G.H. Raisoni College of Engineering and Management, Wagholi, Pune – 412 207

(An Autonomous Institute Affiliated to SPPU, Pune)

M. TECH-MECHANICAL

(HEAT POWER AND COMPUTER AIDED DESIGN, MANUFACTURING AND ENGINEERING)

Course Book

Department of Mechanical Engineering

2016-17

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INDEX		
S. No.	**CONTENTS**	**P. No.**
1	Introduction	4
2	Program Outcomes	5-6
3	Program Specific Outcomes and Course of study	7
4	List of Course Codes	8-9
5	Structure of M.Tech. in Heat Power Engineering	10-12
6	Syllabus of Heat Power Engineering	13-59
7	Structure of M.Tech Computer Aided Design and Manufacturing Engineering	60-61
8	Syllabus of M.Tech Computer Aided Design and Manufacturing Engineering	62-109
9	Rules and Regulations	110-115

DEPARTMENT OF MECHANICAL ENGINEERING

VISION:

To produce excellent Mechanical Engineering graduates to cater the needs of Indian industries to face Research challenges.

MISSION : Our efforts are dedicated towards

1. To imparting quality education through strengthening teaching learning process.
2. Creating competency in core Mechanical Engineering and Computer Aided Engineering.
3. To prepare students for accepting industrial and research challenges through project based learning.
4. To prepare professional engineers having lifelong learning ability and ethical values towards society and environment.

QUALITY POLICY

To pursue global standards of excellence in all our endeavors namely, teaching, research, consultancy and continuing education and to remain accountable in our core and support functions through processes of self-evaluation and continuous improvement.

1. INTRODUCTION

GHRCEM, Pune is nationally acclaimed Institute that aims at creating professionals who will be driven by a firm commitment to excellence, yet rooted in the rich cultural heritage of our nation. GHRCEM, Pune is accredited by National Assessment and Accreditation Council (NAAC), Government of India. This Institute has also been granted autonomy by UGC. GHRCEM, Pune is fast emerging as a pioneering Research cum Teaching Institution molding a new generation of engineers, managers, scientists and entrepreneurs of caliber and character.

The Department of Mechanical Engineering was established in year 2006. Presently the department has well equipped laboratories, including state of art equipment's like CNC Trainer machine, CAD/CAM/CAE software etc. The department organizes Guest Lectures to students, Training services. Faculty of mechanical department organizes and participates in national/international conferences, workshops and seminars. The department has SAE, MESA, ISTE Chapters for professional growth and activities. The students of Mechanical Engineering have been recruited by renowned companies like Engineers India Limited, Infosys, NTPC, Tata Motors etc. They have also brought laurels to the department by winning various competitions of national level (BAJA SAE, SUPRA) co-curricular and extracurricular activities like paper presentations, projects, quizzes, sports etc. The department has organized National and International conference during NCRDME 2012-13, ICRAME 2014-15, NCRDME 2016-17. Department has approved Ph.D. research Centre w.e.f. 2014 under UOP Pune. The Institute offers a fulltime programme of 4-years in Mechanical Engineering and the Programme offered list is given below:

Program Offered

Sr.	Programme	Name of	Course Type	Medium of	Course	Sanctioned
1	UG B. Tech	1st year	Regular Shift	English	2006-2007	120
		Direct 2nd	Regular Shift	English	2007-2008	60
2	PG M. Tech	Heat Power	Regular Shift	English	2011-2012	18
		CADME	Regular Shift	English	2014-2015	24
3	Ph. D	Mechanical	Regular Shift	English	2014-2015	-

2. PROGRAM OUTCOMES

Engineering Graduates will be able to:

1. Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals and an engineering specialization to the solution of complex engineering problems.

2. Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

3. Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

4. Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

5. Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

6. The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

7. Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

8. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

9. Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

10. Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

11. Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

12. Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

3. LIST OF PROGRAM SPECIFIC OUTCOMES (PSOs) AND COURSE OF STUDY

3.1 List of Program Specific Outcomes (PSOs)

At the end of graduation:

1. Able to grasp comprehensive and apply the knowledge of mechanical engineering acquired through core courses of engineering.
2. Will be able to apply design, develop and manufactures skills to solve the real life problems associated with industries.
3. Able to use knowledge of soft skills like software tools and multidisciplinary skills to modify and develop new products.

3.2 Course of Study

The following specializations are offered at present for the M.Tech Course of study.

1. Heat Power Engineering
2. Computer Aided Design, Manufacturing and Engineering

1. LIST OF COURSE CODE OF HEAT POWER ENGINEERING (HPE) AND COMPUTER AIDED DESIGN, MANUFACTURING AND ENGINEERING (CAMDE)

4.1 Course Code of Heat Power Engineering (HPE)

S.N	CODE	Course Name	SEM	SUB	ELEC	OFFER
1	MHPL501	Advanced Mathematics and Numerical Methods	I	THEORY	NO	YES
2	MHPL502	Advanced Thermodynamics and Combustion Technology	I	THEORY	NO	YES
3	MHPL503	Advanced Fluid Mechanics	I	THEORY	NO	YES
4	MHPL504	Research Methodology	I	THEORY	NO	YES
5	MHPL505	Elective I	I	THEORY	YES	YES
6	MHPP506	Lab Practice I	I	LAB	NO	YES
7	MSDP501	Advance Skill Development	I	THEORY	NO	YES
8	MHPL507	Advanced Heat Transfer	II	THEORY	NO	YES
9	MHPL508	Air Conditioning Technology	II	THEORY	NO	YES
10	MHPL509	Computational Fluid Dynamics	II	THEORY	NO	YES
11	MHPL510	Elective II	II	THEORY	YES	YES
12	MHPL511	Elective III	II	THEORY	YES	YES
13	MHPP512	Lab Practice II	II	LAB	NO	YES
14	MHPP601	Technical Writing	III	LAB	NO	YES
15	MHPP602	Seminar I	III	SEMINAR	NO	YES
16	MHPP603	Dissertation Phase-I	III	PROJECT	NO	YES
17	MHPP604	Seminar II	IV	SEMINAR	NO	YES
18	MHPP605	Dissertation Phase-II	IV	PROJECT	NO	YES

4.2 COURSE CODE OF COMPUTER AIDED DESIGN AND MANUFACTURING ENGINEERING (CAMDE)

S.N	CODE	Course Name	SEM	SUB	ELEC	OFFER
1	MCDL501	Advanced Mathematics	I	THEORY	NO	YES
2	MCDL502	Advanced Machine Design	I	THEORY	NO	YES
3	MCDL503	Computer Aided Design	I	THEORY	NO	YES
4	MCDL504	Research Methodology	I	THEORY	NO	YES
5	MCDL505	Elective I	I	THEORY	YES	YES
6	MCDP506	Modelling and Analysis Lab-I	I	LAB	NO	YES
7	MSDP501	Advance Skill Development	I	LAB	NO	YES
8	MCDL507	Computer Integrated Manufacturing	II	THEORY	NO	YES
9	MCDL508	Finite Element Analysis	II	THEORY	NO	YES
10	MCDL509	Automated Manufacturing System Modelling	II	THEORY	NO	YES
11	MCDL510	Elective II	II	THEORY	YES	YES
12	MCDL511	Elective III	II	THEORY	YES	YES
13	MCDP512	Simulation Lab-II	II	LAB	NO	YES
14	MCDP601	Technical Writing	III	LAB	NO	YES
15	MCDP602	Seminar I	III	SEMINAR	NO	YES
16	MCDP603	Dissertation Phase-I	III	PROJECT	NO	YES
17	MCDP604	Seminar II	IV	SEMINAR	NO	YES
18	MCDP605	Dissertation Phase-II	IV	PROJECT	NO	YES

2. STRUCTURE OF M.TECH. IN HEAT POWER ENGINEERING

Semester-I

Scheme of Examination for M. Tech. - Mechanical Engineering													
Heat Power Engineering													
Semester- I													
Course code	Subject Name	Teaching Scheme (Weekly Load in hrs.)				Credits	Evaluation Scheme						ESE Duration (Hrs.)
							Theory			Practical		Total	
		Lecture	Tutorial	Practical	Total		TAE 20%	CAE 20%	ESE 60%	Cont. Ass.	Ext. Ass.		
MHPL501	Advanced Mathematics and Numerical Methods	3	1	--	4	4	20	20	60	--	--	100	3
MHPL502	Advanced Thermodynamics and Combustion Technology	3	1	--	4	4	20	20	60	--	--	100	3
MHPL503	Advanced Fluid Mechanics	3	1	--	4	4	20	20	60	--	--	100	3
MHPL504	Research Methodology	3	1	--	4	4	20	20	60	--	--	100	3
MHPL505	Elective I	2	--	--	2	2	20	20	60	--	--	100	3
MHPP506	Lab Practice I	--	--	4	4	2	--	--	--	50	50	100	--
MSDP501	Advance Skill Development	--	--	2	2	AU	--	--	--	--		--	--
	Total	14	4	6	24	**20**	100	100	300	50	50	**600**	--

MHPL505: Elective-I			
Modules of 2 Credits (Select any One)			
Code No.	**Course**	**Code No.**	**Course**
MHPL505A	Energy Audit and Management	MHPL505G	Operation Management
MHPL505B	Financial Management	MHPL505H	Engineering Economics
MHPL505C	Financial Costing	MHPL505I	Technology Forecasting
MHPL505D	Project Management	MHPL505J	Technology Transfer
MHPL505E	Energy Efficient Technologies in Electrical Systems	MHPL505K	Human Rights
MHPL505F	Environmental Pollution and Control	MHPL505L	Intellectual property Rights

