GOVT. COLLEGE OF ENGINEERING, AMRAVATI

DEPARTMENT OF MECHANICAL ENGINEERING

CURRICULUM

For

M. TECH. (Thermal Engineering)

2019- 2020

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 pertaining to thermal engineering systems

PO5: Ability to apply and use modern tools in the area of thermal engineering

Government College of Engineering, Amravati
Department of Mechanical Engineering
M. Tech. Full Time (Thermal Engineering)

Semester: - I													
Category	Course Code	Name of the Course	Teaching Scheme				Evaluation scheme						Credits
			Theory Hrs /week	Tutorial Hrs/week	Practical Hrs/week	Total	Theory			Practical			
							MSE	TA	ESE	ICA	ESE	Total	
PCC	MEP131	Advanced Heat Transfer	3	-	-	3	30	10	60	-	-	100	3
PCC	MEP132	Thermodynamics and Combustion	3	-	-	3	30	10	60	-	-	100	3
PCC	MEP133	Advanced Fluid Dynamics	3	-	-	3	30	10	60	-	-	100	3
PEC	MEP134	Elective I	3	-	-	3	30	10	60	-	-	100	3
LC	MEP135	Lab Practice-I	-	-	6	6	-	-	-	50	50	100	3
PCC	MEP136	Seminar-I	-	-	4	4	-	-	-	50	-	50	2
MC	SHP121	Audit Course	-	-	-	-	-	-	60	-	-	60	0
		Total	**12**	**-**	**10**	**22**	**120**	**40**	**300**	**100**	**50**	**610**	**17**

ELECTIVES-I (MEP134)	Audit Course(SHP121)
(A) Energy Conservation and Management **(B)** Advanced I C engines **(C)** Nuclear Engineering	**(A)**English for Research Paper Writing **(B)** Disaster Management **(C)**Sanskrit for Technical Knowledge **(D)**Value Education **(E)**Pedagogy Studies **(F)** Stress Management by Yoga **(G)**Personality Development through Life Enlightenment Skills. **(H)**Constitution of India

PCC - Program Core Course **PEC** - Program Elective Course **LC** - Lab Course **MC** - Mandatory Course

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Semester: - II													
Category	**Course Code**	**Name of the Course**	**Teaching Scheme**				**Evaluation scheme**						**Credits**
			Theory Hrs /week	**Tutorial Hrs/week**	**Practical Hrs/week**	**Total**	**Theory**			**Practical**			
							MSE	**TA**	**ESE**	**ICA**	**ESE**	**Total**	
PCC	MEP231	Design of Solar and Wind System	3	-	-	3	30	10	60	-	-	100	3
PCC	MEP232	Steam Engineering	3	-	-	3	30	10	60	-	-	100	3
PCC	MEP233	Refrigeration and Cryogenics	3	-	-	3	30	10	60	-	-	100	3
PEC	MEP234	Elective – II	3	-	-	3	30	10	60	-	-	100	3
SH	SHP221	Research Methodology	2	-	-	2	30	10	60	-	-	100	2
LC	MEP235	Lab Practice-II	-	-	6	6	-	-	-	50	50	100	3
PCC	MEP236	Seminar-II	-	-	4	4	-	-	-	50	-	50	2
		Total	**14**	**-**	**10**	**24**	**150**	**50**	**300**	**100**	**50**	**650**	**19**

ELECTIVES-II (MEP234)
(A) Gas Turbine
(B) Computational Fluid Dynamics
(C) Design of Heat Exchangers

PCC - Program Core Course **PEC** - Program Elective Course **LC** - Lab Course **SH** - SH- Science and Humanities

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Semester: - III														
Category	Course Code	Name of the Course	Teaching Scheme				Evaluation scheme							Credits
			Theory Hrs /week	Tutorial Hrs/week	Practical Hrs/week	Total	Theory			Practical				
							MSE	TA	ESE	ICA	ESE	Total		
PEC	MEP331	Elective-III*	3	-	-	3	30	10	60	-	-	100		3
SH	SHP321	Open Elective*	3	-	-	3	30	10	60	-	-	100		3
PROJECT	MEP332	Dissertation Phase-I	-	-	20	20	-	-	-	100	-	100		10
		Total	**6**	-	**20**	**26**	**60**	**20**	**120**	**100**	-	**300**		**16**

***Student going for Industrial Project/Thesis will complete these courses through MOOC**

ELECTIVES-III (MEU331)*	OPEN ELECTIVE (SHP321)*
(A) Thermal Management of Electronic Cooling Equipment **(B)**Finite Element Method **(C)**Air Conditioning System Design	**(A)** Business Analytics(ME) **(B)** Industrial Safety(ME) **(C)** Operations Research(ME) **(D)** Cost Management of Engineering Projects(CE) **(E)**Composite Materials(ME) **(F)** Waste to Energy(CE) **(G)** Finance Management(EE) **(H)**Project Management(EE) **(I)** Data Structure and Algorithms(CS)

PEC - Program Elective Course **SH** - SH- Science and Humanities

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Category	Semester: - IV													
	Course Code	Name of the Course	Teaching Scheme				Evaluation scheme							Credits
			Theory Hrs /week	Tutorial Hrs/week	Practical Hrs/week	Total	Theory			Practical				
							MSE	TA	ESE	ICA	ESE	Total		
PROJECT	MEP431	Dissertation Phase-II	-	-	32	32	-	-	-	100	200	300		16
		Total	**-**	**-**	**32**	**32**	**-**	**-**	**-**	**100**	**200**	**300**		**16**

Department of Mechanical
Equivalence Scheme
Programme Name:-M.Tech (Thermal Engineering)

Sr. No.	Course code with Name of course(old)		Credit	Course code with Name of course (new)		Credit
1.	SHP102	Advanced Mathematics	4	MEP331B	Finite Element Method	3
2.	MEP101	Advanced Thermodynamics	4	MEP132	Thermodynamics and Combustion	3
3.	MEP103	Advanced Heat Transfer	4	MEP131	Advanced Heat Transfer	3
4.	MEP104	Research Methodology	4	SHP221	Research Methodology	2
5.	MEP105	Lab Practice-I	4	MEP135	Lab Practice-I	3
6.	MEP106	Seminar-I	1	MEP136	Seminar-I	2
7.	MEP107A	Spark Ignition Engine	4	MEP134B	Advanced I C engines	3
8.	MEP107B	Advanced refrigeration	4	MEP233	Refrigeration & Cryogenics	3
9.	MEP107C	Finite Element Method	4	MEP331B	Finite Element Method	3
10.	MEP201	Modern Energy Sources	4	MEP231	Design of Solar and Wind System	3
11.	MEP202	Energy Conservation And Power Plant Economics	4	MEP134A	Energy Conservation and Management	3
12.	MEP204A	Compression Ignition Engine	4	MEP134B	Advanced I C engines	3
13.	MEP204B	Advanced air conditioning	4	MEP331C	Air Conditioning System Design	3
14.	MEP204C	Computational Fluid Dynamics	4	MEP234B	Computational Fluid Dynamics	3
15.	MEP205A	Gas Turbine	4	MEP234A	Gas Turbine	3
16.	MEP205B	Cryogenics	4	MEP233	Refrigeration & Cryogenics	3
17.	MEP205C	Heat Exchanger Design	4	MEP234C	Design of Heat Exchangers	3
18.	MEP206	Lab Practice-II	4	MEP235	Lab Practice-II	3
19.	MEP207	Seminar-II	1	MEP236	Seminar-II	2
20.	MEP208	Fluid Dynamics	4	MEP133	Advanced Fluid Dynamics	3
21.	MEP301	Dissertation Phase-I and Seminar	10	MEP332	Dissertation Phase-I	10
22.	MEP401	Dissertation Phase-II	30	MEP431	Dissertation Phase-II	16
23.		**No equivalence**		MEP134C	Nuclear Engineering	3
24.		**No equivalence**		MEP232	Steam Engineering	3
25.		**No equivalence**		MEP331A	Thermal Management of Electronic Cooling Equipment	3
26.		**No equivalence**		SHP321	Open Elective	3
27.		**No equivalence**		SHP121	Audit Course	0

