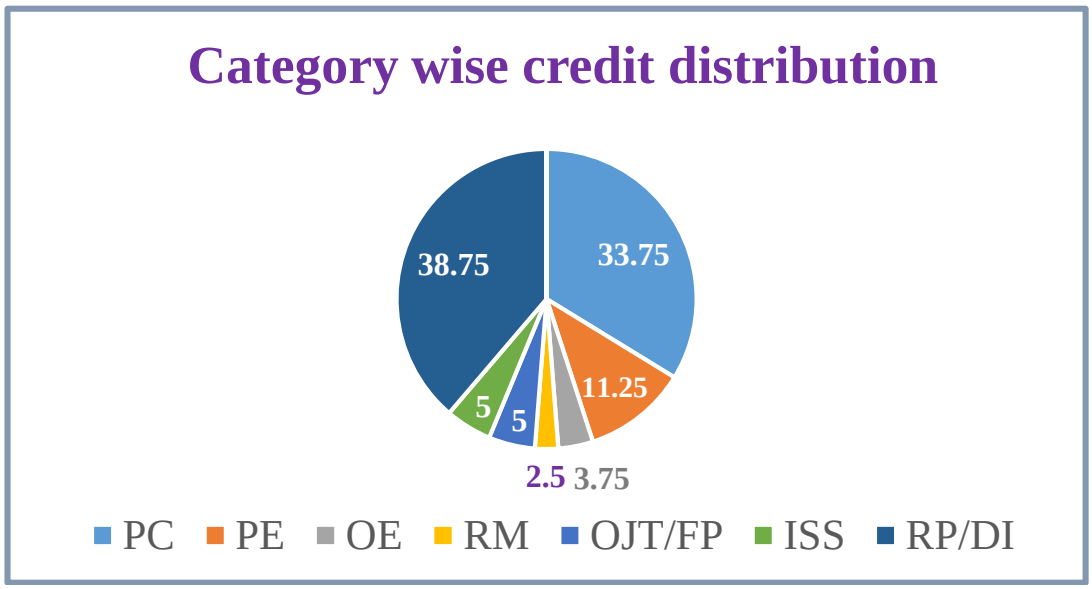
PO5: Ability to apply and use modern tools in the area of Production Engineering

Curriculum Structure for M. Tech. (Thermal Engineering) (In light of NEP 2020)

Category wise credit distribution:

Semester	PC	PE	OE	RM	OJT / FP	ISS	RP / DI	Total
I	15	03	---	---	---	02	---	20
II	12	03	---	02	---	02	---	19
III	---	03	03	---	04	---	13	23
IV	---	---	---	---	---	---	18	18
Total	**27**	**09**	**03**	**02**	**04**	**04**	**31**	**80**

SN	Abbreviation	Meaning	Credits	Percentage
01	PC	Programme Core	27	33.75
02	PE	Programme Elective	09	11.25
03	OE	Open Elective	03	03.75
04	RM	Research Methodology	02	02.50
05	OJT	On-Job Training/ Internship	04	05.00
06	FP	Field Projects		
07	ISS	Independent Study & Seminar	04	05.00
08	RP	Research Project	31	38.75
09	DI	Dissertation		
		Total	80	100.00



General Instructions:

1) 10% content of syllabus of each theory course of first, second and third semesters shall be completed by the students with self-study. The 10% portion of each course (for self-study) shall be declared by the concerned course-coordinator at the beginning of teaching of the course.

2) Student can complete any two theory courses of second semester, if desired, in "online" mode, offered through SWAYAM/ NPTEL. In this case –

i) Students can register and complete these online courses any time after beginning of first semester, however, the student must successfully complete and pass the course, and submit the score card/ certificate before declaration of result of second semester.

ii) In case if a student registers for a course in online mode but fails in the course the student will have to register for the course in the institute whenever it is offered. In this case, the student will have to attend the classes of the course (in order to satisfy the minimum attendance criteria), appear for all the examinations (MSE, TA, ICA, ESE etc) of the course, and successfully complete the course with at least D grade.

3) Student can complete the two theory courses of third semester, if desired, in "online" mode, offered through SWAYAM/ NPTEL. In this case –

i) Students can register and complete these online courses any time after beginning of first semester, however, the student must successfully complete and pass the course, and submit the score card/ certificate before declaration of result of third semester.

ii) In case if a student registers for a course in online mode but fails in the course the student will have to register for the course in the institute whenever it is offered. In this case, the student will have to attend the classes of the course (in order to satisfy the minimum

attendance criteria), appear for all the examinations (MSE, TA, ICA, ESE etc) of the course, and successfully complete the course with at least D grade.

4) Students must complete On-the-job training/ Internship/ Field work for a duration of minimum four weeks during summer break, after completion of second semester of first year in the respective major subject. The assessment of the same shall be done in third semester. The company/ organization for On-job training/ Internship/ Field work must be approved by the DFB

5) Students going for industrial project or going for dissertation at some other institute (approved by DFB), during third and fourth semester, shall complete the courses Programme Elective – III and Open Elective in any one of the two modes –

i) Online courses offered through SWAYAM/ NPTEL: In this case the student must complete the course and submit the score card/ certificate before commencement of fourth semester. Students can register and complete these courses any time after beginning of first semester

In case if a student registers for a course in online mode but fails in the course the student will have to register for the course in the institute whenever it is offered. In this case, the student will have to appear for all the examinations (MSE, TA, ICA, ESE etc) of the course, and successfully complete the course with at least D grade.

ii) Self-study mode: In this case the student will have to study the course of his/her own. The student shall appear for all the college assessments/ examinations (MSE, TA and ESE) personally as per the schedule declared by the institute.

6) Maximum period for completion of M. Tech. programme:

The maximum duration for completion of the PG full time programme is eight semesters from the date of initial registration. The maximum duration of the programme includes the period of withdrawal, absence and different kinds of leaves permissible to a student but it shall exclude the period of rustication of the student from the institute and it shall also exclude the period lapsed between exit after first year (second semester) and reentry at second year (third semester). However, genuine cases on confirmation of valid reasons may be referred to Academic Council for extending this limit by additional one year.

M. Tech. (Thermal Engineering) Semester I

Category	Course Code	Name of the course	Teaching Scheme				Examination Scheme						Credits
							Theory			Practical		Total	
			Theory	Tut	Pract	Total	MSE	TA	ESE	ICA	ESE		
PC	ME2131	Advanced Heat Transfer	04	--	--	04	30	10	60	---	---	100	04
PC	ME2132	Thermodynamics and Combustion	04	--	--	04	30	10	60	---	---	100	04
PC	ME2133	Advance Fluid Dynamics	04	--	--	04	30	10	60	---	---	100	04
PE	ME2134	Programme Elective – I	03	--	--	03	30	10	60	---	---	100	03
PC	ME2135	Laboratory Practice – I	--	--	06	06	--	--	--	50	50	100	03
ISS	ME2136	Seminar – I	--	--	01	01	--	--	--	50	---	50	02
		Total	15	--	07	22	120	40	240	100	50	550	20

List of Programme Electives	
ME2134: Programme Elective – I	
A	Energy Conservation And Management
B	Advanced IC Engine
C	Nuclear Engineering

Note:

I. The contact hours for the students (with concerned supervisor) for Seminar – I shall be one hour per week per student, subject to maximum of four hours per week.