Semester- II

Scheme of Examination for M. Tech. - Mechanical Engineering													
Heat Power Engineering													
Semester- II													
Course code	Course Name	Teaching Scheme (Weekly Load in hrs)				Credits	Evaluation Scheme						ESE Duration (Hrs)
							Theory			Practical		Total	
		Lecture	Tutorial	Practical	Total		TAE 20%	CAE 20%	ESE 60%	Cont. Ass.	Ext. Ass.		
MHPL507	Advanced Heat Transfer	3	1	-	4	4	20	20	60	--	--	100	3
MHPL508	Air Conditioning Technology	3	1	-	4	4	20	20	60	--	--	100	3
MHPL509	Computational Fluid Dynamics	3	1	-	4	4	20	20	60	--	--	100	3
MHPL510	Elective II	3	-	-	3	3	20	20	60	--	--	100	3
MHPL511	Elective III	3	-	-	3	3	20	20	60	--	--	100	3
MHPP512	Lab Practice II	-	-	4	4	2	--	--	--	50	50	100	-
	Total	15	3	4	22	**20**	100	100	300	50	50	**600**	-

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MHPL502: Elective-II			
Modules of 2 Credits (Select any One)			
Course Code	**Course Name**	**Code No.**	**Title**
MHPL510A	Thermal System Design	MHPL510J	Jet Propulsion
MHPL510B	Aerodynamics	MHPL510K	Incompressible Flow Turbo machines
MHPL510C	Introduction to flight	MHPL510L	Cryogenic Engineering Gas Liquefaction
MHPL510D	Vacuum Technology	MHPL510M	Fuel Burning Devices
MHPL510E	Gas Dynamics	MHPL510N	Adsorption Technology
MHPL510F	Turbomachinery	MHPL510O	Industrial Hydraulics
MHPL510G	Gas Turbine	MHPL510P	Turbulent Jets
Modules of 1 Credits (Select any One)			
MHPL510a	Selection of Fans, Pumps and blowers	MHPL510d	Clean-room Technology
MHPL510b	Biomass Technology	MHPL510e	Pneumatics
MHPL510c	Nano-materials	MHPL510f	Insulating Materials and Refractories

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MHPL511: Elective-III			
Modules of 3 Credits (Select any One)			
Course Code	**Corse Name**	**Course Code**	**Course Name**
MHPL511A	Open Elective	MHPL511D	Cryogenics
MHPL511B	Thermal Storage Systems	MHPL511E	Measurements and Controls
MHPL511C	Design of Heat Exchangers	MHPL511F	Optimization Technique

Semester- III

Scheme of Examination for M. Tech. - Mechanical Engineering													
Heat Power Engineering													
Semester- III													
Course Code	**Course Name**	**Teaching Scheme (Weekly Load in hrs)**				**Credits**	**Evaluation Scheme**						**ESE Duration (Hrs)**
							Theory			**Practical**		**Total**	
		Lecture	**Tutorial**	**Practical**	**Total**		**TAE 20%**	**CAE 20%**	**ESE 60%**	**Cont. Ass.**	**Ext. Ass.**		
MHPP601	Technical Writing	--	--	3	3	3	--	--	--	50	50	100	--
MHPP602	Seminar I	--	--	4	4	4	--	--	--	50	50	100	--
MHPP603	Dissertation Phase-I	--	--	8	8	8	--	--	--	100	100	200	--
	Total	--	--	15	15	**15**	--	--	--	200	200	**400**	--

Semester- IV

Scheme of Examination for M. Tech. - Mechanical Engineering													
Heat Power Engineering													
Semester- IV													
Course Code	**Course Name**	**Teaching Scheme (Weekly Load in hrs)**				**Credits**	**Evaluation Scheme**						**ESE Duration (Hrs.)**
							Theory			**Practical**		**Total**	
		Lecture	**Tutorial**	**Practical**	**Total**		**TAE 20%**	**CAE 20%**	**ESE 60%**	**Cont. Ass.**	**Ext. Ass.**		
MHPP604	Seminar II	--	--	4	4	4	--	--	--	50	50	100	--
MHPP605	Dissertation Phase-II	--	--	16	16	16	--	--	--	200	100	300	--
	Total	--	--	20	20	**20**	--	--	--	250	150	**400**	--

3. SYLLABUS OF M.TECH. HEAT POWER ENGINEERING

MHPL501: ADVANCED MATHEMATICS AND NUMERICAL METHODS

Teaching	**Examination Scheme (Theory)**	**Examination Scheme**
Scheme:	**Teacher Assessment Examination:** 20 Marks	**(Laboratory)**
Lectures: 03 hrs.	**Class Assessment Examination:** 20 Marks	**Internal(TW):** NIL
Tutorials: 01 hr.	**End Semester Examination:** 60Marks	**External(OR)**: NIL
Practical: NIL		**External(PR)** : NIL
Credits	**04**	

Prerequisite (If any):

1. Engineering Mathematics I, II & III
2. Numerical Methods & Optimization

Course Objective:

1. The students will have a thorough knowledge of the mathematical methods to be applied to problems in Mechanical Engineering.

Course Outcome:

1. Formulate and solve algebraic equations, Eigen value problems.
2. Demonstrate understanding of common numerical methods and how they are used to obtain approximate solutions to otherwise intractable mathematical problems.
3. Apply numerical methods to obtain approximate solutions to mathematical problems.
4. Apply optimization, numerical methods, statistical methods to solve engineering problems.

Course Contents: **Hrs.**

Unit – I : Linear Algebraic Equations: 6

Gauss – Elimination, Gauss – Seidel, LU Decomposition, Solution of algebraic and transcendental equations : - Bisection Method, False position method, Newton – Raphson Method, Muller's method, Bairstow's Method, Convergence and stability

Unit – II : Regression Analysis: 6

i) Linear regression, multiple linear regressions, polynomial regression. ii) Nonlinear regression – Gauss – Newton method, multiple nonlinear regression. Interpolation: Newton's Divided Difference, Lagrange's Inverse, Spline, Hermite Interpolation, Extrapolation technique of Richardson's Gaunt

Unit – III : Differentiation & Integration: 6

Divided difference formulae, Romberg integration, Gauss quadrature for double & triple integration.

Unit – IV : Eigen Values & Eigen Vectors of Matrices

6

Faddeev- Laeverrier's method, Power Method, Householder & Given's method

Unit – V : Ordinary differential equations: 6

Euler's method, Heun's method, Mid – point method, Runge – Kutta methods, Multi step Methods - explicit Adams – Bash forth technique & Implicit Adams – Moulton Technique, Adaptive RK method, Embedded RK method, step size control. Higher order ODE – Shooting method. Nonlinear ODE – Collocation technique.

Unit – VI : Partial Differential Equations: 6

Solution of Parabolic and Hyperbolic equations –Implicit & Explicit Schemes, ADI methods, Nonlinear parabolic equations-Iteration method. Solution of elliptic equation – Jacobi method, Gauss – Seidel & SOR method. Richardson method.

Text Books: (Book Title, Name of the author, name of the Publisher, edition, year of publication)

1. Numerical Methods for Engineers, Steven C Chapra & Raymond P Canale, TMH, Fifth Edition
2. Applied Numerical Methods, Alkis Constantinides, McGraw Hill
3. Applied Numerical Methods with MATLAB, Steven Chapra, McGraw Hill
4. Numerical Solution of Differential Equations, M.K. Jain, 2nd Edition, Wiley Eastern.

Reference Books:

1. Numerical methods for scientific and engineering computation, Jain, Iyangar Jain, New Age International Publishers
2. Numerical methods in Engineering and Science, Dr. B.S. Grewal, Khanna Publishers

MHPL502: ADVANCED THERMODYNAMICS AND COMBUSTION TECHNOLOGY		
Teaching Scheme: **Lectures:** 03 hrs. **Tutorials:** 01 hrs. **Practical:** NIL	**Examination Scheme (Theory)** **Teacher Assessment Examination:** 20-Marks **Class Assessment Examination:** 20-Marks **End Semester Examination:** 60-Marks	**Examination Scheme (Laboratory)** **Internal(TW):** NIL **External(OR)**: NIL **External(PR)** : NIL
Credits :	**04**	

Prerequisite (If any):

1. Thermodynamics
2. Engineering Chemistry

Course Objective:

1. Students will obtain knowledge of advance thermodynamic analysis to be applied for practical problems
2. To study deeply and research the relations of enthalpy entropy and internal energy and their derivations
3. To gain knowledge about mass and heat balance equations by solving practical problems

Course Outcome:

1. Students will apply basic concepts, the laws of thermodynamics and estimate the physical properties of pure substance.
2. Students should be able to describe the concepts entropy and exergy and their use in analyses of thermal energy systems.
3. Provide the theoretical and practical background in the use of fuels via a physico-chemical approach to combustion.
4. Students should be able to understand alternative fuel and combustion technologies

Course Contents **Hrs**

Unit – I : Equation of State 7

State postulate for Simple System and equation of state, Ideal gas equation, Deviation from ideal gas, Equation of state for real gases, generalized Compressibility chart, Law of corresponding states.

Unit – II : Properties of Pure Substances 7

Phase change process of pure substances, PVT surface, P-v &P- T diagrams, Use of steam tables and charts in common use, Simple numericals.

Unit – III : Laws of thermodynamics 7

2^{nd} law Analysis for Engg. Systems, Entropy flow & entropy generation, Increase of entropy principle, entropy change of pure sub, T-ds relations, entropy generation, thermo electricity, Onsager equation. Exergy analysis of thermal systems, decrease of Exergy

principle and Exergy destruction, Third law of thermodynamics, Nerst heat theorem and thermal death of universe, Simple numericals.