Department of Mechanical Engineering
Equivalence Scheme for *online courses*
Programme Name:-M.Tech. Thermal Engineering

Course Code	Name of the Course	Credits	Equivalent NPTEL/MOOC Course of duration 12-14week and covering 80% course contents / Virtual lab link for lab course	Credits	Course Starting date
Semester – I					
MEP131	Advanced Heat Transfer	3	--	--	--
MEP132	Thermodynamics and Combustion	3	--	--	--
MEP133	Advanced Fluid Dynamics	3	--	--	--
MEP134	Elective I	3	--	--	--
MEP135	Lab Practice-I	3	1. Remote Triggered Virtual Lab on Automotive Systems, IIT Kharagpur Link for the course: http://vlabs.iitkgp.ernet.in/rtvlas/# 2. Virtual Combustion and Atomization Laboratory, IIT Kanpur Link for the course:https://vcal-iitk.vlabs.ac.in/home.html 3. Shakshat Virtual Lab on Thermal and Fluid Sciences, IIT Guwahati Link for the course: https://mfts-iitg.vlabs.ac.in/	3	Experiments to be scheduled on the IIT Kharagpur, Kanpur, Guwahati portal after registration and as per the slots available.
MEP136	Seminar-I	2	--	--	--
SHP121	Audit Course	0	--	--	--
Semester – III				--	--
MEP331	Elective-III*	3	--	--	--
SHP321	Open Elective*	3	--	--	--
MEP332	Dissertation Phase-I	10	--	--	-

MEP131 ADVANCED HEAT TRANSFER

Teaching Scheme: 03 L Total= 03 **Credit: 03**
Evaluation Scheme: 30 MSE + 10 TA + 60 ESE **Total Marks: 100**
Duration of ESE: 2 hrs. 30 min.

Course Objectives:

I. To apply appropriate governing equation and boundary conditions to solve 1D, 2D steady and unsteady state conduction problems
II. To identify the non-dimensional parameters and their significance in the forced and free convection
III. To employ proper analogy and empirical correlations for solving convection problems
IV. To describe phenomenon and mechanisms in condensation, boiling, transpiration cooling and ablation heat transfer
V. To interpret the physical mechanism in heat pipes
VI. To analyze the role of gases as participants in exchange process

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.

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

MEP131.1 Solve 1D and 2D steady and unsteady state heat conduction problems by utilizing analytical, graphical, numerical and chart solution

MEP131.2 Evaluate the performance of fins having non-uniform cross section

MEP131.3 Make use of non-dimensional parameters and empirical correlations to analyse convection heat transfer in external and internal, forced and free convection

MEP131.4 Determine heat transfer coefficient in condensation and boiling phenomena and illustrate the physical mechanism involved in heat pipes

MEP131.5 Estimate the radiative heat exchange between surfaces

Text Books:

1. J.P. Holman, "Heat Transfer", McGraw Hill Book Company, New York, 1990
2. Incropera and Dewitt, "Fundamentals of Heat and Mass Transfer", John Wiley and Sons, NewYork, 2000.

References 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

MEP132 THERMODYNAMICS AND COMBUSTION

Teaching Scheme: 03 L Total= 03 **Credit: 03**
Evaluation Scheme: 30 MSE + 10 TA + 60 ESE **Total Marks: 100**
Duration of ESE: 2 hrs. 30 min.

Course Objectives:

I. To develop methodical problem solving approach about Entropy, Availability and Irreversibility
II. To describe phenomenon of Transient flow analysis
III. To identify proper thermodynamic correlations emphasize on real gas behavior and reacting mixtures
IV. To establish appropriate thermo-chemical correlations on combustion and their significance

Course Contents:

- First law and State postulates, Second law and Entropy, Availability and Irreversibility, 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 of first and second law and Entropy
- Third law of Thermodynamics, Nerst heat theorem

Text Books:

1. Cengel, "Thermodynamics", Tata-McGraw Hill Co., New Delhi, 1980.
2. Van Wylen& Sonntag, "Thermodynamics" , John Wiley and Sons Inc., USA.
3. Holman, "Thermodynamics" McGraw Hill Inc., New York, 2002
4. Rao Y.V.C., "Postulational and Statistical Thermodynamics", Allied Publishers Inc, 1994

Reference Books:

1. Howell and Dedcius, "Fundamentals of Engineering Thermodynamics", McGraw Hill Inc., USA
2. Johns and Hawkings, "Engineering Thermodynamics", John Wiley and Sons Inc, USA, 2004
3. Fairs V.M. and Simmang , "Thermodynamics" Macmillan Publishing Co. Inc. USA

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

MEP132.1 Solve the methodical problems on Entropy, Availability and Irreversibility
MEP132.2 Analyze the Transient flow analysis of thermodynamic systems
MEP132.3 Justify the thermodynamic correlations on real gas behavior and reacting mixtures
MEP132.4 Evaluate the thermodynamic properties using empirical correlations on combustion and chemical equilibrium

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MEP133 ADVANCED FLUID DYNAMICS

Teaching Scheme: 03 L Total= 03 **Credit: 03**
Evaluation Scheme: 30 MSE + 10 TA + 60 ESE **Total Marks: 100**
Duration of ESE: 2 hrs. 30 min.

Course Objectives:

I. To understand the fluid flow concept
II. To Identify the fundamental kinematics of a fluid element
III. To State the conservation principles of mass, linear momentum, and energy for fluid flow
IV. To Apply the basic applied-mathematical tools that support fluid dynamics

Course Contents:

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

Exact Solutions of Navier-Stokes Equations: Fully developed flows, parallel flow in straight channel, Couette flow, Creeping flows

Potential Flow: Kelvin's theorem, Irrotational flow, Stream function-vorticity approach,

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

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

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

Text Books:

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

Reference Books:

1. Cengel, Y.A. and J.M. Cimbala, "Fluid Mechanics", McGraw-Hill, Boston, MA
2. Schlichting, H., "Boundary Layer Theory", McGraw-Hill,.

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

MEP133.1 Understand and define the fluid flow problems along with range of governing parameters

MEP133.2 Take up the fluid flow problems of industrial base.
MEP133.3 Devise the experiments in the field of fluid mechanics.
MEP133.4 Understand the flow patterns and differentiate between the flow regimes and its effects.

ELECTIVE-I

MEP 134(A) ENERGY CONSERVATION AND MANAGEMENT

Teaching Scheme: 03 L Total = 03 **Credit: 03**
Evaluation Scheme: 30 MSE + 10 TA + 60 ESE **Total Marks: 100**
Duration of ESE: 2 hrs. 30 min.

Course Objectives:

I. To utilise data of energy to frame strategy.
II. To plan energy supply on short term, mid-term and long term basis
III. 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
IV. To select optimum energy forms for consumption and to optimize energy consumption of each form of energy for reducing energy costs and for 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

Text 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

Reference Books:

1. W.C. Turner, "Energy Management Handbook ", Wiley, New York, 1982.
2. I.G.C. Dryden, "The Efficient Use of Energy ", Butterworth, London, 1982.
3. R. Loftnen, Van Nostrarid Reinhold C. "Energy Handbook", 1978.
4. TERI Publications.

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

MEP134A.1 Discuss the importance of energy and frame the strategy
MEP134A.2 Analyze energy consumption of electrical and mechanical utility

MEP134A3 Select the methods of energy audit of electrical utilities, mechanical utilities in industry.