II. The hours shown in the teaching scheme for Seminar I are the contact hours for the students with concerned Supervisor. Each student is expected to devote at least four hours per week for Seminar

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M. Tech. (Thermal Engineering) Semester II

Category	Course Code	Name of the course	Teaching Scheme				Examination Scheme						Credits
							Theory			Practical		Total	
			Theory	Tut	Pract	Total	MSE	TA	ESE	ICA	ESE		
PC	ME2231	Design of solar and wind systems	03	--	--	03	30	10	60	--	--	100	03
PC	ME2232	Steam Engineering	03	--	--	03	30	10	60	--	--	100	03
PC	ME2233	Refrigeration And Cryogenics	03	--	--	03	30	10	60	--	--	100	03
PE	ME2234	Programme Elective – II	03	--	--	03	30	10	60	--	--	100	03
RM	SH2201	Research Methodology	02	--	--	02	30	20	--	--	--	50	02
PC	ME2235	Laboratory Practice – II	--	--	06	06	--	--	--	50	50	100	03
ISS	ME2236	Seminar – II	--	--	01	01	--	--	--	50	--	50	02
OJT/FP	ME2237	On Job Training /Field Project OJT/FP	--	--	--	--	--	--	--	50	--	50	04
		Total	14	--	07	21	150	60	240	150	50	650	23

List of Programme Electives	
ME2204: Programme Elective – II	
A	Gas Turbine
B	Computational Fluid Dynamics
C	Design of Heat Exchangers

Note:

I. The contact hours for the students (with concerned supervisor) for Seminar – II, shall be one hour per week per student, subject to maximum of four hours per week.

II. The hours shown in the teaching scheme for Seminar II are the contact hours for the students with concerned Supervisor. Each student is expected to devote at least four hours per week for Seminar II.

III. Individual students are required to choose a topic of their interest for Seminar II. They shall acquire state-of-the art knowledge in that area and shall define the grey area related to topic (gap analysis) so as to carry dissertation in that area. The students are required to review literature on the topic and deliver seminar.

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Exit option:

- The exit option at the end of one year of the Master's degree program will commence from AY 2024-25.
- Students who have joined a two-year Master's degree program may opt for exit at the end of the first year and he/ she shall be eligible for M. Voc. Degree (Level 6.5)
- The M. Voc. Degree may be awarded to a student provided they have earned all 39 credits of first year (first and second semester) and have earned 04 credits of On-job training / Internship/ Field work during summer break, after completion of the second semester of the first year in the respective Major Subject.
- The student must submit the report of On-job training / Internship/ Field work, in the format prescribed by the institute, as partial fulfilment of award of M. Voc. degree.
- Re-entry to complete the PG degree, after taking the exit option, will be permissible up to 05 years from the date of admission to the PG programme. Such students, after completion of PG degree, shall have to surrender the M. Voc. degree. There shall be a gap of at least six months between exit after first year and re-entry to PG degree at third semester

M. Tech. (Thermal Engineering) Semester III

Category	Course Code	Name of the course	Teaching Scheme				Examination Scheme						Credits
							Theory			Practical		Total	
			Theory	Tut	Pract	Total	MSE	TA	ESE	ICA	ESE		
PE	ME2331	Programme Elective – III	03	--	--	03	30	10	60	--	--	100	03
OE	SH2301	Open Elective	03	--	--	03	30	10	60	--	--	100	03
RP/ DI	ME2332	Dissertation Stage – I	--	--	04	04	--	--	--	150	--	150	13
		Total	06	--	04	10	60	20	120	150	--	350	19

List of Programme Electives			List of Open Electives	
ME2331: Programme Elective – III			SH2301: Open Elective	
A	Artificial Intelligence and Machine Learning		A	Industrial Safety
B	Thermal Management of Electronic Cooling Equipment		B	Operations Research
C	Finite Element Method		C	Project Management
D	Air Conditioning System Design		D	Data Structures and Algorithm
			E	Nano Technology

Note: The hours shown in the teaching scheme for Dissertation Stage I are the contact hours for the students with concerned supervisor. The student is expected to devote at least twenty-six hours per week for Dissertation Stage I.

M. Tech. (Thermal Engineering) Semester IV

Category	Course Code	Name of the course	Teaching Scheme				Examination Scheme						Credits
							Theory			Practical		Total	
			Theory	Tut	Pract	Total	MSE	TA	ESE	ICA	ESE		
RP/ DI	ME 2431	Dissertation Stage – II	--	--	04	04	--	--	--	100	200	300	18
		Total	--	--	04	04	--	--	--	100	200	300	18

Note:

I. Dissertation Stage – I is pre-requisite for Dissertation Stage – II

II. The hours shown in the teaching scheme for Dissertation Stage II are the contact hours for the students with concerned supervisor. The student is expected to devote at least thirty-six hours per week for Dissertation Stage II.

Comparison of existing and new programme structure:

i) On the basis of Marks and Credit:

Semester	Marks		Credits	
	Existing	**New**	**Existing**	**New**
I	610	550	17	20
II	600	600	19	19
III	300	400	16	23
IV	400	300	16	18
Total	**1910**	**1850**	**68**	**80**

ii) On the basis of semester wise number of courses:

	Number of courses									
	Semester I		Semester II		Semester III		Semester IV		Total	
	Existing	New	Existing	New	Existing	New	Existing	New	Existing	New
Theory	05	04	05	05	02	02	---	---	12	11
Practical	01	01	01	01	---	---	---	---	02	02
Seminar	01	01	01	01	---	---	---	---	02	02
Internship	---	---	---	---	---	01	---	---	---	01
Dissertation	---	---	---	---	01	01	01	01	02	02

iii) On the basis of course category:

Course category	Number of courses		Credits	
	Existing	**New**	**Existing**	**New**
PC	08	08	24	27
PE	03	03	09	09
OE	02	01	03	03
RM	01	01	02	02
OJT / FP	---	01	---	04
ISS	02	02	04	04
RP / DI	02	02	26	31
Total	**18**	**18**	**68**	**80**