Unit – IV : Thermodynamic Property Relations 7

Partial Differentials, Maxwell relations, Clapeyron equation, general relations for du, dh, ds, and Cv and Cp, Joule Thomson Coefficient, Δh, Δu, Δs of real gases, Simple numericals.

Unit – V : Combustion Technology 7

Chemical reaction - Fuels and combustion, Enthalpy of formation and enthalpy of combustion, First law analysis of reacting systems, adiabatic flame temperature Chemical and Phase equilibrium - Criterion for chemical equilibrium, equilibrium constant for ideal gas mixtures, some remarks about Kp of Ideal-gas mixtures, fugacity and activity, Simultaneous relations, Variation of Kp with Temperature, Phase equilibrium, Gibb's phase rule, Gas Mixtures – Mass & mole fractions, Dalton's law of partial pressure, Amagat's law, Kay's rule.

Unit – VI : Advanced fuels and combustion technologies 7

Alternative fuels- Bio-diesels (edible and non-edibles), Mixed and hybrid fuels. Advanced combustion chambers and injection Systems. Advanced combustion Methods.

List of Practical (Compete Any Three) (Frame the practical list as per curriculum structure) **Hrs.**

1. Computer aided energy analysis of steady flow cyclic system. 2
2. Study of mixture of gases, gas and vapour, estimation of properties and preparation of charts. 2
3. Study of different I C Engine combustion chambers and injection systems 2
4. Study of behavior of pure substance with change in pressure and temperature 2
5. Preparation of computer program to study the effect of percentage of theoretical on adiabatic flame temperature and equilibrium composition for a hydrocarbon fuel. (Program to be run for variable input data.) 2

Text Books: (Book Title, Name of the author, name of the Publisher, edition, year of publication)

1. Thermodynamics – An Engineering Approach, Yunus Cengel and Michael Boles,7th Ed., Tata McGraw Hill

Reference Books:

2. Modern Engineering Thermodynamics, Robert Balmer, Elseveir.
3. Advanced Thermodynamics for Engineers, Winterbone, John Wiley
4. Advanced Thermodynamics for Engineers, Kenneth Wark, McGraw Hill
5. Thermodynamics for Engineers, Mathur, Gupta, Metropolitan Book Co. Pvt. Ltd.
6. Fundamentals of Engineering Thermodynamics, Michael Moran, Howard Shapiro, John

MHPL503:ADVANCED FLUID MECHANICS

Teaching Scheme:	Examination Scheme (Theory)	Examination Scheme
Lectures: 03 hrs.	**Teacher Assessment Examination :** 20 Marks	**(Laboratory)**
Tutorials: 01 hr.	**Class Assessment Examination :** 20 Marks	**Internal(TW):** NIL
Practical: NIL	**End Semester Examination:** 60 Marks	**External(OR):** NIL
		External(PR) : NIL
Credits:	**04**	

Prerequisite (If any):

1. Advanced Mathematics
2. Thermodynamics and Fluid Mechanics
3. Heat Transfer

Course Objective:

1. Study of the flow of fluids
2. General equations, including continuous equation, momentum equation and energy equation are derived.
3. Model a vast range of physical phenomena and plays a vital role in science and engineering.

Course Outcome:

1. Apply the concept of fluid flow for the formation of various mathematical models of fluid flow
2. Formulate the basic equations of continuity and momentum to apply them in practical applications
3. Evaluate the problem on boundary layer and apply them on various objects like airplane and jet
4. Ability to derive the equation for viscous flow, including laminar flow and turbulent flow
5. Ability to address fluid flow problems in engineering like in pipes and ducts with the help of Semi-empirical theories and similarity hypothesis.

Course Contents **Hrs**

Unit – I : Fluid Flow Concepts 6

Euler's equation of motion, Continuity equation, Stream function, potential function, flow nets, rotational and irrotational flow, Circulation Vortices.

Unit – II : Navier-Stock's equations 6

Fundamental equation of motion and continuity applied to fluid flow, General stress in a deformable body, rate at which the fluid element strained in a flow; relation between stress and rate deformation, Stoke's hypothesis. Navier-Stoke's equation, Exact solutions of Navier-Stoke's equations.Reynold's principle of similarity.

Unit – III : Laminar Boundary Layer 6

Boundary Layer equations for flow along flat plate, separation of boundary layer, Momentum-Integral equation of the Boundary Layer. Exact solution of Boundary Layer equations to flow past a cylinder, two-dimensional jet. Boundary Layer control and its applications, Drag; Pressure, form and skin friction.

Unit – IV : Turbulent Flow **6**

The origin of turbulence, Reynolds modification of Navier-Stokes equation for Turbulent flow. Mean values and fluctuations, Semi-empirical theories of similarity hypothesis, Turbulent flow in pipes, Turbulent boundary layer.

Unit – V : Introduction to Boundary layer 6

Introduction to Boundary layer for compressible fluid. Advance topic on subject.

Unit-VI: Advance applications in fluid Mechanics 4

Flow analysis using composites, Nano fluids. Applications in aerodynamic modeling,

Lab Experiments / Assignments (Any Three):	**Hrs.**
1. Flow over a cylinder/sphere at different Re. Pressure variation over the body and drag Estimation.	2
2. Flow past an aerofoil: Pressure measurements, calculation of lift.	2
3. Flow through a converging-diverging nozzle: subsonic and supersonic flows.	2
4. Friction factor determination: incompressible flow through pipes/ducts of variable cross section.	2
5. Laminar/Turbulent boundary layer over a flat plate.	2

Reference Books:

1. Fluid Mechanics Yuan, S.W Prentice Hall, 1970
2. Fluid Mechanics White, F.M Tata McGraw Hill , 1986
3. Elementary Fluid Mechanics Vennard J.K. and Street R.L John Wiley 1982 6th edition
4. Fundamental Mechanics of Fluids Currie, LG CRC Press 2002 3rd edition

MHPL504: RESEARCH METHODOLOGY		
Teaching Scheme: **Lectures:** 03hrs. **Tutorials:** 01 hr. **Practical:** NIL	**Examination Scheme (Theory)** **Teacher Assessment Examination:** 20-Marks **Class Assessment Examination:** 20-Marks **End Semester Examination:** 60-Marks	**Examination Scheme (Laboratory)** **Internal(TW):** NIL **External(OR)**: NIL **External(PR)** : NIL
Credits	**04**	

Course Objective:

1. To develop understanding of the basic framework of research process
2. To develop an understanding of various research designs and techniques
3. To identify various sources of information for literature review and data collection
4. To develop an understanding of the ethical dimensions of conducting applied research
5. Appreciate the components of scholarly writing and evaluate its quality

Course Outcome:

1. Ability to think like a researcher – Understanding Concepts, scope and objective of research problem.
2. Students should be able to distinguish a static and dynamic characteristics of instrument used in experimental setup.
3. Students should be able to develop Research Proposal.

Course Contents **Hrs**

Unit – I : Research Problem 6

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

Unit – II : Basic instrumentation 6

Instrumentation schemes, Static and dynamic characteristics of instruments used in experimental set up, Performance under flow or motion conditions, Data collection using a digital computer system, Linear scaling for receiver and fidelity of instrument, Role of DSP in data collection in noisy environment.

Unit – III : Applied statistics 6

Regression analysis, Parameter estimation, Multivariate statistics, Principal component analysis, Moments and response curve methods, State vector machines and uncertainty analysis, Probable errors in the research, Error analysis, simple numerical.

Unit – IV : Research Modelling 6

Types of modeling, Tools used, Setting up a computing model to predict performance of experimental system, Multi-scale modelling and verifying performance of process system,

simple numerical.

Unit – V : Prediction of performance 6

Nonlinear analysis of system and asymptotic analysis, Verifying if assumptions hold true for a given apparatus setup, Plotting family of performance curves to study trends and tendencies, Sensitivity theory and applications, simple numerical.

Unit – VI : Developing a Research Proposal 6

Format of research proposal, Individual research proposal, Institutional proposal, Proposal of a student – a presentation and assessment by a review committee consisting of Guide and external expert only, Other faculty members may attend and give suggestions relevant to topic of research.

Text Books: (Book Title, Name of the author, name of the Publisher, edition, year of publication)

1. Research Methodology: Methods and Trends, by Dr. C. R. Kothari

Reference Books:

1. Research methodology: an Introduction for Science & Engineering students, by Stuart Melville and Wayne Goddard
2. Research Methodology: An Introduction by Wayne Goddard and Stuart Melville 4. 5.
3. Research Methodology: A Step by Step Guide for Beginners, by Ranjit Kumar, 2nd Edition
4. Operational Research by Dr. S.D. Sharma, Kedar Nath Ram Nath & Co.