MEP134A.4 Plan energy conservation solutions

MEP134 (B) ADVANCED IC ENGINE

Teaching Scheme: 03 L Total = 03 **Credit: 03**
Evaluation Scheme: 30 MSE + 10 TA + 60 ESE **Total Marks: 100**
Duration of ESE: 2 hrs. 30 min.

Course Objectives:

I. To understand the underlying principles of operation of IC Engines components and combustion phenomenon of SI and CI engines
II. To provide knowledge on pollutant formation, control, alternate fuel etc.
III. To Study Modern Trend in IC Engine

Course Contents:

Spark Ignition Engines: Mixture requirements – Fuel injection systems – Monopoint, 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, Unburnt 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 Adsorbers - Onboard Diagnostics

Text Books:

1. Haywood, "I.C. Engines", McGraw Hill.
2. V. Ganeshan, "Internal Combustion Engines", Tata McGraw Hill, New Delhi, 1996.

Reference Books:

1. Ramos J (1989) Internal Combustion Engine Modeling. Hemisphere Publishing Company
2. C. D. Rakopoulos and E. G. Giakoumis, "Diesel Engine Transient
3. Operation Principles of Operation and Simulation Analysis", Springer, 2009.
4. P.A. Lakshminarayanan and Y. V. Aghav, " Modelling Diesel Combustion" Springer, 2010
5. Bernard Challen and RodicaBaranescu, "Diesel Engine Reference Book" Butterworth-Heinemann, 1999.

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

MEP134B.1 Analyse the effect of various operating variables on engine performance
MEP134B.2 Evaluate performance analysis of IC engine and justify the suitability of IC engine for different application
MEP134B.3 Understand the conventional and unconventional fuels for IC engine and effect of emission formation and its control.
MEP134B.4 Develop the knowledge of technological advancements of I.C Engine

MEP134(C) NUCLEAR ENGINEERING

Teaching Scheme: 03 L Total= 03 **Credit: 03**
Evaluation Scheme: 30 MSE + 10 TA + 60 ESE **Total Marks: 100**
Duration of ESE: 2 hrs. 30 min.

Course Objectives:

I. To understand the reactor physics
II. To understand the reprocessing of nuclear fuels.
III. To learn reactor kinetics and control
IV. To learn about the waste disposal and radiation protection.

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 hour 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

Text Books:

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

Reference Books:

1. Nuclear Reactor Analysis, by James J. Duderstadt and Lewis J. Hamilton, John Wiley(1976)

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

MEP134C.1 Acquire insight about the basic concepts and processes taking place inside a nuclear reactor, such as nuclear fission, neutron production, scattering, diffusion, slowing down and absorption

MEP134C.2 Perceive with the concepts of reactor criticality, the relationship between the dimension and fissile material concentration in a critical geometry

MEP134C.3 Understand, time dependent (transient) behavior of power reactor in non-steady state operation and the means to control the reactor

MEP134C.4 Familiar with the concepts of heat removal from reactor core, reactor safety and radiation protection.

MEP 135 LAB PRACTICE-I

Teaching Scheme: 04P = Total 04 **Credit: 02**
Evaluation Scheme: 50 ICA + 50 ESE **Total Marks: 100**

Course Objectives:

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

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:

MEP131	Advanced Heat Transfer
MEP132	Thermodynamics and Combustion
MEP133	Advanced Fluid Dynamics
MEP134 B	Advanced IC engines

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

MEP135.1 Formulate problems, perform experimental investigations, interpret and analyze the data using modern mathematical and scientific methods.
MEP135.2 Identify and interpret the effect of various parameters on the system performance and correlate these parameters
MEP135.3 Provide feasible solutions to the real problems faced by the industry and research organizations

MEP136 SEMINAR-I

Teaching Scheme : 04 P = Total 04 **Credit : 02**
Evaluation Scheme: 50 ICA **Total Marks: 50**

Course Objectives:

I. To Promote and develop effective communication and presentation skills
II. To utilize technical resources
III. To identify, evaluate and synthesize information from a range of sources to enhance knowledge of current developments in the field of production engineering
IV. To engage in continuous education, training and research, and take control of their own learning and development

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

MEP136.1 Collect and review the relevant literature from various sources
MEP136.2 Explore development in the topic of interest and inculcate self-learning
MEP136.3 Write technical report and give presentation
MEP136.4 Demonstrate ethical and professional attitude

AUDIT COURSE

SHP121 (A) ENGLISH FOR RESEARCH PAPER WRITING

Teaching Scheme: 00 L = Total 00 **Credit: 00**
Evaluation Scheme: 60 ESE **Total Marks: 60**

Course objectives:

I. Understand that how to improve your writing skills and level of readability
II. Learn about what to write in each section
III. Understand the skills needed when writing a Title

Course Contents:

- Planning and Preparation, Word Order, Breaking up long sentences, Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and vagueness
- Clarifying Who Did What, Highlighting Your Findings, Hedging 4 and Criticising, Paraphrasing and Plagiarism, Sections of a Paper, Abstracts. Introduction
- Review of the Literature, Methods, Results, Discussion, Conclusions, the Final Check.
- Key skills are needed when writing a Title, key skills are needed when writing an Abstract, key skills are needed when writing an Introduction, skills needed when writing a Review of the Literature
- Skills are needed when writing the Methods, skills needed when 4 writing the Results, skills are needed when writing the Discussion, skills are needed when writing the Conclusions
- Useful phrases, how to ensure paper is as good as it could possibly be the first- time submission

Suggested reading:

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 Wall work , English for Writing Research Papers, Springer New York Dordrecht Heidelberg London, 2011

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

MEP121A.1 Write plan and research paper

SHP121 (B) DISASTER MANAGEMENT

Teaching Scheme: 00 L = Total 00 **Credit: 00**
Evaluation Scheme: 60 ESE **Total Marks: 60**

Course Objectives:

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

Course Contents:

- **Introduction** Disaster: Definition, Factors and Significance; Difference between Hazard and Disaster; Natural and Manmade Disasters: Difference, Nature, Types and Magnitude.
- **Repercussions of Disasters and Hazards**: Economic Damage, Loss of Human and Animal Life, Destruction of Ecosystem.
- Natural Disasters: Earthquakes, Volcanisms, Cyclones, Tsunamis, Floods, Droughts And Famines, Landslides And Avalanches, Man-made disaster: Nuclear Reactor Meltdown, Industrial Accidents, Oil Slicks And Spills, Outbreaks Of Disease And Epidemics, War And Conflicts.
- **Disaster Prone Areas In India** Study Of Seismic Zones; Areas Prone To Floods And Droughts, Landslides And Avalanches; Areas Prone To Cyclonic And Coastal Hazards With Special Reference To Tsunami; Post-Disaster Diseases And Epidemics
- **Disaster Preparedness And Management Preparedness:** Monitoring Of Phenomena Triggering A Disaster Or Hazard; Evaluation Of Risk: Application Of Remote Sensing, Data From Meteorological And Other Agencies, Media Reports: Governmental And Community Preparedness.
- **Risk Assessment** – Disaster Risk: Concept and Elements, Disaster Risk Reduction, Global and National Disaster Risk Situation. Techniques of Risk Assessment, Global Co-Operation in Risk Assessment and Warning, People's Participation in Risk Assessment. Strategies for Survival.
- **Disaster Mitigation** Meaning, Concept and Strategies of Disaster Mitigation, Emerging Trends in Mitigation. Structural Mitigation and Non-Structural Mitigation, Programs of Disaster Mitigation in India.