Department of Mechanical
Equivalence Scheme

Sr	Course code with Name of course(old)		Credit	Course code with Name of course (new)		Credit
1	MEP131	Advanced Heat Transfer	3	ME2131	Advanced Heat Transfer	3
2	MEP132	Thermodynamics and combustion	3	ME2132	Thermodynamics and combustion	3
3	MEP133	Advance Fluid Dynamics	3	ME2133	Advance Fluid Dynamics	3
4	MEP134 (A)	Energy conservation and management	3	ME2134 (A)	Energy conservation and management	3
5	MEP134 (B)	Advanced IC engine	3	ME2134 (B)	Advanced IC engine	3
6	MEP134 (C)	Nuclear engineering	3	ME2134 (C)	Nuclear engineering	3
7	MEP135	Laboratory Practice – I	2	ME2135	Laboratory Practice – I	2
8	MEP136	Seminar – I	2	ME2136	Seminar – I	2
9	MEP231	Design of solar and wind systems	3	ME2231	Design of solar and wind systems	3
10	MEP232	Steam Engineering	3	ME2232	Steam Engineering	3
11	MEP233	Refrigeration And Cryogenics	3	ME2233	Refrigeration And Cryogenics	3
12	MEP234 (A)	Gas Turbine	3	ME2234 (A)	Gas Turbine	3
13	MEP234 (B)	Computational Fluid Dynamics	3	ME2234 (B)	Computational Fluid Dynamics	3
14	MEP234 (C)	Design Of Heat Exchangers	3	ME2234 (C)	Design Of Heat Exchangers	3
15	SHP221	Research Methodology	3	SH2201	Research Methodology	3
16	MEP235	Laboratory Practice – II	2	ME2235	Laboratory Practice – II	2
17	MEP236	Seminar – II	2	ME2236	Seminar – II	2

Programme Name:-M.Tech (Thermal Engineering)

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Course Code	ME2131							Course category		PC
Course Name	ADVANCED HEAT TRANSFER									
Teaching Scheme				Examination Scheme						Credits
Th	Tu	Pr	Total	Theory				Practical		Total	
				MSE	TA	ESE	ESE Duration	ICA	ESE		
04	--	--	04	30	10	60	2 hrs 30 min	--	--	100	04

Course Objectives:

1. To apply appropriate governing equation and boundary conditions to solve 1D, 2D steady and unsteady state conduction problems
2. To identify the non-dimensional parameters and their significance in the forced and free convection
3. To employ proper analogy and empirical correlations for solving convection problems
4. To describe phenomenon and mechanisms in condensation, boiling, transpiration cooling and ablation heat transfer
5. To interpret the physical mechanism in heat pipes

Course Contents:

Steady state conduction: Basics of heat transfer, General heat conduction equationin rectangular, cylindrical and spherical co-ordinate systems, One dimensional steady state conduction with and without heat generation, Variable thermal conductivity, Critical radius of insulation. Fins of non-uniform cross section. Two dimensional heat conduction, analytical, and graphical methods, Conduction shape factor. Introduction to finite difference numerical solution.

Unsteady state heat conduction: Lumped capacitance, Infinite plate of finite thickness, Semi- infinite solid, Applicability of Heisler and Grober charts.

Convection heat transfer: Forced convection, Conservation equations, Integral and analytical solutions, Boundary layer analogies, Internal and external flows, Laminar and turbulent flows, Flow across cylinders and tube banks, Empirical solutions.

Free convection: Governing equations, Laminar and turbulent flows, Analytical and empirical solutions. Combined free and forced convection.

Boiling, Condensation and Heat pipes: Pool boiling and convective boiling. Film condensation and drop-wise condensation. Transpiration cooling, Ablation. Classification, construction and applications of heat pipe.

Radiation: Fundamentals, Radiation shape factor, Heat exchange between non-black bodies using network approach, Enclosure analysis, Radiation shields, gas radiation, radiation network for an absorbing and transmitting medium, Effect of radiation on temperature measurement.

Reference Books:

1. Frank Kreith, "Principles of Heat Transfer", Harper and Row Publishers, New York, 1973.
2. D.Q. Kern "Process Heat Transfer", Tata McGraw Hill Publishing Company Ltd., New Delhi, 1975.
3. Gupta and Prakash, "Engineering Heat Transfer", New Chand and Bros, Roorkee (U.P.) India, 1996.
4. R.C. Sachdeva "Fundamentals of Engineering Heat and Mass Transfer", New Age International, 2017.
5. C.P.Kothandaraman and S.Subramanyam, "Heat and Mass Transfer Data Book", New Age International 2014
6. J.A. Adams and D.E. Roger. "Computer Aided Heat Transfer Analysis". Tata McGraw Hill Publication, 1997
7. Kays and Crawford, "Convective Heat andMass Transfer", Tata McGraw Hill Publication, 1998
8. S.W. Chi. "Heat Pipe Theory and Application", Springer Link Publication, 1998

Course Outcomes:

On completion of the course, students will be able to:

ME2131.1 Solve ID and 2D steady and unsteady state heat conduction problems by utilizing analytical, graphical, numerical and chart solution
ME2131.2 Evaluate the performance of fins having non-uniform cross section
ME2131.3 Make use of non-dimensional parameters and empirical correlations to analyse convection heat transfer in external and internal, forced and free convection
ME2131.4 Determine heat transfer coefficient in condensation and boiling phenomena and illustrate the physical mechanism involved in heat pipes
MEP231.5 Estimate the radiative heat exchange between surfaces

CO – PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5
ME2131.1	2	3	2	1	1
ME2131.2	1	2	2	2	3
ME2131.3	2	3	3	1	3
ME2131.4	1	1	2	3	2
ME2131.5	3	2	1	1	3

0 - Not correlated 1 - Weakly Correlated 2 - Moderately Correlated 3 - Strongly Correlated

Course Code	ME2132							Course category		PC
Course Name	THERMODYNAMICS AND COMBUSTION									
Teaching Scheme				Examination Scheme						Credits
Th	Tu	Pr	Total	Theory				Practical		Total	
				MSE	TA	ESE	ESE Duration	ICA	ESE		
04	--	--	04	30	10	60	2 hrs 30 min	--	--	100	04

Course Objectives:

1. To develop methodical problem solving approach about Entropy, Availability and irreversibility
2. To describe phenomenon of Transient flow analysis
3. To identify proper thermodynamic correlations emphasize on real gas behaviour and reacting mixtures
4. To establish appropriate thermo-chemical correlations on combustion and their significance
5. To interpret first, second law and Entropy

Course Contents:

First law and State postulates, Second law and Entropy, Availability and lrreversibility, Transient flow analysis

Nonreactive ideal gas mixtures, P-V-T behavior of Real Gases and Real Gas Mixture

Generalized Thermodynamic Relationships

Combustion and Thermo-chemistry, Second law analysis of reacting mixtures, Availability analysis of reacting mixtures, Chemical Equilibrium

Statistical Thermodynamics, Statistical interpretations offirst and second law and Entropy

Third law of Thermodynamics, Nerst heat theorem

Reference Books:

1. Cengel, "Thermodynamics", Tata-McGraw HillCo., New Delhi, 1980.
2. Van Wylen& Sonntag, "Thermodynamics" . John Wiley and Sons lnc., USA.
3. Holman, "Thermodynamics" McGraw Hill Inc., New York,2002
4. Rao Y.V.C., "Postulational and Statistical Thermodynamics", Allied Publishers Inc, 1994
5. Howell and Dedcius, "Fundamentals of Engineering Thermodynamics", McGraw Hill Inc., USA
6. Johns and Hawkings, "Engineering Thermodynamics", John Wiley and Sons lnc, USA, 2004
7. Fairs V.M. and Simmang, "Thernrodynamics" Mactnillan Publishing Co. Inc. USA