MHPL505: ELECTIVE-I		
Teaching Scheme: **Lectures:** 02hrs. **Tutorials:** NIL **Practical:** NIL	**Examination Scheme (Theory)** **Teacher Assessment Examination:** 20-Marks **Class Assessment Examination:** 20-Marks **End Semester Examination:** 60-Marks	**Examination Scheme (Laboratory)** **Internal(TW):** NIL **External(OR)**: NIL **External(PR)** : NIL
Credits	**02**	

MHPL505: Elective-I			
Modules of 2 Credits (Select any One)			
Code No.	**Title**	**Code No.**	**Title**
MHPL505A	Energy Audit and Management	MHPL505G	Operation Management
MHPL505B	Financial Management	MHPL505H	Engineering Economics
MHPL505C	Financial Costing	MHPL505I	Technology Forecasting
MHPL505D	Project Management	MHPL505J	Technology Transfer
MHPL505E	Energy Efficient Technologies in Electrical Systems	MHPL505K	Human Rights
MHPL505F	Environmental Pollution and Control	MHPL505L	Intellectual property Rights

MHPL505A: Energy Audit and Management

Definition, Energy audit- need, Types of energy audit, Energy management (audit) approach-understanding energy costs, Bench marking, Energy performance, Matching energy use to requirement, Maximizing system efficiencies, Optimizing the input energy requirements, Fuel and energy substitution, Energy audit instruments

Reference Books: 1. Guide Books, Bureau of Energy Efficiency

MEHPL505B: Financial Management

Investment-need, Appraisal and criteria, Financial analysis techniques- Simple payback period, Return on investment, Net present value, Internal rate of return, Cash flows, Risk and sensitivity analysis, Financing options, Energy performance contracting and role of Energy Service Companies (ESCOS).

Reference Books: 1. Guide Books, Bureau of Energy Efficiency

MHPL505C: Financial Costing

Significance, Traditional absorption costing, Marginal costing, Contract costing, Activity based costing, Process costing**.**

Reference Books: Cost Accounting, N K Prasad, Book Syndicate Pvt. Ltd.

MHPL505D: Project Management

Definition and scope of project, Technical design, Financing, Contracting, Implementation and performance monitoring. Implementation plan for top management, Planning Budget, Procurement Procedures, Construction, Measurement & Verification.

MHPL505E: Energy Efficient Technologies in Electrical Systems

Maximum demand controllers, Automatic power factor controllers, Energy efficient motors, Soft starters with energy saver, Variable speed drives, Energy efficient transformers, Electronic ballast, Occupancy sensors, Energy efficient lighting controls.

Reference Books: Guide Books, Bureau of Energy Efficiency

MHPL505G: Operation Management

Introduction, Importance, Operating systems models, key decisions, Planning and controlling, Strategic approach, Processes and systems, supply chain or network approach, Technology and knowledge management, Quality Management, Operations - Challenges, Opportunities, Excellence, risk management and sustainability, Case studies

Reference Books: 1. Operations Management - An Integrated Approach, Danny Samson and Prakash J. Singh, Cambridge, Universal Press. 2. Modern production/Operations Management, 8th Edition, E.S. Buffa and R. K. Sarin, John Wiley & Sons

MHPL505H: Engineering Economics

Fundamentals, Markets and Government in a Modern economy, Basic Elements of Supply and Demand, Demand and Consumer Behaviour, Analysis of Perfectly Competitive Markets, Unemployment, Inflation and Economic policy

Reference Books: Economics, Samuelson Nordhaus, Tata McGraw Hill

MHPL505I: Technology Forecasting

Approaches, Technology Performance Parameters, Use of Experts in Technology Forecasting, Planning, Technology Progress. Morphological Analysis of a Technology System.

Reference Books: 1) Gerard H. Gaynor, Hand Book of Technology Management, Mc Graw Hill.

MMEHPL1105J: Technology Transfer

Definition, Source of Technology Transfer [TT], Model of TT with Public and Private Enterprises, Success and Failure Factors in Technology Transfer. The concepts of Invention and Innovation, Definition and classifications of Research and Development, New Product Development, Challenges in Commercializing Research Results.

Reference Books: 1. Gerard H. Gaynor, Hand Book of Technology Management, Mc Graw Hill.

MHPL505K: Human Rights

Human Rights – Concept, Development, Evolution, Philosophical, Sociological and Political debates, Benchmarks of Human Rights Movement. Human Rights and the Indian Constitution Human Rights & State Mechanisms, Police & Human Rights, Judiciary & Human Rights, Prisons & Human Rights, National and State Human Rights Commissions, Human Rights of the Different Sections and contemporary issues, Citizens' Role and Civil Society, Human Rights and the international scene Primary Information with reference to Engineering Industry

Reference Books: 1)Study material on UNESCO,UNICEF web site, 2)HUMAN RIGHTS IN INDIA A MAPPING,Usha Ramanathan, 3)Introduction to International Humanitarian Law by Curtis F. J. Doebbler - CD Publishing , 2005 .This book is an introductory text on international humanitarian law (the laws of war) that provides the basics of law, including excerpts from some of the leading treaty

texts. Perfect for a short course in the law -- one to five weeks, 4) Freedom of Information by Toby Mendel - UNESCO, 2008.

MHPL505F: Environmental and Pollution control

Pollution and Environmental Ethics, Air pollution, Water pollution, Soil pollution, Marine pollution, Noise pollution, Thermal pollution, Nuclear hazards Environmental impact and economic aspects, Emission standards and regulations for Automobiles.

Referance Books: 1) Environmental Pollution and Control, J. Jeffrey Peirce, P Aarne Vesilind, Ruth Weiner, Butterworth-Heinemann, 2) Environmental Pollution Control Engineering, C.S. Rao, New Age International

MHPL505L: Intellectual property Rights

Patentable and non-patentable inventions, statutory exceptions, Persons entitled to apply for patents.

Referance Books: 1) Satyawrat Ponkshe, The Management of Intellectual Property, by, Ponkshe & Bhate Publications, Pune.

MHPP506: LAB PRACTICE - I		
Teaching Scheme: **Lectures:** NIL **Tutorials:** NIL **Practical:** 04hrs.	**Examination Scheme (Theory)** **Teacher Assessment Examination:** NIL **Class Assessment Examination:** NIL **End Semester Examination:** NIL	**Examination Scheme (Laboratory)** **Continuous Assessment:** 50 Marks **External Assessment:** 50 Marks
Credits:	**04**	

Lab. work or Assignments have to be carried out at respective labs as mentioned in the syllabus of respective subjects **excluding Research Methodology and Elective.** It is to be submitted as term work at the end of semester after continuous assessment of each by respective teacher.

MSDP501: ADVANCE SKILL DEVELOPMENT		
Teaching Scheme: **Lectures:** NIL **Tutorials:** NIL **Practical:** 02hrs.	**Examination Scheme (Theory)** **Teacher Assessment Examination:** NIL **Class Assessment Examination:** NIL **End Semester Examination:** NIL	**Examination Scheme (Laboratory)** **Continuous Assessment:** NIL
Credits:	**Audit Course (AU)**	

AUDIT COURSE			
The students must complete any one (A or B) of the following audit course for 20-25 hrs. and submit the certificate			
A Certificate Course:		**B General Proficiency / Foreign Language:**	
i	Advanced CFD Tool	I	German
ii	Industrial H.E. Design	Ii	Spanish
iii	Energy audit of any process/Industry	Iii	French
Iv	Optimization Tools	Iv	Japanese
V	Mechanical CAE Simulation	V	Chinese
vi	Certification course in Quality and testing		

MHPL507: ADVANCED HEAT TRANSFER		
Teaching Scheme: **Lectures:** 03 hrs. **Tutorials:** 01 hr. **Practical:** NIL	**Examination Scheme (Theory)** **Teacher Assessment Examination:** 20 Marks **Class Assessment Examination:** 20 Marks **End Semester Examination:** 60 Marks	**Examination Scheme (Laboratory)** **Internal(TW):** NIL **External(OR)**: NIL **External(PR)** : NIL
Credit	**04**	

Prerequisite (If any):

1. Fluid Mechanics
2. Thermodynamics

Course Objective:

1. To cover the basic principles and equations of conduction, convection and radiation heat transfer.
2. To present numerous and diverse real-world engineering examples to give students a feel for how heat transfer is applied in engineering practice.
3. To develop an intuitive understanding of convection heat transfer by emphasizing the physics, and visual aids.

Course Outcome:

1. Apply heat transfer principles to suggest remedial solutions for real life problems.
2. Ability to formulate the heat transfer equations to solve engineering problems.
3. Ability to design, analyze, interpret data to enhance heat transfer effectiveness.
4. Apply Reynolds analogy to heat transfer problems.
5. Apply Numerical techniques to conduction, convection heat transfer.
6. Use data tables, charts and equations to obtain appropriate data to solve heat transfer problems.

Course Contents **Hrs.**

Unit – I : Introduction 6

Introduction to Heat Transfer – Different Modes, Governing Laws, Quasi-Linearization of the Stefan-Boltzmann Law, Applications to Heat Transfer, Simple Problems for recapitulation of the above.

General Heat Conduction Equation : General Heat Conduction Equation in (i) Cartesian, (ii) Polar and (iii) Spherical Co-ordinate Systems – Derivation of all the equations from first principles, Solution to heat conduction equation – Initial and Boundary Conditions, Different kinds of boundary conditions with examples. 6

Unit – II : Heat Conduction

Steady-state one-dimensional heat conduction problems in Cartesian System : Steady-state one-dimensional heat conduction problems (i) with and without heat generation and (ii) with and without varying thermal conductivity - in Cartesian system with various possible boundary conditions, Numerical Problems.

Steady-state radial heat conduction problems in Polar System: Steady-state radial heat conduction problems (i) with and without heat generation and (ii) with and without varying thermal conductivity - in cylindrical system with various possible boundary conditions, Numerical Problems.

Steady-state radial heat conduction problems in Spherical System: Steady-state radial heat conduction problems (i) with and without heat generation and (ii) with and without varying thermal conductivity - in Spherical system with various possible boundary conditions, Numerical Problems.