Suggested reading:

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

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

MEP121B.1 Apply concept of disaster management

SHP121 (C) SANSKRIT FOR TECHNICAL KNOWLEDGE

Teaching Scheme: 00 L = Total 00 **Credit: 00**
Evaluation Scheme: 60 ESE **Total Marks: 60**

Course Objectives:

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

Course Contents:

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

Suggested reading:

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

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

MEP121C.1 Understanding basic Sanskrit language
MEP121C.2 Ancient Sanskrit literature about science & technology can be understood
MEP121C.3 Being a logical language will help to develop logic in students

SHP121 (D) VALUE EDUCATION

Teaching Scheme: 00 L = Total 00
Evaluation Scheme: 60 ESE

Credit: 00
Total Marks: 60

Course Objectives:

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

Course Contents:

- Values and self-development – Social values and individual attitudes. Work ethics, Indian vision of humanism. Moral and non- moral valuation. Standards and principles. Value judgements
- Importance of cultivation of values. Sense of duty Devotion, Self-reliance. Confidence, Concentration, Truthfulness, Cleanliness. Honesty, Humanity. Power of faith, National Unity. Patriotism. Love for nature ,Discipline
- Personality and Behavior Development - Soul and Scientific attitude. Positive Thinking. Integrity and discipline. Punctuality, Love and Kindness. Avoid fault Thinking. Free from anger, Dignity of labour. Universal brotherhood and religious tolerance True friendship. Happiness Vs suffering, love for truth. Aware of self-destructive habits. Association and Cooperation. Doing best for saving nature
- Character and Competence – Holy books vs. Blind faith. Self-management and Good health. Science of reincarnation. Equality, Nonviolence, Humility, Role of Women. All religions and same message. Mind your Mind, Self-control. Honesty, Studying effectively

Suggested reading:

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

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

MEP121D.1 Apply knowledge of self-development
MEP121D.2 Learn the importance of Human values
MEP121D.3 Develop the overall personality

SHP121 (E) PEDAGOGY STUDIES

Teaching Scheme: 00 L = Total 00 **Credit: 00**
Evaluation Scheme: 60 ESE **Total Marks: 60**

Course Objectives:

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

Course Contents:

- **Introduction and Methodology:** Aims and rationale, Policy background, Conceptual framework terminology Theories of learning, Curriculum, Teacher education. Conceptual framework, Research questions. Overview of methodology and Searching.
- Thematic overview: Pedagogical practices are being used by teachers in formal and informal classrooms in developing countries. Curriculum, Teacher education.
- Evidence on the effectiveness of pedagogical practices Methodology for the in depth stage: quality assessment of included studies. How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy? Theory of change. Strength and nature of the body of evidence for effective pedagogical practices. Pedagogic theory and pedagogical approaches. Teachers' attitudes and beliefs and Pedagogic strategies.
- Professional development: alignment with classroom practices and follow-up support Peer support from the head teacher and the community. Curriculum and assessment. Barriers to learning: limited resources and large class sizes
- Research gaps and future directions Research design Contexts Pedagogy Teacher education Curriculum and assessment Dissemination and research impact.

Suggested reading:

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

Course outcomes: After completion of the course, the student will be able to:

MEP121E.1 Understand what pedagogical practices are being used by teachers in formal and informal classrooms in developing countries?

MEP121E.2 Understand what is the evidence on the effectiveness of these pedagogical practices, in what conditions, and with what population of learners?

MEP121E.3 Understand how can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy?

SHP121 (F) STRESS MANAGEMENT BY YOGA

Teaching Scheme: 00 L = Total 00 **Credit: 00**
Evaluation Scheme: 60 ESE **Total Marks: 60**

Course Objectives:

I. To achieve overall health of body and mind
II. To overcome stress

Course Contents:

- Definitions of Eight parts of yog. (Ashtanga)
- Yam and Niyam.
- Do`s and Don't's in life.
  i) Ahinsa, satya, astheya, bramhacharya and aparigraha
  ii) Shaucha, santosh, tapa, swadhyay, ishwarpranidhan
- Asan and Pranayam
- Various yog poses and their benefits for mind & body
- Regularization of breathing techniques and its effects-
- Types of pranayama

Suggested reading:

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

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

MEP121F.1 Develop healthy mind in a healthy body thus improving social health also
MEP121F.2 Improve efficiency

SHP121 (G) PERSONALITY DEVELOPMENT THROUGH LIFE ENLIGHTENMENT SKILLS

Teaching Scheme: 00 L = Total 00 **Credit: 00**
Evaluation Scheme: 60 ESE **Total Marks: 60**

Course Objectives:

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

Course Contents:

- Neetisatakam-Holistic development of personality
- Verses- 19,20,21,22 (wisdom)
- Verses- 29,31,32 (pride & heroism)
- Verses- 26,28,63,65 (virtue)
- Verses- 52,53,59 (dont's)
- Verses- 71,73,75,78 (do's)
- Approach to day to day work and duties. Shrimad Bhagwad Geeta
- Chapter 02 – Verses 41, 47,48,
- Chapter 03 – Verses 13, 21, 27, 35, Chapter 6-Verses 5,13,17, 23, 35
- Chapter 18 – Verses 45, 46, 48.
- Statements of basic knowledge. Shrimad Bhagwad Geeta:
- Chapter 2 – Verses 56, 62, 68
- Chapter 12 –Verses 13, 14, 15, 16,17, 18
- Personality of Role model. Shrimad Bhagwad Geeta:
- Chapter 2 –Verses 17,
- Chapter 3 –Verses 36,37,42,
- Chapter 4 –Verses 18, 38,39
- Chapter18 – Verses 37,38,63

Suggested reading:

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

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

MEP121G.1 Study of Shrimad-Bhagwad-Geeta will help the student in developing his personality and achieve the highest goal in life

MEP121G.2 The person who has studied Geeta will lead the nation and mankind to peace and prosperity.

MEP121G.3 Study of Neetishatakam will help in developing versatile personality of student.

SHP121 (H) CONSTITUTION OF INDIA

Teaching Scheme: 00 L = Total 00 **Credit: 00**
Evaluation Scheme: 60 ESE **Total Marks: 60**

Course Objectives:

I. Understand the premises informing the twin themes of liberty and freedom from a civil rights perspective.
II. 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.
III. 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

Course Contents:

- **History of Making of the Indian Constitution:** History, Drafting Committee, (Composition & Working)
- **Philosophy of the Indian Constitution:** Preamble, Salient Features
- **Contours of Constitutional Rights &Duties:** Fundamental Rights Right to Equality Right to Freedom Right against Exploitation Right to Freedom of Religion Cultural and Educational Rights Right to Constitutional Remedies Directive Principles of State Policy Fundamental Duties.
- **Organs of Governance,** Parliament Composition Qualifications and Disqualifications Powers and Functions Executive President Governor Council of Ministers Judiciary, Appointment and Transfer of Judges, Qualifications Powers and Functions
- **Local Administration:** District's Administration head: Role and Importance, Municipalities: Introduction, Mayor and role of Elected Representative, CEO of Municipal Corporation. Pachayati raj: Introduction, PRI: Zila Pachayat, Elected officials and their roles, CEO Zila Pachayat: Position and role. Block level: Organizational Hierarchy (Different departments),Village level: Role of Elected and Appointed officials, Importance of grass root democracy
- **Election Commission:** Election Commission: Role and Functioning. Chief Election Commissioner and Election Commissioners. state Election Commission: Role and Functioning. institute and Bodies for the welfare of SC/ST/OBC and women

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

MEP121H.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.
MEP121H.2 Discuss the intellectual origins of the framework of argument that informed the conceptualization of social reforms leading to revolution in India.

MEP121H.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.

MEP121H.4 Discuss the passage of the Hindu Code Bill of 1956.

MEP231 DESIGN OF SOLAR AND WIND SYSTEMS

Teaching Scheme: 03 L Total = 03 **Credit: 03**
Evaluation Scheme: 30 MSE + 10 TA + 60 ESE **Total Marks: 100**
Duration of ESE: 2 hrs. 30 min.