Course Outcomes:

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

ME2132.1 Solve the methodical problems on Entropy, Availability and Irreversibility

ME2132.2 Analyze the Transient flow analysis of thermodynamic systems

ME2132.3 Justify the thermodynamic correlations on real gas behaviour and reacting mixtures

ME2132.4 Evaluate the thermodynamic properties using empirical correlations on combustion and chemical equilibrium

ME2132.5 Statistical interpretations of first and second law

CO – PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5
MEP132.1	2	3	1	2	3
MEP132.2	3	2	1	3	2
MEP132.3	2	2	2	2	3
MEP132.4	1	1	2	1	1
MEP132.5	1	2	2	1	2

0 - Not correlated 1 - Weakly Correlated 2 - Moderately Correlated 3 - Strongly Correlated

Course Code	ME2133	Course category	PC
Course Name	ADVANCE FLUID DYNANIICS		

Teaching Scheme				Examination Scheme							Credits
Th	Tu	Pr	Total	Theory				Practical		Total	
				MSE	TA	ESE	ESE Duration	ICA	ESE		
04	--	--	04	30	10	60	2 hrs 30 min	--	--	100	04

Course Objectives:

1. To understand the fluid flow concept
2. To Identify the fundamental kinematics of a fluid element
3. To State the conservation principles of mass, linear momentum, and energy for fluid flow
4. To Apply the basic applied-mathematical tools that support fluid dynamics
5. To apply derivation of governing equations for turbulent flow

Course Contents:

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

Reference Books:

1. Muralidhar and Biswas, "Advanced Engineering Fluid Mechanics", Alpha Science International, 2005

2. *I*rsin 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, lnnq
5. Cengel, Y.A. and J.M. Cimbala, "Fluid Mechanics", McGraw-Hill, Boston, MA
6. Schlichting, H., "Boundary Layer Theory", McGrar.v-Hill,.

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

ME2133.1 Understand and define the fluid flow problems along with range of governing parameters

ME2133.2 Take up the fluid flow problems of industrial base.

ME2133.3 Devise the experiments in the field of fluid mechanics.

ME2133.4 Understand the flow patterns and differentiate between the flow regimes.

ME2133.5 Apply data analysis and design of experiments

CO – PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5
ME2133.1	2	3	2	1	1
ME2133.2	1	2	2	2	3
ME2133.3	2	3	3	1	3
ME2133.4	1	1	2	3	2
ME2133.5	3	2	1	1	3

0 - Not correlated 1 - Weakly Correlated 2 - Moderately Correlated 3 - Strongly Correlated

Course Code	ME2134(A)	Course category	PE
Course Name	ENERGY CONSERVATION AND MANAGEMENT		

Teaching Scheme				Examination Scheme							Credits
Th	Tu	Pr	Total	Theory				Practical		Total	
				MSE	TA	ESE	ESE Duration	ICA	ESE		
03	--	--	03	30	10	60	2 hrs 30 min	--	--	100	03

Course Objectives:

1. To utilise data of energy to frame strategy.
2. To plan energy supply on short term, mid-term and long term basis
3. To ensure adequate supply of various forms of secondary (usable) energy to various consumers in the allocated geographical zone with minimum cost and minimum environmental pollution and to regulate energy flow
4. To select optimum energy forms for consumption and to optimize energy consumption of each form of energy for reducing energy costs and
5. To improving productivity, standard of living and environment

Course Contents:

Introduction The energy market, energy scenario, planning, utilization pattern and future - strategy. Importance of energy management Energy consumption in electric motor, illumination, compressors .pumps, cooling towers, fans blowers, generating set run by diesel engine

Energy Auditing- Energy auditing methodology and analysis

Energy Economics - Energy economics and cost calculations

Energy conservation-Energy conservation in industries, Cogeneration, Combined heating and power systems, different mechanical systems

Relevant standards & laws- Energy Relevant international standards and laws

Reference Books:

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.

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

ME2134A.1 Discuss the importance of energy and frame the strategy

ME2134A.2 Analyze energy consumption of electrical and mechanical utility

ME2134A.3 Select the methods of energy audit of electrical utilities, mechanical utilities in industry.

ME2134A.4 Plan energy conservation solutions

ME2134A.5 Energy Relevant international standards and laws

CO – PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5
ME2134A.1	2	3	2	1	1
ME2134A.2	1	2	2	2	3
ME2134A.3	2	3	3	1	3
ME2134A.4	1	1	2	3	2
ME2134A.5	3	2	1	1	3

0 - Not correlated 1 - Weakly Correlated 2 - Moderately Correlated 3 - Strongly Correlated

Course Code	ME2134(B)							Course category		PE
Course Name	ADVANCED IC ENGINE									
Teaching Scheme				Examination Scheme						Credits
Th	Tu	Pr	Total	Theory				Practical		Total	
				MSE	TA	ESE	ESE Duration	ICA	ESE		
03	--	--	03	30	10	60	2 hrs 30 min	--	--	100	03

Course Objectives:

1. To understand the underlying principles of operation of IC Engines components and combustion phenomenon of SI and CI engines
2. To provide knowledge on pollutant formation, control, alternate fuel etc
3. To Study Modern Trend in IC Engine
4. To study Air motion introduction to Turbo charging
5. To studyFuel Spray behaviour and spray structure

Course Contents:

Spark ignition Engines: Mixture requirements - Fuel injection systems - Monopolist, Multipoint & Direct injection - Stages of combustion - Normal and Abnormal combustion - Knock - Factors affecting knock - combustion chambers. Performance characterises
compression Ignition Engines: Diesel Fuel Injection systems - Stages of combustion - Knocking - Factors affecting knock - Direct and Indirect injection systems - combustion chambers * Fuel Spray behaviour - spray structure and spray penetration - Air motion - introduction to Turbo charging. Performance Characterises
Pollutant Formation And Control: pollutant - Sources - Formation of carbon Monoxide, Un burnt hydrocarbon, oxides of Nitrogen, Smoke and particulate matter - Methods of controlling Emissions - Catalytic converters, Selective Catalytic Reduction and particulate Traps - Methods of measurement - Emission norms and Driving cycles
Alternative Fuels: Alcohol, Hydrogen, compressed Natural Gas, Liquefied petroleum gas and Bio Diesel - Properties, Suitability, Merits and Demerits - Engine Modifications.
Recent Trends: Air assisted combustion, Homogeneous charge compression ignition engines - variable Geometry turbochargers - common Rail Direct Injection Systems - Hybrid electric Vehicles -Nox Absorbers - Onboard Diagnostics

Reference Books:

1. Haywood, "1.C. Engines", McGraw Hill.

2. V. Ganeshan, "Internal Combustion Engines", Tata McGraw Hill, New Delhi, 1996.

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3. Ramos J (1989) Internal Combustion Engine Modeling. Hemisphere Publishing Company

4. C. D. Rakopoulos and E. G. Giakoumis, "Diesel Engine Transient

5. Operation Principles of Operation and Simulation Analysis", Springer, 2009.

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

ME2134B.1 Analyse the effect of various operating variables on engine performance

ME2134B.2 Evaluate performance analysis of IC engine and justify the suitability of IC engine for different application

ME2134B.3 Understand the conventional and unconventional fuels for IC engine and effect of emission formation and its control.