Unit – III : Extended Surfaces or Fins 6

Extended Surfaces or Fins of various geometries – Uniform Fins, like Straight Rectangular and Circular Fins, Non-Uniform Fins, like Annular Fins and Triangular Fins, Corrected fin-length concept of Harper and Brown, Fin Efficiency and Fin Effectiveness, Numerical Problems covering all the topics.

Unit – IV : Steady-Unsteady state Heat Conduction 6

Steady-state two-dimensional heat conduction problems: Steady-state two-dimensional heat conduction problems in Cartesian and Cylindrical co-ordinates, Use of Bessel's functions, Numerical Problems.

Transient [Unsteady-state] heat conduction: Transient heat conduction, Different cases - Negligible internal thermal resistance, Negligible surface resistance, Comparable internal thermal and surface resistances, Lumped body, Infinite plate of finite thickness and Semi-infinite Solid, Numerical problems, Heisler and Grober charts for Transient Conduction – Solution to (i) One-dimensional, (ii) Two-dimensional and (iii) Three-dimensional problems using the charts, Numerical problems.

Unit – V : Convection 6

Force convection: Forced Convection Flow over a flat plate, Boundary Layer Theory, Velocity and Thermal Boundary Layers, Prandtl number, Governing Equations – Continuity, Navier-Stokes and Energy equations, Boundary layer assumptions, Integral and Analytical solutions to above equations, Turbulent flow, Various empirical solutions, Numerical Problems concerning the above topics, Forced convection flow over cylinders and spheres, Internal forced convection flows – Constant wall temperature and Constant wall heat flux boundaries, laminar and turbulent flow solutions, Numerical Problems.

Free convection: Laminar and Turbulent flows, analytical and empirical solutions, Numerical Problems.

Unit – VI : Thermal Radiation 6

Prevost's theory, Theories of propagation of thermal radiation, Fundamental principles - White, Opaque, Transparent, Black and Gray bodies, Spectral and Total emissive powers, Wien's, Rayleigh-Jeans and Planck's laws, Spectral energy distribution of a black body, Stefan-Boltzmann law for the total emissive power of a black body, Emissivity – types of emissivity, Numerical Problems, View factor, View factor algebra, Summation rule, Reciprocity Theorem, Hottel's crossed-string method, Electrical resistance concept to tackle two-body enclosures, Numerical problems.

Assignments (Any Three)	**Hrs.**
1. Transient Heat Conduction using Heisler and Grober charts	4
2. Numerical method in heat conduction & convection.	4
3. Combined Natural and Forced Convection heat transfer.	4
4. Radiation Heat Transfer in Two Surface Enclosures	4
5. Heat transfer augmentation techniques.	4

Text Books: (Book Title, Name of the author, name of the Publisher, edition, year of publication)

1. Fundamentals of Heat and Mass Transfer, Incropera, Dewitt, John Wiley and sons
2. Heat and Mass Transfer, Yunus Cengel, Afshin Ghajar, Tata Mc Graw Hill.
3. Heat transfer, J.P. Holman, Mc Graw Hill

Reference Books:

1. Sadik Kakac and Yaman Yener: Heat Conduction, Hemisphere, 2nd Edition, 2001.
2. Kays, W. M. and Crawford, M. E., Convective Heat and Mass Transfer, Tata McGraw Hill, 4th Edition, 2012.
3. Siegel, R. and Howell, J. R., Thermal Radiation Heat Transfer, Taylor and Francis, 4th Edition, 2002
4. Heat transfer - A basic approach, M.N. Ozisik, Mc Graw Hill Int.
5. Convective Heat transfer, A Bejan, John Wiley and sons.

MHPL508: AIR CONDITIONING TECHNOLOGY		
Teaching Scheme: **Lectures:** 3hrs. **Tutorials:** 1 hr. **Practical:** NIL	**Examination Scheme (Theory)** **Teacher Assessment Examination:** 20 Marks **Class Assessment Examination:** 20 Marks **End Semester Examination:** 60 Marks	**Examination Scheme (Laboratory)** **Internal(TW):** NIL **External(OR)**: NIL **External(PR)** : NIL
Credits:	**04**	

Prerequisite:

1. Thermodynamics
2. Basic Refrigeration & Air conditioning
3. Engineering Mathematics

Course Objective:

1. Develop the skills to analyze the large air conditioning systems.
2. Estimate the heating/cooling load & design the system components.
3. Gain the knowledge of contemporary air conditioning systems.

Course Outcome:

1. Apply the knowledge of air conditioning system in various applications.
2. Able to design a complex air conditioning system.
3. Able to design duct and to control noise, odour and bacteria.

Course Contents	**Hrs**
Unit – I : Psychrometry Moist Air properties , use of Psychrometric Chart , Psychrometric Processes, Air washer, Bypass Factor, ADP, Applied Psychrometry – RSHF, GSHF and ESHF. Numerical on Applied Psychrometry.	**6**
Unit – II : Load estimation & air conditioning control Solar Radiation-Heat Gain through Glasses, Heat transfer through roofs and walls, Total Cooling Load Estimation. Numerical on summer and winter load calculations.	6
Unit – III : Air distribution Fundamentals of air flow in ducts, pressure drop calculations, sizing of ducts using equal friction method, Equal velocity method & static regain method, duct materials and properties, insulating materials, types of grills, diffusers, wall registers, etc.	6
Unit – IV : Sound Control Definition of various terms like level, pitch, attenuation, frequency, sources of noise in air conditioning plants, design procedure for noise prevention. Fans and Blowers: Types, performance characteristics, series and parallel arrangement,	6

selection

Unit – V : Direct and indirect evaporative cooling

Basic psychrometry of evaporative cooling, types of evaporative coolers, design calculations, indirect evaporative cooling for tropical countries 6

Heating: Heat loss calculations, heat pumps, heating coils, electric heating, warm air systems, hot water systems.

Unit – VI : Air conditioning equipment and controls

Cooling coils, humidifiers, dehumidifiers, various types of filters, air washers, thermostat, humidistats, cycling and sequence controls, modern controls for purity, odour and bacteria. 6

Air conditioning systems : Classification, study of central and unitary systems, typical air conditioning systems such as automobile, air planes, ships, railway coach air-conditioning systems, clean rooms (Descriptive treatment only).

Text Books:

1. Refrigeration and Air-conditioning, Stoecker W.F., and Jones J.W., McGraw - Hill, New Delhi
2. Refrigeration and Air-conditioning, Arora C.P., Tata McGraw –Hill, New Delhi
3. Air conditioning Applications and Design, Jones W. P., Edward Arnold Publishers Ltd.

Reference Books:

1. Handbook of Heating,Ventilation and Air Conditioning- Jan F.Kredier- CRC
2. Control System for Heating, Ventilation and Air conditioning, Hainer R. W., Van Nastrand Reinhold Co., New York, 1984.
3. Fundamentals of HVAC systems, Robert McDowall, Elseveir

E-Books/Web Links

1. http://ishrae.in
2. http://ashrae.org

MHPL509: COMPUTATIONAL FLUID DYNAMICS		
Teaching Scheme: **Lectures:** 3hrs. **Tutorials:** 1 hr. **Practical:** NIL	**Examination Scheme (Theory)** **Teacher Assessment Examination:** 20 Marks **Class Assessment Examination:** 20 Marks **End Semester Examination:** 60 Marks	**Examination Scheme(Lab)** **Internal(TW):** NIL **External(OR)**: NIL **External(PR)** : NIL
Credits:	**04**	

Prerequisite (If any):

1. Basics of Mathematics and matrix operations.
2. Concepts of Fluid Mechanics
3. Concepts of Heat Transfer and numerical methods.

Course Objective:

1. To have a good understanding of the algorithms used in flow solvers
2. To be able to compare different algorithms

Course Outcome:

1. Understand the stepwise procedure to completely solve a fluid dynamics problem using computational methods
2. Derive the governing equations and understand the behaviour of the equations
3. Analyze the consistency, stability and convergence of various discretization schemes for parabolic, elliptic and hyperbolic partial differential equations.
4. Analyze various methods of grid generation techniques and application of finite difference and finite volume methods to various thermal problems

Course Contents **Hrs**

Unit – I : Introduction to CFD: 6

Governing equations: the continuity equation, momentum equation and energy equations, convective forms of the equations and general description, Reynolds transport theorem. Classification of partial differential equations; physical examples of elliptic, parabolic and hyperbolic equations. Mathematical nature of the flow equations& their boundary conditions

Unit – II : Discretization: 6

Basic discretization techniques applied to model equations and systems of equations: finite difference, finite volume and finite element methods. Finite difference methods: Taylor series expansion, different means for formulating finite difference equation; accuracy of finite difference method. Finite Volume Methods: Finite volume methods; approximation of surface and volume integrals; interpolation methods; central, upwind and hybrid formulations and comparison for convection-diffusion problem.

Analysis of numerical schemes: concept of consistency, accuracy, stability and convergence; Error and stability analysis; some applications.

Unit – III : Numerical Grid Generation: 6

Introduction, Structured and Unstructured mesh generation techniques • Structured grid generation: a)Algebraic method, b) Elliptic generation systems. • Unstructured grid generation: a)Voronoi diagram and Delaunay triangulation; b) Advancing front grid generation.

Unit – IV : Solution to Eulers equations: 6

Formulations of Euler equations, Discretization methods for Euler equations. High resolution schemes and TVD.

Unit – V : Navier-Stokes Equations: 6

Governing equations, Properties of Navier-Stokes equations; Discretization of NS equations; Boundry conditions; Convergence acceleration techniques.