Course Objectives:

I. To get insight into energy scenario and promising alternative energy sources available
II. To get conversant with estimation and measurement of solar radiation
III. To analyze the performance of liquid flat plate collectors, concentrating collectors and solar photovoltaic systems
IV. To identify design aspects and performance parameters of wind energy conversion
V. To recognize principles of energy conversion using other renewable energy sources

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: Thermochemical conversion, Biochemical conversion, Dual fuel engine.

Geothermal Energy: Resources and potential, Utilization methods and aspects.

Text Books:

1. S.P.Sukhatme, "Solar Energy: Principles of Thermal Collection and Storage", Tata McGraw-Hill, 2006
2. M.M. El- Wakil, "Power Plant Technology", McGraw Hill, 2010.
3. A.B.Meinal and M.P.Meinal, "Applied Solar Energy", Addison Wesley, 1976.

References Books:

1. D.Y. Goswami, F. Kreith and J.F. Kreider, "Principle of Solar Engineering", Taylor and Francis, 2000.
2. N.K. Bansal, "Non-Conventional Energy Resources", Vikas Publishing House, 2014.
3. J.F. Kreider, F. Kreith, "Solar Energy Handbook", McGraw Hill, 1981.
4. J.A. Duffie and W.A. Beckman, "Solar Engineering of Thermal Processes", John Wiley, 1991.

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

MEP231.1 Identify potential and importance of non-conventional energy sources and their use for power generation

MEP231.2 Estimate the radiation received and absorbed by the solar collector at a given location

MEP231.3 Evaluate the performance liquid flat plate collectors, concentrating collectors and photovoltaic cell

MEP231.4 Illustrate the aspects related to thermal energy storage

MEP231.5 Classify wind energy converters and determine the power produced

MEP231.6 Identify principles and methods of power generation using ocean, biomass and geothermal energy

MEP232 STEAM ENGINEERING

Teaching Scheme: 03 L Total= 03 **Credit: 03**
Evaluation Scheme: 30 MSE + 10 TA + 60 ESE **Total Marks: 100**
Duration of ESE: 2 hrs. 30 min.

Course Objectives:

I. Explain types of boilers and Design piping and insulation
II. Estimate steam distribution losses
III. Determine boiler efficiency and performance
IV. Manage waste minimisation and control of boiler

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 and temperature measuring and controlling instruments, its selection

Text Books:

1. Arora 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
3. Book IV - Energy Performance Assessment for Equipment & Utility Systems; Bureau of Energy Efficiency

Reference Books:

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

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

MEP232.1 Design water line and steam line piping and its insulation
MEP232.2 Use steam engineering practices to handle steam leakages and steam recovery
MEP232.3 Assess the performance of boiler by test codes and procedure
MEP232.4 Apply energy conservation techniques and proper instrumentation for control

MEP233 REFRIGERATION AND CRYOGENICS

Teaching Scheme: 03 L Total= 03 **Credit: 03**
Evaluation Scheme: 30 MSE + 10 TA + 60 ESE **Total Marks: 100**
Duration of ESE: 2 hrs. 30 min.

Course Objectives:

I. To compare the phenomenon of refrigeration and cryogenics
II. To analyze the VCR & vapour absorption refrigeration cycles for performance improvement
III. To describe the mechanism of multiple components refrigeration and gas liquefaction systems
IV. To employ Recent Trends in Refrigerants & norms

Course Contents:

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 systems, Cascade systems,

Refrigeration Components: Performance characteristics and capacity control of reciprocating and centrifugal compressors, screw compressor and scroll compressor, Design, selection of evaporators, condensers, control systems, motor selection,

Refrigerants: 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, Linde dual pressure, Claude cycle.

Text Books:

1. AhmadulAmeen,"Refrigeration and Air-conditioning", Prentice Hall of India, New Delhi,2006
2. C.P.Arora, "Refrigeration and Air-conditioning", Tata McGraw-Hill, 2nd edition,2003
3. Tomczyk, J. A., Whitman, W. C.Johnson, Refrigeration and Air Conditioning Technology, W. M., Pub: Delmar S.Africa, 4th edition, 2000.
4. R.Barron, "Cryogenic systems", McGraw–Hill Company, New York, 1985.

Reference Books:

1. R.J.Dossat, "Principles of Refrigeration", Pearson Education Asia, 2001.
2. Stoecker& Jones, "Refrigeration and Air-conditioning", McGraw Hill Book Company, New York, 1982.
3. Jordan &Priester, "Refrigeration and Air-conditioning".
4. A.R.Trott, "Refrigeration and Air-conditioning", Butterworths, 2000.
5. J.L.Threlkeld, "Thermal Environmental Engineering", Prentice Hall, 1970.

6. Electricity For Refrigeration, Heating, and Air Conditioning, Russell E. Smith, Delmar Cengage Learning; 7th edition, 2006
7. G.G.Hasseldon. "Cryogenic Fundamentals", Academic Press.
8. Bailey, "Advanced Cryogenics", Plenum Press, London, 1971.
9. W.F.Stoecker, "Industrial Refrigeration Handbook", McGraw-Hill, 1998.
10. John A.Corinchock, "Technician's Guide to Refrigeration systems", McGrawHill.
11. P.C.Koelet, "Industrial Refrigeration: Principles, Design and Applications", Macmillan, 1992.
12. ASHRAE HANDBOOKS (i) Fundamentals (ii) Refrigeration.
13. Graham Walker, "Miniature Refrigerators for Cryogenic Sensors and Cold Electronics", Clarendon Press, 1989

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

MEP233.1	Identify the application areas of refrigeration and cryogenics
MEP233.2	Perform thermodynamic analysis of refrigeration and cryogenics cycles
MEP233.3	Suggest the environment friendly refrigerant for given applications based on ODP, GWP and related environment issues
MEP233.4	Design a multiple components of refrigeration systems from given input

MEP234 (A) GAS TURBINES

Teaching Scheme: 03 L Total = 03 **Credit: 03**
Evaluation Scheme: 30 MSE + 10 TA + 60 ESE **Total Marks: 100**
Duration of ESE: 2 hrs. 30 min.

Course Objectives:

I. To familiarize with the application of each component like Compressor, combustion Chamber, fans, nozzle, integrate into aircraft system
II. To impart the detail concept of various types of Compressor like Centrifugal and axial
III. To get conversant with blade materials of gas turbine

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.

Text books:

1. V. Ganesan, "Gas Turbines", Tata McGraw Hill, 2003
2. W WBathic, "Fundamentals of Gas Turbines", John Wiley and Sons

Reference Books:

1. H Cohen, GFC Rogers and HIH Saravanamuttoo, "Gas Turbine Theory", Pearson Education, 2000.
2. S.M.Yahya "Turbines, Compressors and Fans", Tata McGraw Hill, 1992.
3. Vincent "The theory and design of Gas Turbine and Jet Engines", McGraw Hill, 1950.

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

MEP234A.1 Analyze thermodynamics cycles, and different sizes layouts of gas turbine plant
MEP234A.2 Apply the thermodynamics concept to the components for enhancing the efficiency of gas turbines
MEP234A.3 Compare features of gas turbines engines integrates into an aircraft system

MEP234 (B) COMPUTATIONAL FLUID DYNAMICS

Teaching Scheme: 03 L Total = 03 **Credit: 03**
Evaluation Scheme: 30 MSE + 10 TA + 60 ESE **Total Marks: 100**
Duration of ESE: 2 hrs. 30 min.