ME2134B.4 Develop the knowledge of technological advancements of LC Engine

ME2134B.5 Variable Geometry turbochargers ,common Rail Direct Injection Systems.

CO – PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5
ME2134B.1	2	3	1	2	3
ME2134B.2	3	2	1	3	2
ME2134B.3	2	2	2	2	3
ME2134B.4	1	1	2	1	1
ME2134B.5	1	1	2	1	1

0 - Not correlated 1 - Weakly Correlated 2 - Moderately Correlated 3 - Strongly Correlated

Course Code	ME2134(C)							Course category			PE
Course Name	NUCLEAR ENGINEERING										
Teaching Scheme				Examination Scheme							Credits
Th	Tu	Pr	Total	Theory				Practical		Total	
				MSE	TA	ESE	ESE Duration	ICA	ESE		
03	--	--	03	30	10	60	2 hrs 30 min	--	--	100	03

Course Objectives:

1. To understand the reactor physics
2. To understand the reprocessing of nuclear fuels.
3. To learn reactor kinetics and control
4. To learn about the waste disposal and radiation protection
5. To leaconcept of criticality of thermal reactors

Course Contents:

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

Multi group, multi region diffusion equation, concept of criticality: Solution of multi group diffusion equations in one region and multi-region reactors, concept of criticality of thermal reactors

Reactor kinetics and control: Derivation of point kinetics equations, in our 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

Reference Books:

1. lntroduction_to Nucrear Engineering (3rd Edition) by John R. Lamarsh, Anthony J.Barrata, Prentice Hall, (2001)
2. lntroduction to Nucrear Reactor Theory. by John R.Lamarsh, Addison-Wesley, 1966

3. Nuclear Reactor Anarvsis. by James J. Duderstadt and Lewis J. Hamirton, John winey(1976)

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

ME2134C.1 Acquire insight about the basic concepts and processes taking place inside a nuclear reactor, such as nuclear fission, neutron production, scattering, diffusion, stowing down and absorption

ME2134C.2 Perceive with the concepts of reactor criticality, the relationships between the dimension and fissile material concentration in a critical geometry

ME2134C.3 Understand, time dependent (transient) behaviour of power reactor in non steady state operation and the means to control the reactor

ME2134C.4 Familiar with the concept of heat removal from reactor core, reactore safety and radiation protection.

ME2134C.5 Apply the Diffusion equations in one region and multi-region reactors

CO – PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5
ME2134C.1	2	3	1	2	3
ME2134C.2	3	2	1	3	2
ME2134C.3	2	2	2	2	3
ME2134C.4	1	1	2	1	1
ME2134C.5	1	2	2	2	1

0 - Not correlated 1 - Weakly Correlated 2 - Moderately Correlated 3 - Strongly Correlated

Course Code	ME2135							Course category		PC
Course Name	LAB PRACTICE I									
Teaching Scheme				Examination Scheme						Credits
Th	Tu	Pr	Total	Theory				Practical		Total	
				MSE	TA	ESE	ESE Duration	ICA	ESE		
	--	06	06	--		--		50	50	100	03

Course Objectives:

1. To acquire knowledge of experimental methods and their applications
2. To get insight into design, simulation and programming tools
3. To apply experimental and modem advanced techniques to solve practical problems

Course Contents:

Laboratory Practice shall constitute laboratory experiments, design, simulation, programming assignments, industrial visits with reports and its outcome etc. The tutorials and experiments shall decided by the course teachers of the Program Core Courses (PCC) namely Advanced Heat Transfer, Thermodynamics and Combustion, Advanced Fluid Dynamics and Elective I Course of Advanced IC Engines.

List of Tutorials and Experiments:

The students shall perform minimum of (8) experiments based on the following courses

- Advanced Heat Transfer
- Thermodynamics and Combustion
- Advanced Fluid Dynamics
- Advanced IC engine

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

ME2135.1 Formulate problems, perform experimental investigations, interpret and analyze the data using modem mathematical and scientific methods.
ME2135.2 Identify and interpret the effect of various parameters on the system performance and correlate these parameters
ME2135.3 Provide feasible solutions to the real problems faced by the industry and research organizations

CO – PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5
ME2135.1	2	3	3	3	2
ME2135.2	3	3	2	2	3
ME2135.3	3	1	2	3	3

0 - Not correlated 1 - Weakly Correlated 2 - Moderately Correlated 3 - Strongly Correlated

Course Code	ME2136					Course category		ISS
Course Name	SEMINAR-I							
Teaching Scheme				Examination Scheme				Credits
Th	Tu	Pr	Total	Theory				Practical		Total	
				MSE	TA	ESE	ESE Duration	ICA	ESE		
--	--	01	01					50	--	50	02

Course Objectives:

1. To Promote and develop effective communication and presentation skills
2. To utilize technical resources
3. To identify, evaluate and synthesize information from a range of sources to enhance knowledge of current developments in the field of production engineering

Course Contents:

Topic of the seminar shall be a general topic. Evaluation would be done by three member committee based on seminar report and a presentation. Evaluation would be based on the seminar report submitted by the student and on the presentation made by him.

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

ME2136.1 Collect and review the relevant literature from various sources

ME2136.2 Explore development in the topic of interest and inculcate self-learning

ME2136.3 Write technical report and give presentation

CO – PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5
ME2136.1	2	3	2	1	1
ME2136.2	1	2	2	2	3
ME2136.3	2	3	3	1	3

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M. Tech. (Thermal Engineering) Semester II

Course Code	ME2231	Course category	PC
Course Name	DESIGN OF SOLAR AND WIND SYSTEMS		

Teaching Scheme				Examination Scheme							Credits
Th	Tu	Pr	Total	Theory				Practical		Total	
				MSE	TA	ESE	ESE Duration	ICA	ESE		
03	--	--	03	30	10	60	--	--	---	100	03

Course Objectives:

1. To get insight into energy scenario and promising alternative energy sources available
2. To get conversant with estimation and measurement of solar radiation
3. To analyze the performance of Liquid flat prate collectors, concentrating collectors and solar photovoltaic systems
4. To identify design aspects and performance parameters of wind energy conversion
5. To study Environmental impacts and challenges

Course Contents:

Solar Energy: Solar radiation estimation, prediction and measurement, Flat plate and concentrating collectors- design, analysis and performance, applications. Solar thermal systems, applications, power generation. Photovoltaic power - principle, performance. Economic analysis.