Unit – VI : Turbulence Modeling: 6

Introduction, Statistical representation of turbulent flows: General Properties of turbulent quantities, Closure problem: Necessity of turbulence modeling, Reynolds average Navier stokes (RANS) equation, Different types of turbulence model: Eddy viscosity models, Mixing length model, Turbulent kinetic energy and dissipation, The κ-ε model, Advantages and disadvantages of κ-ε model, Two-equation models: κ-ε model and κ-ω model, Reynolds stress equation model (RSM).

Text Books:

1. Anderson, J.D. Computational Fluid Dynamics, McGraw Hill, 1995.
2. Anderson,D.A., Tannehill,J.C. and Pletcher,R.H., Computational Fluid Dynamics and Heat Transfer, McGraw Hill, 1984.

Reference Books:

1. Hirsch,C. Numerical Computation of Internal and External Flows, Vol.I, John Wiley, 1990.
2. PradipNiyogi, S.K. Chakraborty, M.K. Laha, Introduction to Computational Fluid Dynamics, Pearson
3. Muralidhar, K., and Sundararajan, T., "Computational Fluid Flow and Heat Transfer", Narosa Publishing House, New Delhi, 1995
4. Ghoshdasdidar, P.S., "Computer Simulation of flow and heat transfer" Tata McGraw Hill Publishing Company Ltd., 1998.

Assignment (Any Three):

1. CFD analysis of 2D problems for flow analysis.
2. Flow analysis on aerofoil like curved surface.
3. CFD analysis of flow through pipe.
4. CFD analysis of flow through channel.
5. Thermal flow analysis in composite walls.

MHPL510: ELECTIVE-II		
Teaching Scheme: **Lectures:** 3 hrs. **Tutorials:** NIL **Practical:** NIL	**Examination Scheme (Theory)** **Teacher Assessment Examination:** 20-Marks **Class Assessment Examination:** 20-Marks **End Semester Examination:** 60-Marks	**Examination Scheme (Laboratory)** **Internal(TW):** NIL **External(OR)**: NIL **External(PR)** : NIL
Credits:	**05**	

MHPL502: ELECTIVE-II			
Modules of 2 Credits (Select any One)			
Code No.	**Title**	**Code No.**	**Title**
MHPL510A	Thermal System Design	MHPL510J	Jet Propulsion
MHPL510B	Aerodynamics	MHPL510K	Incompressible Flow Turbo machines
MHPL510C	Introduction to flight	MHPL510L	Cryogenic Engineering Gas Liquefaction
MHPL510D	Vacuum Technology	MHPL510M	Fuel Burning Devices
MHPL510E	Gas Dynamics	MHPL510N	Adsorption Technology
MHPL510F	Turbomachinery	MHPL510O	Industrial Hydraulics
MHPL510G	Gas Turbine	MHPL510P	Turbulent Jets
Modules of 1 Credits (Select any One)			
MHPL510a	Selection of Fans, Pumps and blowers	MHPL510d	Clean-room Technology
MHPL510b	Biomass Technology	MHPL510e	Pneumatics
MHPL510c	Nano-materials	MHPL510f	Insulating Materials and Refractories

MHPL511A: Thermal System Design

Designing a workable system: Workable and optimum systems, Outline of sequence of tasks and decisions for a workable design. Modeling Thermal Equipment: Using physical insight, Selection Vs Simulation, Case study on modeling thermal equipment. System Simulation: Classes of simulation, Sequential and simultaneous calculations, case study on system simulation

Ref. Books: Design of Thermal Systems, W.F. Stoecker, Tata McGraw – Hill

MHPL511B: Aerodynamics

Fundamental principles and equations, Airfoils, wings and their nomenclature; lift, drag and pitching moment coefficients; centre of pressure and aerodynamic centre. Normal shock waves, Oblique shock waves, bow shock, expansion waves, Compressible flow through wind tunnels, introduction to Supersonic and hypersonic flows. Numerical techniques for nonlinear supersonic flow.

Ref. Books: 1) Fundaments of Aerodynamics, J.D. Anderson, 4th Ed. Tata McGraw Hill. 2) Introduction to Flight, J.D. Anderson, 5th Ed. Tata McGraw Hill. 3) Bertin, J. J., Aerodynamics for Engineers, Pearson Education, 2002. 4) Houghton , E. L. and Carpenter, P. W., Aerodynamics for

Engineers, Butterworth-Heinemann, 2001.

MHPL511C: Introduction to Flight

Aerodynamic Shapes- Airfoils and wings, Incompressible flow over Airfoils and wings, Compressible flow over airfoils, elements of Airplane performance, principles of stability and control, Space Flight, Theory on jet propulsion, Hypersonic Vehicles

Ref. Books:1) Introduction to Flight, J.D. Anderson, 5th Ed. Tata McGraw Hill. 2) Fundaments of Aerodynamics, J.D. Anderson, 4th Ed. Tata McGraw Hill. 3) Introduction To Aircraft Performance, Selection, And Design, Francis J. Hale, Wiley India Pvt Ltd. 2011. 4) Barnard, R.H., and Phillpott, D.R., Aircraft Flight, Longman, 2009.

MHPL511D: Vacuum Technology

Introduction ,Units for Vacuum, Vacuum Pumps, Positive Displacement Pump, Roots Pump, Diffusion Pumps, Molecular Pumps , Pumping System Design, Selection of Vacuum Pumps, Calculation of Pumping Speed ,Conductance and Pumping Speed, Baffles and Traps, Outgassing, Vacuum Pumping (Pressure–Time Relations) Calculation of Pumping Time, Measurement of Vacuum, Mechanical Gauges, Conductivity Gauges, Ionization Gauge

Ref. Book: Industrial Heating - Principles, Techniques, Materials, Applications, and Design,Yeshvant V. Deshmukh, CRC Press 2005.

MHPL511E: Gas Dynamics

Introduction, One dimensional flow basics, Normal shock waves, Flow with heat addition – Rayleigh flow, Flow with Friction – Fanno Flow, Quasi One dimensional Flows, Oblique shock waves, Prandtl Meyer Flow

Ref. Books: 1)Fundamentals of Gas Dynamics, Robert D. Zucker, Oscar Biblarz, Wiley, 2nd Edition., 2)Fundamentals of Gas Dynamics, V. Babu, Ane Books Pvt. Ltd., 3)Elements of Gas Dynamics, Liepmann H. W. and Roshko A., Dover, 2001

MHPL511F: Turbomachinery

Basics of turbo machinery, Analysis of Axial flow Compressors, Centrifugal flow compressors, Axial flow Turbines and Radial flow Turbines, Three-dimensional Flows in Axial Turbomachines.

Ref. Books: 1) Principles of Turbomachinery, R.K. Turton, Springer, 2nd Edition. 2) Turbomachinery Design and Theory, Rama S.R. Gorla and Aijas.A. Khan, CRC Press. 3) Fluid Mechanics and Thermodynamics of Turbomachinery, S.L. Dixon, Butterworth Heinemann.

MHPL511G: Gas Turbine

Basics of Compressible flow, Cycle arrangements, Turbojet Engine and Turbofan Engine, Thrust calculations, Ramjet and Scramjet Engine, Parametric cycle analysis of ideal and real engine

Ref. Books: 1)Elements of Gas Turbine Propulsion – Jack D. Mattingly , Tata Mc-Graw Hill 2) Fundamentals of Propulsion, V. Babu, Ane Books Pvt. Ltd. 3) Introduction to Flight, J.D. Anderson, 5th Ed. Tata McGraw Hill.

MHPL511J: Jet Propulsion

Ideal and Non-ideal cycle analysis, Diffusers, Nozzles, Combustors and Afterburners, Ducts and Mixers, System matching and analysis, Rocket Propellants, rocket equation, rocket staging, electric propulsion.

Ref. Books: 1)Fundamentals of Jet Propulsion with Applications, Ronald D. Flack, Cambridge University , 2) Introduction to Flight, J.D. Anderson, 5th Ed. Tata McGraw Hill.

MHPL511K: Incompressible Flow Turbomachines

Some aspects of Design, Design of impellers and runners of single and double curvature, Inlet and outlet elements, Head losses in Turbine and Pump systems, Cavitation, water hammer and Corrosion

Ref. Books: 1) Incompressible Flow Turbomachines, G. F. Round , Elsevier Publications 2) Fundamentals of Incompressible Fluid Flow, V. Babu, Ane Books Pvt. Ltd.

MHPL511L: Cryogenic Engineering Gas Liquefaction

Gas Liquefaction: Fundamentals, ideal liquefaction work, various liquefaction cycles, analysis of various cycles. Gas Separation and gas purification systems - Fundamentals of gas separation, Ideal work of gas separation, basics of gas Mixtures, distillation column, column efficiency, theoretical plate, Calculations, double columns, Plate structures, Oxygen and argon separation systems.

Ref. Books: 1) Barron R. F., Cryogenic Systems, 2nd Ed., Oxford University Press, 1985. 2) Timmerhaus K. D. and Flynn T. M., Cryogenic Process Engineering, CRC Press.

MHPL511M: Fuel Burning Devices

Combustion of Liquid Fuels, Classification of Oil Burners, High Pressure Burners, Low Pressure Burners, Burners for Distillate Fuels, Preheating of Oils, Kinetics of Combustion of Gases, Burning Properties of Gases, Classification of Gas Burners, Flame Stabilization, Ignition and Detection, Atmospheric Gas Burners, Nozzle Mixing Gas Burners, Radiant Tubes, Immersion Tubes, Dual Fuel Burners, Packaged Burners, Combustion of Solid Waste and Garbage, Burner Auxiliaries, Burner Blocks, Ignition Devices, Flame Protection Devices

Ref. Books: Industrial Heating - Principles, Techniques, Materials, Applications, and Design, Yeshvant V. Deshmukh, CRC Press 2005.