Course Objective:

I. To develop an understanding for the major theories, approaches and methodologies used in CFD
II. To build up the skills in the actual implementation of CFD methods (e.g. boundary conditions, turbulence modelling etc.) in using commercial CFD codes
III. To gain experience in the application of CFD analysis to real engineering designs.

Course Content:

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 gridapproach

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

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

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

Text 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.

Reference Books:

1. An Introduction to Computational Fluid Flow (Finite Volume Method), by H.K. Versteeg, W. Malalasekera, Printice Hall
2. Computational Methods for Fluid Dynamics by Ferziger and Peric, Springer Publication.
3. An Introduction to Computational Fluid Mechanics by Chuen-Yen Chow, Wiley

Publication.
4. Computational Fluid Flow & Heat Transfer by Murlidhar and Sundarrajan, Narosa Publication

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

MEP234B.1 Understand the subject of Computational Fluid Dynamics
MEP234B.2 Apply CFD as tool to solve the Heat Transfer and Fluid Mechanics related Industrial Problems.
MEP234B.3 Create the base and interest to carry out the Future Research

MEP234 (C) DESIGN OF HEAT EXCHANGERS

Teaching Scheme: 03 L Total = 03 **Credit: 03**
Evaluation Scheme: 30 MSE + 10 TA + 60 ESE **Total Marks: 100**
Duration of ESE: 2 hrs. 30 min.

Course Objectives:

I. To get insight into thermal modelling and design of heat exchangers
II. To get conversant with empirical correlations as applied to design of heat exchangers
III. To identify aspects and principles of mechanical design of heat exchangers
IV. To get acquainted with the standard codes for design 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 heat exchangers, flow induced vibrations.

Text Books:

1. R.K. Shah and D.P. Sekulic, "Fundamentals of Heat Exchanger Design" John Wiley, 2003
2. K.P. Sing and A.I. Soler, "Mechanical design of heat exchangers and pressure vessel components",Arcturus Publishers, 1984
3. D.Q. Kern, "Process Heat Transfer", McGraw Hill, 1950
4. A.P. Frass and M.N. Ozisik, "Heat Exchanger Design", McGraw Hill, 1984

Reference Books:

1. SadikKakac and Hongton Liu, "Heat Exchangers: Selection, Rating and Thermal Design" CRC Press, 1998.
2. N. Afgan and E.V. Schlinder, "Heat Exchanger Design and Theory Source Book", CRC press, 2017.

3. T. Kuppan, "Hand Book of Heat Exchanger Design".
4. "T.E.M.A. Standard", New York, 1999.
5. G. Walkers, "Industrial Heat Exchangers-A Basic Guide", McGraw Hill, 1982
6. ANSI Standards for pipe and nozzle selection, 1996
7. ASME Section VIII Division for pressure Vessel and Boiler Design Code, 1995
8. ASME section II, Material Specifications, 1995

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

MEP234C.1 Apply principles of fluid mechanics and heat transfer for thermal modeling of heat exchangers

MEP234C.2 Design and analyze thermal performance of double pipe heat exchanger, shell and tube heat exchanger and cross flow heat exchanger

MEP234C.3 Illustrate mechanical design of components of heat exchangers

MEP324C.4 Identify aspects of selection of materials for heat exchangers

SHP221RESEARCH METHODOLOGY

Teaching Scheme: 02 L Total = 02 **Credit: 02**
Evaluation Scheme: 30 MSE + 10 TA + 60 ESE **Total Marks: 100**
Duration of ESE: 2 hrs. 30 min.

Course Objectives:

I. To understand some basic concepts of research and its methodologies
II. To Learn the ethical, political, and pragmatic issues involved in the research process
III. To write a research Proposal
IV. Gain a practical understanding of the various methodological tools used for social scientific research
V. To help and encourage the students for startups and innovations.

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 IITs.

Text Books:

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, 2nd Edition , "Research Methodology: A Step by Step Guide for beginners"
4. Halbert, "Resisting Intellectual Property", Taylor & Francis Ltd ,2007.
5. Mayall , "Industrial Design", McGraw Hill, 1992.
6. Niebel , "Product Design", McGraw Hill, 1974.

References Books :

1. Asimov , "Introduction to Design", Prentice Hall, 1962.
2. Robert P. Merges, Peter S. Menell, Mark A. Lemley, " Intellectual Property in New Technological Age", 2016.
3. T. Ramappa, "Intellectual Property Rights Under WTO", S. Chand, 2008

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

SHP221.1 Describe research problem formulation.
SHP221.2 Compare research related information.
SHP221.3 Adapt research ethics.
SHP221.4 Interpret that today's world is controlled by Computer, Information Technology, but tomorrow world will be ruled by ideas, concept, and creativity.
SHP221.5 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

MEP 235 LAB PRACTICE II

Teaching Scheme: 04P = Total 04 **Credit: 02**
Evaluation Scheme: 50 ICA + 50 ESE **Total Marks: 100**

Course Objectives:

I. To acquire knowledge of experimental methods and their applications
II. To get insight into design, simulation and programming tools
III. 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 its 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 II Course of Gas Turbines.

List of Tutorials and Experiments:

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

MEP231	Design of Solar and Wind Systems
MEP232	Steam Engineering
MEP233	Refrigeration and Cryogenics
MEP234A	Gas Turbines

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

MEP235.1	Formulate problems, perform experimental investigations, interpret and analyze the data using modern mathematical and scientific methods
MEP235.2.	Identify and interpret the effect of various parameters on the system performance and correlate these parameters
MEP235.3	Provide feasible solutions to the real problems faced by the industry and research organizations

MEP236 SEMINAR II

Teaching Scheme: 04P = Total 04 **Credit: 02**
Evaluation Scheme: 50 ICA **Total Marks: 50**

Course Objectives:

I. To expose students to the 'real' working environment and get acquainted with the latest technology in the production engineering field
II. To promote and develop presentation skills and import a knowledgeable society

Course Contents:

Topic of seminar shall be a related to dissertation work. 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: After completion of the course, the student will be able to:

MEP236.1 Collect and review the relevant literature from various sources
MEP236.2 Explore development in the topic of interest and inculcate self-learning
MEP236.3 Write technical report and give presentation
MEP236.4 Demonstrate ethical and professional attitude

MEP331(A)THERMAL MANAGEMENT OF ELECTRONIC COOLING EQUIPMENT

Teaching Scheme: 03 L Total = 03 **Credit: 03**
Evaluation Scheme: 30 MSE + 10 TA + 60 ESE **Total Marks: 100**
Duration of ESE: 2 hrs. 30 min.

Course Objectives:

I. To provide an overview of the importance of thermal management of electronics and the range of options available to solve thermal issues,
II. To develop the skills to analyze and solve electronics cooling problems.
III. To develop the novel compact thermal energy storage system.

Course Contents:

Introduction: importance of thermal management of electronics, temperature effects on different failure modes; Basics of conduction, convection, and radiation heat transfer.

Cooling methods used in the industry for electronics: conduction cooling, cooling by heat sinks– design aspects of heat sinks, convection cooling, selection of fan, liquid immersion cooling, flow-through cooling of CCAs, cold wall cooling, cold plates, jet impingement cooling. Metal foam cooling concept.

Synthetic jet cooling, thermoelectric or solid state coolers, cooling using phase change– cooling with PCM materials, micro/mini channel cooling.

Cooling using heat pipes: working principle, selection of heat pipe working fluid; Selection of cooling technique– ranges of cooling rates of different cooling methods, selection criteria; Experimental techniques used for thermal measurements.

Text Books:

1. Yunus A. Cengel, Heat Transfer: A Practical Approach. McGraw-Hill, 2003
2. YounesShabany, Heat Transfer: Thermal Management of Electronics, CRC Press Inc, 2010.