Thermal Energy Storage: Solar Pond, Sensible, Latent, Thermochemical storage.

Wind Energy: Atmospheric circulation, Wind speed monitoring, Wind energy converters- classification, characteristics, application, design aspects, performance and Betz limit.

Ocean Energy: Ocean thermal energy conversion, open cycle & closed cycle plants. Tidal energy, single basin and double basin plants. Wave energy, conversion devices. Environmental impacts and challenges.

Energy from Biomass: Thermo chemical conversion, Biochemical conversion, Dual fuel engine.

Geothermal Energy Resources and potential, Utilization methods and aspects.

Reference Books:

1. SP Sukhatme. "Solar Energy: Principles of Thermal Collection and Storage". Tata McGraw-Hill, 2006
2. M.M.LI- Wakil. "Power Plant Technology". McGraw Hill, 2010
3. AB Meinal and M.P Meinal. "Applied Solar Energy", Addison Wesley, 1976
4. D.Y. Goswami, F. Kreith and J.F. Kreider, "Principle of Solar Engineering", Taylor Francis, 2000.

5. N.K. Bansal, "Non-Conventional Energy Resources", Vikas Publishing House, 2014.

Course Outcomes:

On completion of the course, students will be able to:

ME2231.1 Identify potential and importance of non-conventional-energy sources and their use for power generation

ME2231.2 Estimate the radiation received and absorbed by the solar collector at a given location

ME2231.3 Evaluate the performance liquid flat plate collectors, concentrating collectors and photovoltaic cell

ME2231.4 Illustrate the aspects related to thermal energy storage

ME2231.5 Classify wind energy converters and determine the power produced

CO – PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5
ME2231.1	2	3	2	1	1
ME2231.2	1	2	2	2	3
ME2231.3	2	3	3	1	3
ME2231.4	1	1	2	3	2
ME2231.5	3	2	1	1	3

0 - Not correlated 1 - Weakly Correlated 2 - Moderately Correlated 3 - Strongly Correlated

Course Code	ME2232	Course category	PC
Course Name	STEAM ENGINEERING		

Teaching Scheme				Examination Scheme							Credits
Th	Tu	Pr	Total	Theory				Practical		Total	
				MSE	TA	ESE	ESE Duration	ICA	ESE		
03	--	--	03	30	10	60	2 hrs 30 min	--	--	100	03

Course Objectives:

1. Explain types of boilers and Design piping and insulation
2. Estimate steam distribution losses
3. Determine boiler efficiency and performance
4. Manage waste minimisation and control of boiler
5. To study factors affecting boiler performance

Course Contents:

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 loss, Heat savings and application criteria. Refractory-types, selection and application of refractory

Steam Systems: Assessment of steam distribution losses, Steam leakages, Steam trapping. Condensate and flash steam recovery system, Steam Engineering Practices; Steam Based Equipment/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, economic viability of waste minimization

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

Reference Books:

1. Amra S.C and Domkundwar, A Course in Power Plant Engineering: Dhanapat Rai and Sons
2. Book II-Energy Efficiency in Thermal Utilities; Bureau of Energy Efficiency Book IV-Energy Performance Assessment for Equipment & Utility Systems, Bureau of Energy Efficiency

3. T.D. Estop. A. McConkey, Applied Thermodynamics, Parson Publication
4. Edited by J. B. Kitto& S C Stultz; Its Generation and Use; The Babcock and Wilcox Company
5. Yunus A. Cengel and Boles. "Engineering Thermodynamics", Tata McGraw-Hill Publishing Co. Ltd

Course Outcomes: On completion of the course, students will be able to:

ME2232.1 Design water line and steam line piping and its insulation

ME2232.2 Use steam engineering practices to handle steam leakages and steam recovery

ME2232.3 Assess the performance of boiler by test codes and procedure

ME2232.4 Apply energy conservation techniques and proper instrumentation for a control

ME2232.5 Apply the Performance Test codes and procedure

CO – PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5
ME2232.1	2	3	1	2	3
ME2232.2	3	2	1	3	2
ME2232.3	2	2	2	2	3
ME2232.4	1	1	2	1	1
ME2232.5	1	1	2	1	1

0 - Not correlated 1 - Weakly Correlated 2 - Moderately Correlated 3 - Strongly Correlated

Course Code	ME2233	Course category	PC
Course Name	REFRIGERATION AND CRYOGENICS		

Teaching Scheme				Examination Scheme							Credits
Th	Tu	Pr	Total	Theory				Practical		Total	
				MSE	TA	ESE	ESE Duration	ICA	ESE		
03	--	--	03	30	10	60	2 hrs 30 min	--	--	100	03

Course Objectives:

1. To compare the phenomenon of refrigeration and cryogenics
2. To analyze the VCR & vapour absorption refrigeration cycles for performance improvement
3. To describe the mechanism of multiple components refrigeration and gas liquefaction systems
4. To employ Recent Trends in Refrigerants & norms
5. To study food preservation and transportation

Course Contents:

Steady state conduction: Review of Basic Refrigeration Cycles: Reverse Carnot Cycle, Vapour compression refrigeration, actual cycle, second law efficiency, Introduction to Vapor absorption refrigeration single effect and double effect systems, Refrigeration applications, food preservation, transport,

Multi Pressure Systems: Multistage compression with inter-cooling. Multi-evaporator system: Cascade systems,

Refrigeration Components: Performance characteristics and capacity control of reciprocating and centrifugal compressors, screw compressor and scroll compressor, Design, selection evaporators, condensers, control systems, motor selection, Refrigerants: Classification of Refrigerants, Green House Effect, Numbering and Colour Coding of Refrigerants, alternative refrigerants, CFC/HCFC phase-out regulations.

Gas liquefaction systems: Introduction to Cryogenics & its applications, Linde-Hampson, Lind dual pressure, Claude cycle.

Reference Books:

1. Ahmadul Ameen. "Refrigeration and Air-conditioning", Prentice Hall of India, New Delhi,200
2. CP.Arora, "Refrigeration and Air-conditioning, Tata McGraw-Hill, 2nd edition.2003
3. J. A., Whitman, W. C.Johnson, Refrigeration and Air Conditioning Technology. W.M., Pub:

Sign Member Secretary | Sign BoS Chairperson | Sign Dean (Academics) | Sign Principal

Delmar S.Africa, 4" edition, 2000

4. RJDossat, "Principles of Refrigeration. Pearson Education Asia, 2001.

5. Stoecker& Jones, "Refrigeration and Air-conditioning", McGraw Hill Book Company, NewYork, 1982

Course Outcomes:

On completion of the course, students will be able to:

ME2233.1 Identify the application areas of refrigeration and cryogenics

ME2233.2 Perform thermodynamic analysis of refrigeration and cryogenics cycles

ME2233.3 Suggest the environment friendly refrigerant for given applications based on ODP, GWP and related environment issues

ME2233.4 Design a multiple components of refrigeration systems from given input

ME2233.5 Apply the Numbering and Colour Coding of Refrigerants.