MHPL511N: Adsorption Technology

Adsorbents, Fundamentals of adsorption equilibria, rate of adsorption of gases and vapors by porous medium, processes and cycles, Design procedures and break through Curves, pressure swing adsorption processes, Thermal adsorption processes.

Ref. Books: 1) Adsorption Technology and Design, Barry Crittenden and W John Thomas, Butterworth Heinemann Publications 2)Diffusion Mass transfer in fluid systems (chapter 15), E L Cussler, Cambridge University Press.

MHPL511O: Industrial Hydraulics

Vane and piston pumps, power units, accessories, accumulators, check valves, various pressure control, directional control, flow control valves, center positions, proportional valves, cartridge

valves, prefill valve, linear and rotary actuators, design considerations for cylinders, various hydraulic circuits and their applications, circuit design and analysis, selection of components, troubleshooting of hydraulic components and circuits, maintenance and safety.

Ref. Books: 1) J.J.Pipenger – 'Industrial Hydraulics', McGraw Hill, 2)A. Esposito – 'Fluid Power with application', Prentice hall

MHPL511a: Selection of Fans, Pumps and blowers

Types, Performance evaluation, efficient system operation, Flow control strategies and energy conservation opportunities and Selection of fans, pumps and blowers

Ref. Books:1) Guide Books, Bureau of Energy Efficiency, 2) Turbines, Compressors and Fans, S.M. Yahya, 3rd Ed., Tata McGraw Hill., 3)Fan Handbook, Frank P Bleier, McGraw Hill, 4) Pumps, Principles and Practice, Jaico Publishing House, Mumbai.

MHPL511b: Biomass Technology

Photosynthesis and crop yields, Biomass potential and Use, Biomass Energy Production, Environmental impact of biomass, Economics and potential of biomass.

Ref. Book: Energy Science – Principles, Technologies and Impacts, John Andrews and Nick Jelley, OXFORD University Press

MHPL511C: Nanomaterials

Nanoparticles, Carbon Nanotubes, and Semiconducting Nanowires: Physics, Synthesis, Characterization and Applications.

Ref. Books:1) Nano: The Essentials, Pradeep, T., McGraw-Hill, 2007, 2) Nanoscale Science and Technology, Kelsall, R., Hamley I. and Geoghegan, M.(Eds.) Wiley, 2005.

MHPL511f: Insulating Materials and Refractories

Need of insulation, Classification of Thermal Insulations, Properties of Thermal Insulations, Applications (Case Studies) in Refrigeration, HVAC, Cryogenic, Chemical and Process industries, Degree days and pay back periods, Refractories types and applications

Ref. Books: 1)Energy Efficiency, Estop and Croft 2) Guide Books, Bureau of Energy Efficiency, 3)Mass and Heat Transfer, T.W.Fraser Russel, Robinson,Wagner-Cambridge University Press

MHPL511P: Turbulent Jets

Free Jets, Coflowing Jets, Multiple Free Jets, Jet Flocculator, Wall Jets

Ref. Books: Turbulent Jets, Bidya Sagar Pani, Cambridge University press.

MHPL511d: Cleanroom Technology

Introduction to cleanrooms, types, classifications, cleanroom standards, testing and validation of clean rooms, design considerations, energy conservation in cleanrooms.

Ref. books: ASHRAE Handbook – HVAC Applications (Clean Spaces)

MHPL511e: Pneumatics

Different pneumatic components, different pneumatic circuits, trouble shooting in pneumatics, logic valves, building circuit for a given logic, Electro pneumatic circuits, Selection criteria of pneumatic

components, Installation fault finding and maintenance of pneumatic components. Microprocessor and PLC- Applications in pneumatics, Low cost Automation, case studies.**Ref. Books:** 1) A. Esposito – 'Fluid Power with application', Prentice hall, 2) Majumdar S.R., "Pneumatic systems – Principles and maintenance", Tata McGraw Hill

MHPL511: Elective-III			
Modules of 3 Credits (Select any One)			
Code No.	**Title**	**Code No.**	**Title**
MHPL511A	Open Elective	MHPL511D	Cryogenics
MHPL511B	Thermal Storage Systems	MHPL511E	Measurements and Controls
MHPL511C	Design of Heat Exchangers	MHPL511F	Optimization Technique

MHPL511A: OPEN ELECTIVE		
Teaching Scheme: **Lectures:** 03 hrs. **Tutorials:** NIL **Practical:** NIL	**Examination Scheme (Theory)** **Teacher Assessment Examination:** 20 Marks **Class Assessment Examination:** 20 Marks **End Semester Examination:** 60Marks	**Examination Scheme (Laboratory)** **Internal(TW):** NIL **External(OR)**: NIL **External(PR)** : NIL
Credits :	**03**	

Note: Student is expected to select one open elective subject (other departments). They will inform course name in begging of the semester to the respective department.

MHPL511B: THERMAL STORAGE SYSTEMS		
Teaching Scheme: **Lectures:** 03 hrs. **Tutorials:** NIL **Practical:** NIL	**Examination Scheme (Theory)** **Teacher Assessment Examination:** 20 Marks **Class Assessment Examination:** 20 Marks **End Semester Examination:** 60Marks	**Examination Scheme (Laboratory)** **Internal(TW):** NIL **External(OR)**: NIL **External(PR)** : NIL
Credits :	**03**	

Course Outcome:

1. Analyze the quantum of energy that can be retrieved and stored in a thermal system
2. Apply principles of fluid mechanics and heat transfer to model the heat storage units.
3. Understand the heat transfer enhancement configurations.
4. Understand the heat transfer enhancement configurations.

Course Contents: **Hrs**

Unit – I : Introduction: 6

Necessity of Thermal storage, Energy storage devices, types of storage system, Specific areas of application, Heat Transfer Enhancement methods.

Unit – II : Sensible Heat Storage system:: 6

Basic Concepts and modeling of heat storage units, modeling of simple water and rock bed storage system, Use of TRNSYS, pressurized water storage system for power plant applications , packed beds.

Unit – III : Regenerators: 6

Parallel flow and counter flow regenerators, Finite conductivity model, Non-linear model, Transient performance, step changes in inlet gas temperature, step changes in gas flow rate, Parameterization of transient response, Heat storage exchangers. Latent Heat Storage system, Storage materials modeling of phase change problems and solution methodologies, Enthalpy modeling, Heat transfer enhancement configuration, Parameterization of rectangular, cylindrical geometric problems.

Unit – IV : Applications: 6

Specific areas of application of energy storage, Food preservation, Waste heat recovery, solar energy storage, Green House heating, Power Plant applications, drying and heating for process industries.

Text Books: (Book Title, Name of the author, name of the Publisher, edition, year of publication)

1. Thermal Energy Storage: Systems and Applications, İbrahim Dinçer, Marc A. Rosen Second Edition, John Wiley & Sons, Ltd

2. Sustainable Thermal Storage Systems: Planning Design and Operations, Lucas B Hyman, Goss Engineering ,Mc Graw Hill Publisher,2011.

3. Reference Books:

1. Thermal storage & Regeneration, F. W. Schmidt & A. J. Willmott, Hemisphere Publishing Corporation.
2. Heat Transfer in cold climates, V. J. I. Unardini, D Van Nostrand Reinhold, New York

MHPL511C: DESIGN OF HEAT EXACHANGER		
Teaching Scheme: **Lectures:** 03 hrs. **Tutorials:** NIL **Practical:** NIL	**Examination Scheme (Theory)** **Teacher Assessment Examination:** 20 Marks **Class Assessment Examination:** 20 Marks **End Semester Examination:** 60Marks	**Examination Scheme (Lab)** **Internal(TW):** NIL **External(OR)**: NIL **External(PR)** : NIL
Credits :	**03**	

Course Objective:

1. Exposer to different kinds of heat exchanger, their working and selection for a given application.
2. To learn different techniques of heat exchanger analysis.
3. To learn construction & thermal design methodology of shell & tube, plate & compact heat exchanger.
4. To learn principle of boilers, condensers and cooling towers and their working

Course Outcome:

1. Apply LMTD and effectiveness method in the design of heat exchanger.
2. Able to design and analyze the shell and tube heat exchanger and compact heat exchanger for various applications.
3. Apply knowledge of technical feature of cooling towers in various applications.

Course Contents: **Hrs**

Unit – I : Constructional details and Heat Transfer 6

Types, Shell and Tube heat Exchangers, Regenerators, Recuperator, Industrial applications, temperature distribution and its implications, LMTD, Effectiveness.

Unit – II : Flow distribution and stress analysis 6

Effect of Turbulence, Friction factor, Pressure loss, Channel diversion, heater sheets and pressure vessels, thermal stresses, shear stresses, Types of failure.

Unit – III : Design Aspects 6

Heat transfer and Pressure loss, Flow configuration, Effects of Baffles, effects of deviation from ideality, Design of typical liquid, gas, gas -Liquid heat exchanger.