Reference Books:

1. Ravi Kandasamy and Arun S. Mujumdar, Thermal Management of Electronic Components, Lambert Academic Publishing, 2010.
2. Dave S. Steinberg, Cooling Techniques for Electronic Equipment, Wiley, 1991.
3. Sung Jin Kim, Sang Woo Lee, Air Cooling Technology for Electronic Equipment, Taylor & Francis, 1996.
4. Rao R. Tummala, Fundamentals of Microsystems Packaging, McGraw-Hill, 2001.

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

MEP331A.1 Understand how and where heat is generated in electronics
MEP331A.2 Identify the various options available for thermal management of electronics
MEP331A.3 Apply the fundamental heat transfer and fluid flow equations to solve electronics cooling problems

MEP331 (B) ELECTIVE-III FINITE ELEMENT METHOD

Teaching Scheme: 03 L Total = 03 **Credit: 03**
Evaluation Scheme: 30 MSE + 10 TA + 60 ESE **Total Marks: 100**
Duration of ESE: 2 hrs. 30 min.

Course Objectives:

I. To illustrate the FEM and its applications to common problems in engineering, especially structural and thermal areas.
II. To develop a practical approach to Finite Element Method (FEM) as tool to solve engineering problems.

Course Contents:

Introduction to FEM: Basic concepts, application of FEM, general description, advantages of FEM, comparison of FEM with other methods: finite difference method, variational method, Galerkin Method, basic element shapes, interpolation function. Virtual energy principle, treatment of boundary conditions, solution of system of equations, basic equations of elasticity, strain displacement relations

1-D structural problems: Axial bar element, stiffness matrix, load vector, temperature effects, quadratic shape function, analysis of trusses–plane truss and space truss elements.Analysis of beams, frames–Hermite shape functions, stiffness matrix, load vector problems, analysis.

2-D problems– CST, force terms, stiffness matrix and load vector, boundary conditions, Iso-parametric element, Quadric element, shape functions, Numerical Integration, 3-D problems–Tetrahedron element, Jacobian matrix, stiffness matrix.Axis Symmetric formulations, Finite Element Modeling-Triangular element, Problem modeling and Boundary conditionsDynamic considerations, Dynamic equations, consistent mass matrix, Eigen values, Eigen vector, natural frequencies, mode shapes, modal analysis.

Scalar field problems –Generalized Heat Conduction Equation–Variation Principle–Boundary Conditions –Internal heat generation, heat flux and convection-1-D Steady state Heat conduction –Thermal load vector -1-D fin element–Quadratic fin elements I D unsteady state heat conduction –Thermal load vector-2-D steady state heat conduction –Concepts of 3D heat conduction Finite Element Formulation of Torsion, Potential flow, seepage and fluid flow in ducts.

Computer Implementation: Pre-processing, mesh generation, elements connecting, boundary conditions, input of material and processing characteristics –solutions and post processing-overview and application packages.

Text Books:

1. Finite Element Procedure in Engineering Analysis K.J. Bathe McGraw Hill
2. Introduction to Finite Elements in Engineering T.R Chandragupta and A.D. Belegundu Prentice Hall India

Reference Books:

1. The Finite Element Method O.C. Zienkiewicz and R.L. Taylor McGraw Hill
2. An Introduction to Finite Element Method J. N. Reddy McGraw Hill
3. Finite Element Analysis C.S. Krishnamoorthy Tata McGraw Hill
4. Concepts and Application of Finite Element Analysis R.D. Cook, D.S. Malcus and M.E. Plesha John Wiley
5. Finite Element and Approximation O.C. Zenkiewicy & Morgan
6. The Finite element method in Engineering science, O.C. Aienkowitz, Mc. Graw Hill.

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

MEP331B.1 Synthesise information and ideas for use in the evaluation process.

MEP331B.2 Develop governing equations of mechanical systems using domain knowledge and mathematical principles and apply principles of variation and integral forms of solution to formulate finite element problem

MEP331B.3 Analyze and build FEA model for complex engineering problems.

MEP331B.4 Perceive the fundamental theory of the finite elements.

MEP331B.5 Develop skills to model the behaviour of structures under mechanical and thermo-mechanical loads.

MEP331(C) AIR CONDITIONING SYSTEM DESIGN

Teaching Scheme: 03 L Total = 03 **Credit: 03**
Evaluation Scheme: 30 MSE + 10 TA + 60 ESE **Total Marks: 100**
Duration of ESE: 2 hrs. 30 min.

Course Objectives:

I. To apply the concept of psychrometry in Air-conditioning systems
II. To describe the methodology adopted for cooling load calculations
III. To identify air distribution techniques adopted in Air-conditioning practices
IV. To differentiate simulation methods adopted in duct-design

Course Contents:

Psychrometry: Properties of Air Water Mixture, Basic psychrometric terms, Psychrometric Processes related to various air-conditioning, Enthalpy deviation curve, dehumidified air quantity, human comfort and indoor air quality

Cooling Load Calculations: Sources of Cooling and Heating Loads in air-conditioning systems, Sensible Heat Factor, Effective Sensible Heat Factor and Grand Sensible Heat Factor.

Air distribution system: Design of air delivery system for specific applications (such as Hospital, Auditorium, Hotels Etc.), noise and vibration control in air-conditioning hall. Air-conditioning component selection (Component Matching)

Duct Design: Designing Air Ducts, Window Air Conditioner / Split Air Conditioner Performance Testing, Energy calculations Degree-Day procedure, Bin Method, Comprehensive Simulation methods, Flow Pump - and piping Design

Text Books:

1. Ahmadul Ameen, Refrigeration and air conditioning, Prentice Hall of India, New Delhi, 2006
2. C P Arora, Refrigeration and air conditioning, Tata McGraw-Hill, 2nd ed, 2003
3. E G Pita, Air Conditioning Principles and Systems, Prentice Hall of India, 4th edition, 2005.
4. Tomczyk, J. A., Whitman, W. C., Johnson, Refrigeration and Air Conditioning Technology, W. M., Pub: Delmar S. Africa, 4th edition, 2000.

Reference Books:

1. Norman C. Harris, "Modern Air Conditioning", New York, McGraw-Hill,1974.
2. Jones W.P., "Air Conditioning Engineering", Edward Arnold Publishers Ltd., London, 1984.
3. Hainer R.W., "Control Systems for Heating, Ventilation and Air-Conditioning", Van Nostrand
4. Reinhold Co., New York, 1984. 7. Arora C.P., "Refrigeration & Air Conditioning", Tata McGraw Hill, 1985.
5. Manohar Prasad, "Refrigeration & Air Conditioning", New Age Publishers.
6. Stoecker, "Refrigeration & Air Conditioning", McGraw Hill, 1992.
7. Stoecker, "Design of Thermal Systems", McGraw Hill, 1992.

8. The ASHRAE Handbooks with CDs, 2005-2008

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

MEP331C.1 Employ the fundamentals of Psychrometry in Air-conditioning systems
MEP331C.2 Perform the cooling load calculations for a specific application from given input
MEP331C.3 Classify air distribution techniques adopted in Air-conditioning practices
MEP331C.4 Compare the simulation methods adopted in duct-design

SHP321 (A) BUSINESS ANALYTICS

Teaching Scheme: 03 L Total = 03 **Credit: 03**
Evaluation Scheme: 30 MSE + 10 TA + 60 ESE **Total Marks: 100**
Duration of ESE: 2 hrs. 30 min.

Course Objectives:

I. To get conversant with business analytics and forecasting technique

Course Contents:

Business analytics: Overview of Business analytics, Scope of Business analytics, Business Analytics Process, Relationship of Business Analytics Process and organisation, competitive advantages of Business Analytics. Statistical Tools: Statistical Notation, Descriptive Statistical methods, Review of probability distribution and data modelling, sampling and estimation methods overview.