CO – PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5
ME2232.1	2	3	1	2	3
ME2232.2	3	2	1	3	2
ME2232.3	2	2	2	2	3
ME2232.4	1	1	2	1	1
ME2232.5	2	1	2	2	1

0 - Not correlated 1 - Weakly Correlated 2 - Moderately Correlated 3 - Strongly Correlated

Course Code	ME2234(A)							Course category			PE
Course Name	GAS TURBINE										
Teaching Scheme				Examination Scheme							Credits
Th	Tu	Pr	Total	Theory				Practical		Total	
				MSE	TA	ESE	ESE Duration	ICA	ESE		
03	--	--	03	30	10	60	2 hrs 30 min	--	--	100	03

Course Objectives:

1. To familiarize with the application of each component like Compressor, combustion
2. Chamber, fans, nozzle, integrate into aircraft system
3. To impart the detail concept of various types of Compressor like Centrifugal and axial
4. To get conversant with blade materials of gas turbine
5. To understand environmental considerations and applications.

Course Contents:

Introduction, Cycles, Performance characteristics and improvement,

Gas Dynamics. Centrifugal, axial and mixed flow compressor, principles and characteristics,. 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.

Reference Books:

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

Course Outcomes:

On completion of the course, students will be able to:

ME2234A.1 Analyze thermodynamics cycles, and different sizes layouts of gas turbine plant
ME2234A.2 Apply the thermodynamics concept to the components for efficiency of gas turbines
ME2234A.3 Compare features of gas turbines engines integrates enhancing the into an aircraft

system

ME2234A.4 Parameters affecting performance in gas turbine

ME2234A.5 Compare the Combustion Systems, various fuels and fuel systems.

CO – PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5
ME2234A.1	2	3	3	3	2
ME2234A.2	3	3	2	2	3
ME2234A.3	3	1	2	3	3
ME2234A.4	1	3	1	2	1
ME2234A.5	3	2	2	1	3

0 - Not correlated 1 - Weakly Correlated 2 - Moderately Correlated 3 - Strongly Correlated

Course Code	ME2234 (B)							Course category		PE
Course Name	COMPUTATIONAL FLUID DYNAMICS									
Teaching Scheme				Examination Scheme						Credits
Th	Tu	Pr	Total	Theory				Practical		Total	
				MSE	TA	ESE	ESE Duration	ICA	ESE		
03	--	--	03	30	10	60	2 hrs 30 min	--	--	100	03

Course Objectives:

1. To develop an understanding for the major theories, approaches and methodologies used in CFD
2. To build up the skills in the actual implementation of CFD methods (e.g. boundary 11. conditions, turbulence modelling etc.) in using commercial CFD codes
3. To gain experience in the application of CFD analysis to real engineering designs.
4. To understand domain discretization and types of mesh
5. To study NS Equations for Incompressible Flows

Course Contents:

Steady 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

Modelling and Grid Generation: Practical aspects of computational modelling 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 NS Equations for Incompressible Flows

Reference Books:

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. Introduction to Computational Fluid Flow (Finite Volume Method), by K. Versteeg Malalaskene. Printice Hall

4. Computational Methods for Fluid Dynamics by Verziger and Peris, Springer Publication
5. Adition Computational hood Mechanics by Clinen Yen Wiley

Course Outcomes:

On completion of the course, students will be able to:

ME2234B.1 Understand the subject of Computational Fluid Dynamics

ME2234B.2 Apply CFD as tool to solve the Heat Transfer and Fluid Mechanics related Industrial Problems.

ME2234B.3 Create the base and interest to carry out the Future Research

ME2234B.4 Describe objectives and importance of CFDHT

ME2234B.5 Undertake computational modelling of flow domains

CO – PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5
ME234B.1	2	3	3	3	2
ME2234B.2	3	1	2	3	3
ME2234B.3	3	1	2	3	3
ME2234B.4	3	1	2	3	3
ME2234B.5	3	1	2	3	3

0 - Not correlated 1 - Weakly Correlated 2 - Moderately Correlated 3 - Strongly Correlated

Course Code	ME2234(C)	Course category	PC
Course Name	DESIGN OF HEAT EXCHANGERS		

Teaching Scheme				Examination Scheme							Credits
Th	Tu	Pr	Total	Theory				Practical		Total	
				MSE	TA	ESE	ESE Duration	ICA	ESE		
03	--	--	03	30	10	60	2 hrs 30 min	--	--	100	03

Course Objectives:

1. To get insight into thermal modelling and design of heat exchangers
2. To get conversant with empirical correlations as applied to design of heat exchangers
3. To identify aspects and principles of mechanical design of heat exchangers
4. To get acquainted with the standard codes for design of heat exchangers
5. To study simulation and optimization of heat exchangers

Course Contents:

Fluid 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 hear exchangers, flow induced vibration.

Reference Books:

1. RK. Shah and DP. Sekulic. "Fundamentals of Heat Exchanger Design" John Wiley, 2003

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2. KP Sing and Al Soler, "Mechanical design of heat exchangers and pressure vessel Arcturus Publishers,1984
3. DQ Kem. Process Heat Transfer, McGraw Hill, 1950
4. A.P. Frass and MN Ozisik, "Heat Exchanger Design", McGraw Hill, 1984
5. Sadikkakac and Hongton Liu, "Heat Exchangers: Selection, Rating and Thermal press, 2017 CRC Press, 1998. Design

Course Outcomes:

On completion of the course, students will be able to:

ME2234C.1 Apply principles of fluid mechanics and heat transfer for thermal modeling of heat exchangers

ME2234C.2 analyze thermal performance of double pipe heat exchanger, shell and tube heat exchanger and cross flow heat exchanger

ME2234C.3 Illustrate mechanical design of components of heat exchangers

ME2234C.4 Identify aspects of selection of materials for heat exchangers

ME2234C.5 Design of Heat Exchangers

CO – PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5
ME2234C.1	2	3	1	2	3
ME2234C.2	3	2	1	3	2
ME2234C.3	2	2	2	2	3
ME2234C.4	1	1	2	1	1
ME2234C.5	2	1	2	1	1

0 - Not correlated 1 - Weakly Correlated 2 - Moderately Correlated 3 - Strongly Correlated

Course Code	SH2201							Course category			RM
Course Name	RESEARCH METHODHOLOGY										
Teaching Scheme				Examination Scheme							Credits
Th	Tu	Pr	Total	Theory				Practical		Total	
				MSE	TA	ESE	ESE Duration	ICA	ESE		
02	--	--	02	30	20			50	--	50	02

Course Objectives:

1. To understand some basic concepts of research and its methodologies
2. To Learn the ethical, political, and pragmatic issues involved in the research process
3. To write a research Proposal
4. Gain a practical understanding of the various methodological tools used for social scientific research
5. To study traditional knowledge Case Studies, IPR and TITS..

Course Contents:

Introduction: 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

Literature Review: 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 Intellectual Property and Patents: 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 TITS..

Reference Books:

1. Stuan 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 McCraw Hill, 1992

Course Outcomes:

On completion of the course, students will be able to:

SH2221.1 Describe research problem formulation.

SH2221.2 Compare research related information.

SH2221.3 Adapt research ethics. Interpret that today's world is controlled by Computer, Information Technology, but tomorrow world will be ruled by ideas, concept, and creativity.

SH2221.4 Describe 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

SH2221.5 Apply the Patent information and databases

CO – PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5
SH2221.1	3	2	1	2	3
SH2221.2	3	2	2	3	2
SH2221.3	2	3	2	1	3
SH2221.4	1	1	2	1	1
SH2221.5	1	1	2	1	1

0 - Not correlated 1 - Weakly Correlated 2 - Moderately Correlated 3 - Strongly Correlated

Course Code	ME2235							Course category			PC
Course Name	LAB PARCTICE- II										
Teaching Scheme				Examination Scheme							Credits
Th	Tu	Pr	Total	Theory				Practical		Total	
				MSE	TA	ESE	ESE Duration	ICA	ESE		
--	--	06	06					50	50	100	03

Course Objectives:

1. To acquire knowledge of experimental methods and their applications
2. To get insight into design, simulation and programming tools
3. To apply experimental and modern advanced techniques to solve practical problems

Course Contents:

Laboratory Practice shall constitute laboratory experiments, design, simulation, programming assignments, industrial visits with reports and outcome etc. The tutorials and experiments shall be decided by the course teachers of the Program Core Courses (PCC) namely Design of Solar and Wind Systems, Steam Engineering, Refrigeration and Cryogenics and Elective I Course of Gas Turbines..

List of Tutorials and Experiments: The students shall perform minimum of (8) experiments based on the following courses:

- Design of Solar and Wind Systems Steam Engineering
- Refrigeration and Cryogenics
- Gas Turbines

Course Outcomes:

ME2235.1 Formulate problems, perform experimental investigations, interpret and analyze the data using modern mathematical and scientific methods

ME2235.2 Identify and interpret the effect of various parameters on the system performance and correlate these parameters

ME2235.3 Provide feasible solutions to the real problems faced by the industry and research organizations

CO – PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5
ME2235.1	2	3	3	3	2
ME2235.2	3	3	2	2	3
ME2235.3	3	1	2	3	3

0 - Not correlated 1 - Weakly Correlated 2 - Moderately Correlated 3 - Strongly Correlated

Course Code	ME2236						Course category		ISS
Course Name	SEMINAR –II								
Teaching Scheme				Examination Scheme					Credits
Th	Tu	Pr	Total	Theory				Practical		Total	
				MSE	TA	ESE	ESE Duration	ICA	ESE		
--	--	01	01					50	--	50	02

Course Objectives:

1. To Promote and develop effective communication and presentation skills
2. To utilize technical resources
3. To identify, evaluate and synthesize information from a range of sources to enhance knowledge of current developments in the field of production engineering

Course Contents:

Topic of the seminar shall be a general topic. Evaluation would be done by three member committee based on seminar report and a presentation. Evaluation would be based on the seminar report submitted by the student and on the presentation made by him.

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

ME2236.1 Collect and review the relevant literature from various sources

ME2236.2 Explore development in the topic of interest and inculcate self-learning

ME2236.3 Write technical report and give presentation

CO – PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5
ME2236.1	1	1	3	2	3
ME2236.2	1	3	1	3	2
ME2236.3	2	2	2	2	3

0 - Not correlated 1 - Weakly Correlated 2 - Moderately Correlated 3 - Strongly Correlated

Sign
Member Secretary

Sign
BoS Chairperson

Sign
Dean (Academics)

Sign
Principal

M. Tech. (Thermal Engineering) Semester – III

Course Code	ME2332	Course category	RP/DI
Course Name	DISSERTAION STAGE- I		

Teaching Scheme				Examination Scheme							Credits
Th	Tu	Pr	Total	Theory				Practical		Total	
				MSE	TA	ESE	ESE Duration	ICA	ESE		
--	--	04	04	---	---	---	---	150	--	150	13

Course Objectives:

I. Select and develop the topic based on literature survey
II. Decide the scope and boundary of topic
III. Prepare synopsis report
IV. Present the work completed in the prescribed format

Course Contents:

Dissertation Phase-I and Seminar: Student has to submit the report and deliver the seminar based on minimum of 25% of his work on dissertation topic. It is to be evaluated internally by three member panel of examiners headed by HOD wherein guide should be one of the members of a panel. Last date of submission of report shall be two weeks before the end of the semester.

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

ME2332.1 Identify/define problems and generate questions and/or hypotheses
ME2332.2 Review and summarize the literature
ME2332.3 Make the action plan to complete the dissertation work
ME2332.4 Develop and sustain an evidence-based argument and submit the report
ME2332.5 Ability to apply and use modern tools in the area of Production Engineering

CO	PO1	PO2	PO3	PO4	PO5
ME2332.1	1	3	1	1	2
ME2332.2	3	3	1	3	1
ME2332.3	2	2	2	2	1
ME2332.4	2	2	1	1	1
ME2332.5	1	2	3	2	1

1 - Weakly Correlated 2- Moderately Correlated 3- Strongly Correlated

Course Code	ME2431	Course category	RP/DI
Course Name	DISSERTATION STAGE- II		

Teaching Scheme				Examination Scheme							Credits
Th	Tu	Pr	Total	Theory				Practical		Total	
				MSE	TA	ESE	ESE Duration	ICA	ESE		
--	--	36	36	---	---	36	---	100	200	300	18

Course Objectives:

I. Identify research technique and collect the data
II. Organise, interpret, analyse data and compile the factual results
III. Draw the conclusion

Course Contents:

Dissertation Phase-II: Internal assessment of complete work of dissertation is to be carried out by a guide for 100 marks. External assessment of dissertation is to be carried out by a panel of examiners consisting of internal examiner (guide) and external examiner for 200 marks. Candidate shall present the entire work on dissertation, followed by a viva-voce. Last date of submission of dissertation will be the end of the semester. Please see Appendix-C of rules and regulation for further information.

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

ME2431.1 Apply the appropriate research technique and collect the data
ME2431.2 Conduct research responsibly and ethically
ME2431.3 Evaluate, interpret, and analyse data and evidence and discuss findings in the broader context of the field
ME2431.4 Compile the report with critical and coherent documentation and present the work
ME2431.5 Ability to apply and use modern tools in the area of Production Engineering

CO – PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5
ME2431.1	1	3	1	1	2
ME2431.2	3	3	2	3	1
ME2431.3	2	1	2	2	2
ME2431.4	3	2	1	1	1
ME2431.5	2	2	3	1	2

1 - Weakly Correlated 2- Moderately Correlated 3- Strongly Correlated

Sign Member Secretary | Sign BoS Chairperson | Sign Dean (Academics) | Sign Principal