Trendiness and Regression Analysis: Modelling Relationships and Trends in Data, simple Linear Regression. Important Resources, Business Analytics Personnel, Data and models for Business analytics, problem solving, Visualizing and Exploring Data, Business Analytics Technology.

Organization Structures of Business analytics, Team management, Management Issues, Designing Information Policy, Outsourcing, Ensuring Data Quality, Measuring contribution of Business analytics, Managing Changes. Descriptive Analytics, predictive analytics, predicative Modelling, Predictive analytics analysis, Data Mining, Data Mining Methodologies, Prescriptive analytics and its step in the business analytics Process, Prescriptive Modelling, nonlinear Optimization.

Forecasting Techniques: Qualitative and Judgmental Forecasting, Statistical Forecasting Models, Forecasting Models for Stationary Time Series, Forecasting Models for Time Series with a Linear Trend, Forecasting Time Series with Seasonality, Regression Forecasting with Casual Variables, Selecting Appropriate Forecasting Models. Monte Carlo Simulation and Risk Analysis: Monte Carle Simulation Using Analytic Solver Platform, New-Product Development Model, Newsvendor Model, Overbooking Model, Cash Budget Model.

Decision Analysis: Formulating Decision Problems, Decision Strategies with the without Outcome Probabilities, Decision Trees, The Value of Information, Utility and Decision Making.

Recent Trends in : Embedded and collaborative business intelligence, Visual data recovery, Data Storytelling and Data journalism.

Reference Books:

1. Business analytics Principles, Concepts, and Applications by Marc J. Schniederjans, Dara G. Schniederjans, Christopher M. Starkey, Pearson FT Press.
2. Business Analytics by James Evans, persons Education

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

SHP321A.1 Students will demonstrate knowledge of data analytics.

SHP321A.1 Students will demonstrate the ability of think critically in making decisions based on data and deep analytics.

SHP321A.1 Students will demonstrate the ability to use technical skills in predicative and prescriptive modeling to support business decision-making.

SHP321A.1 Students will demonstrate the ability to translate data into clear, actionable insights

SHP321 (B) INDUSTRIAL SAFETY

Teaching Scheme: 03 L Total = 03 **Credit: 03**
Evaluation Scheme: 30 MSE + 10 TA + 60 ESE **Total Marks: 100**
Duration of ESE: 2 hrs. 30 min.

Course Objectives:

I. To get acquainted with industrial safety
II. To get familiar with fault tracing and maintenance importance

Course Contents:

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 fire fighting, equipment and methods.

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

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

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

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

Text books:

1. Maintenance Engineering, H. P. Garg, S. Chand and Company.
2. Foundation Engineering Handbook, Winterkorn, Hans, Chapman & Hall London

Reference books:

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.

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

SHP321B.1 Demonstrate knowledge industrial safety
SHP321B.2 Identify fault and implement proper maintenance

SHP321 (C) OPERATIONS RESEARCH

Teaching Scheme: 03 L Total = 03 **Credit: 03**
Evaluation Scheme: 30 MSE + 10 TA + 60 ESE **Total Marks: 100**
Duration of ESE: 2 hrs. 30 min.

Course Objectives:

I. Decision making and improve its quality
II. Identify optimal solution
III. Integrating the systems
IV. Minimization of the cost and maximization of the profit
V. Improve the productivity

Course Contents:

Optimization Techniques: Optimization Techniques Model Formulation, models, General L.R Formulation, Simplex Techniques, Sensitivity Analysis, Inventory Control Models

Linear Programming: Formulation of a LPP - Graphical solution revised simplex method - duality theory - dual simplex method - sensitivity analysis - parametric programming

Nonlinear Programming: Nonlinear programming problem - Kuhn-Tucker conditions min cost flow problem - max flow problem - CPM/PERT

Scheduling and Sequencing - Scheduling and sequencing, single server and multiple server models - deterministic inventory models - Probabilistic inventory control models - Geometric Programming

Dynamic Programming and Graph Theory: Competitive Models, Single and Multi-channel Problems, Sequencing Models, Dynamic Programming, Flow in Networks, Elementary Graph Theory, Game Theory Simulation

Text Books:

1. H.A. Taha, Operations Research, An Introduction, PHI, 2008
2. H.M. Wagner, Principles of Operations Research, PHI, Delhi, 1982
3. J.C. Pant, Introduction to Optimisation: Operations Research, Jain Brothers, Delhi, 2008
4. Hitler Libermann Operations Research: McGraw Hill Pub. 2009

Reference Books:

1. Pannerselvam, Operations Research: Prentice Hall of India 2010
2. Harvey M Wagner, Principles of Operations Research: Prentice Hall of India 2010

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

SHP321C.1 Apply the dynamic programming to solve problems of discreet and continuous variables
SHP321C.2 Apply the concept of non-linear programming
SHP321C.3 Carry out sensitivity analysis
SHP321C.4 Student should able to model the real world problem and simulate it

SHP 321 (E) COMPOSITE MATERIALS

Teaching Scheme: 03 L Total = 03 **Credit: 03**
Evaluation Scheme: 30 MSE + 10 TA + 60 ESE **Total Marks: 100**
Duration of ESE: 2 hrs. 30 min.

Course Objectives:

I. To name the main classification of composite materials and identify its distinguishing features
II. To understand the strengthening mechanisms of various composites
III. To know properties, applications and the manufacturing processes for various composites
IV. To calculate the strength of composite materials

Course Contents:

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.

Reinforcements: Preparation-layup, curing, properties and applications of glassfibers, carbon fibers, Kevlar fibers and Boron fibers. Properties and applications of whiskers, particle reinforcements. Mechanical Behavior of composites: Rule of mixtures, Inverse rule of mixtures. Isostrain and Isostress conditions.

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.

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.

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.

Text Books:

1. Composite Materials – K.K.Chawla.
2. Composite Materials Science and Applications – Deborah D.L. Chung.

References 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.

3. Hand Book of Composite Materials-ed-Lubin.
4. Composite Materials Design and Applications – Danial Gay, Suong V. Hoa, and Stephen W. Tasi.

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

SHP321E.1 Apply knowledge of composite material
SHP321E.2 Calculate strength of composite material

MEP332 DISSERTATION PHASE-I

TeachingScheme: 20P = Total 20 **Credit : 10**
Evaluation Scheme: 100 ICA **Total Marks: 100**

Course Objectives:

I. Select and develop the topic based on literature survey.
II. Decide the frame work of topic.
III. Decide the scope tentative end.
IV. Declare 25% work of total work in the prescribed format of the department.

Course Contents:

Dissertation Phase-I: Student has to submit the report and deliver the seminar based on minimum of 25% of his work on dissertation topic. The student has to present before the committee andit 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 the course, the student will be able to:

MEP332.1 Identify/define problems and generate questions and/or hypotheses,
MEP332.2 Review and summarize the literature
MEP332.3 Make the action plan to complete the dissertation
MEP332.4 Develop and sustain an evidence-based argument, Write and speak critically and coherently, submit and publish the work.

MEP 431 DISSERTATION PHASE-II

Teaching Scheme: 32 P = Total 32
Evaluation Scheme: 100 ICA + 200 ESE

Credit: 16
Total Marks: 300

Course Objectives:

I. Identify research technique and collect the data
II. Organise, Interpret, analyse data and compile the factual results
III. Draw the conclusion
IV. Compile the report and Publish

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. All rules and guidelines to be followed by the candidate, given by guide and other related authority.

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

MEP431.1 Apply the appropriate research technique and collect the data
MEP431.2 Conduct research responsibly and ethically
MEP431.3 Evaluate, interpret and analyse a body of empirical data and evidences, discuss findings in the broader context of the field.
MEP431.4 Develop and sustain an evidence-based argument, Write and speak critically and coherently, submit and publish the work.