Unit – IV : Condensers and Evaporators design 6

Design of surface and evaporative condensers, Design of shell and tube, plate type evaporator, Cooling Tower

Text Books: (Book Title, Name of the author, name of the Publisher, edition, year of publication)

1. Fundamentals of Heat Exchanger Design, R. K. Shah , D.P. Sekulic, John Wiley & Sons Ltd.
2. Heat Exchanger Design, P. O. Fraas, John Wiley & Sons, 1988

Reference Books:

1. Heat Exchangers: Theory & Practices, T. Taboreck, G.F. Hewitt & N. Afgan, TMH,1980
2. Industrial Heat Exchanger: A Basic Guide, Walkar, TMH Book co,1980
3. Heat Exchangers: Basics Design Applications, Edited by Jovan Mitrovic, InTech Publisher

MHPL511D: CRYOGENIC		
Teaching Scheme: **Lectures:** 03 hrs. **Tutorials:** NIL **Practical:** NIL	**Examination Scheme (Theory)** **Teacher Assessment Examination:** 20 Marks **Class Assessment Examination:** 20 Marks **End Semester Examination:** 60Marks	**Examination Scheme (Laboratory)** **Internal(TW):** NIL **External(OR)**: NIL **External(PR)** : NIL
Credits :	**03**	

Course Outcome:

1. Ability to understand various gas liquefaction, gas separation & purification systems.
2. Ability to evaluate the performance of different cryogenic systems.
3. Ability to understand different working fluids and engineering materials in cryogenic systems.
4. Ability to analyze low temperature systems for various applications.

Course Contents: **Hrs**

Unit – I : Introduction: 6

Limitations of Carnot cycle, vapor compression cycle and air refrigeration cycle. Production of low temperature by reversible and irreversible adiabatic expansion of a gas , Joule Thomson effect; Joule Thomson co-efficient, Inversion curve.

Gas Liquefaction Systems:

Linde -Hampson, Linde dual pressure, Claude, Heylandt and Kapitza systems; Systems for liquefaction of Neon, Hydrogen and Helium; Collins and Simon systems for helium liquefaction

Unit – II : Gas Separation and Purification Systems: 6

Ideal system, Gas separation by simple condensation or evaporation, principles of rectification.

Air separation systems:

Design of surface and evaporative condensers, Design of shell and tube, plate type evaporator, Cooling Tower.

Unit – III : Gas Refrigeration Systems: 6

Joule Thomson refrigeration system, Pre cooled Joule Thomson refrigeration system, Expansion engine refrigeration system, Cold gas refrigeration system, Stirling cryocooler.

Unit – IV : Material and fluid properties: 6

Thermal and Mechanical properties of engineering materials at cryogenic temperatures, Properties of cryogens, Cryogenic insulations.

Cryogenic Applications:

Applications in space, on-ground, medical, electronic cooling, manufacturing processes,

preservation and bio-technology.

Text Books: (Book Title, Name of the author, name of the Publisher, edition, year of publication)

1. Cryogenic systems, R. Barron, McGraw–Hill Company
2. Fundamentals of Cryogenics Engineering, Mamata Mukhopadhyay, PHI Learning Pvt. Ltd.
3. Cryogenic Fundamentals, G. G. Hasseldon, Academic Press
4. Advanced Cryogenics, Bailey, Plenum Press

Reference Books:

1. Industrial Refrigeration Handbook, W. F. Stoecker, McGraw-Hill Publication.
2. ASHRAE HANDBOOKS (i) Fundamentals (ii) Refrigeration

MHPL511E: MEASUREMENTS AND CONTROLS		
Teaching Scheme: **Lectures:** 3 hrs. **Tutorials:** 1 hr. **Practical:** NIL	**Examination Scheme (Theory)** **Teacher Assessment Examination:** 20-Marks **Class Assessment Examination:** 20-Marks **End Semester Examination:** 60-Marks	**Examination Scheme (Laboratory)** **Internal(TW):** NIL **External(OR)**: NIL **External(PR)** : NIL
Credits:	**04**	

Course Objective:

1. To introduce students to monitor, analyze and control any physical system.
2. To understand students how different types of meters work and their construction
3. To provide a student a knowledge to design and create novel products and solutions for real life problems
4. To introduce students a knowledge to use modern tools necessary for electrical projects

Course Outcome:

1. To use the techniques and skills for projects.
2. Design a system, component or process to meet desired needs in electrical engineering.
3. Measurement of R,L,C ,Voltage, Current, Power factor , Power, Energy
4. Ability to measure strain, displacement, Velocity, Angular Velocity, temperature, Pressure, Vacuum, and Flow

Course Contents **Hrs**

Unit – I : Instrument types and performance characteristics 7

Active and Passive instruments, Null type and deflection type instruments, Analogue and digital instruments, Indicating instruments and instruments with signal output, smart and non smart instruments. Static and Dynamic characteristics of instruments, Necessity of calibration

Unit – II : Measurement Uncertainty 10

Sources of Systematic Error, System Disturbance due to Measurement, Errors due to Environmental Inputs, Wear in Instrument Components, Accumulation of Accepted Error, Improper Functioning of Instruments, Dual Sensitivity Errors, Other Sources of Error, Minimizing Experimental Error, Statistical Analysis of Measurements subject to Random Errors, Aggregation of Measurement System Errors, Reduction of Systematic Errors, Quantification of Systematic Errors, Sources and Treatment of Random Errors, parameter estimation, regression analysis, correlations, analysis of data

Unit – III : Measurement of field quantities 7

Temperature, heat flux measurement, heat transfer coefficient, measurement of force, pressure, flow rate, velocity, humidity, noise, vibration

Unit – IV : Measurement of derived quantities 6

Force, Acceleration, Torque, power, thermo physical properties, radiation and surface properties, Miscellaneous Measurements - Time, Frequency, and Phase-Angle Measurement, Liquid Level, Chemical Composition, Current and Power Measurement

Text Books: (Book Title, Name of the author, name of the Publisher, edition, year of publication)

1. Measurement Systems-Application and Design, Doebelin E.O., McGraw Hill Publication.

Reference Books:

1. Measurement and Instrumentation – Theory and Application, Alan Morris, Reza Langari, Elseveir
2. Instrumentation for Engineering Measurements, James Dally, William riley and Kenneth McConnell, Wiley.
3. Mechanical Measurements, S.P. Venkateshan, Ane Books Pvt. Ltd.

MCDL511F-OPTIMIZATION TECHNIQUES		
Teaching Scheme: **Lectures:** 03hrs. **Tutorials:** NIL **Practical:** NIL	**Examination Scheme (Theory)** **Teacher Assessment Examination:** 20 Marks **Class Assessment Examination:** 20 Marks **End Semester Examination:** 60Marks	**Examination Scheme (Laboratory)** **Internal(TW):** NIL **External(OR)**: NIL **External(PR)** : NIL
Credit	**3**	

Course Objective:

1. The course is spent on discussing evolutionary multi-objective optimization (EMO) methods in details. Strengths and weaknesses of each method are highlighted.
2. The course also discusses a number of current research issues, besides discussing a number of interesting case studies.
3. This course where students get an exposure to both theory and numerical optimization methodologies involving classical and evolutionary methods

Course Outcome:

1. Can formulate engineering design problems as mathematical optimization problems.
2. Can apply linear programing for solving engineering problems
3. Can solve One Dimensional and multi-Dimensional engineering problems

Course Contents **Hrs**

Unit – I : Introduction To Optimization

Introduction to optimization, formulation of optimization problem, Classification of optimization problems, Optimum design of components like pins, beams, columns, shafts, spur gears, pressure vessels, etc queue, simulation of inventory problem. 6

Unit – II : Linear Programming

Linear programming, simplex method and duality in linear programming, sensitivity or post-optimality analysis, Karmarkar's method. 6

Unit – III : One Dimensional Optimization

One dimensional minimization, optimality criterion, minimum bracketing methods like exhaustive search method, bounding phase method; optimum seeking methods like interval halving, golden section search, successive quadratic estimation, Newton Raphson, bisection, secant, cubic search method. 6

Unit – IV : Multi-Dimensional Optimization

Multivariable unconstrained optimization, optimality criteria, direct search methods Powell's conjugate direction method; gradient search methods like Cauchy's method, Newton's method, conjugate gradient method and variable metric method. 6

Text Books: (Book Title, Name of the author, name of the Publisher, edition, year of publication)

1. S. S. Rao, Engineering Optimization Theory and Practice, New age international (P) Ltd., reprint 2003
2. Kalyanmoy Deb, Optimization for Engineering Design, PHI, New Delhi, 2005
3. J. S. Arora, Introduction to Optimum Design, McGraw Hill, New York, 1989.

Reference Books:

1. S. S. Stricker, Optimizing Performance of Energy Systems, Battelle Press, New York, 1985.
2. R.C. Johnson, Optimum Design of Mechanical Elements, Willey, New York, 1980.
3. L.C.W. Dixon, Non-Linear Optimization - Theory and Algorithms, Birkhauser, Boston, 1980.
4. R.J. Duffin, E.L. Peterson and C. Zener, Geometric Programming-Theory and Applications, Willey, New York, 1967.
5. G.B. Dantzig Linear Programming and Extensions Princeton University Press, Princeton, N. J. 1963.

MHPP512: LAB PRACTICE II		
Teaching Scheme: **Lectures:** NIL **Tutorials:** NIL **Practical:** 4hrs.	**Examination Scheme (Theory)** **Teacher Assessment Examination:** NIL **Class Assessment Examination:** NIL **End Semester Examination:** NIL	**Examination Scheme (Laboratory)** **Continuous Assessment:** 50 Marks **External Assessment:** 50 Marks
Credits:	**02**	

Lab. work or Assignments have to be carried out at respective labs as mentioned in the syllabus of respective subjects **excluding Elective.** It is to be submitted as term work at the end of semester after continuous assessment of each by respective teacher.

MHPP601-TECHNICAL WRITING		
Teaching Scheme: **Lectures:** NIL **Tutorials:** NIL **Practical:** 03 hrs.	**Examination Scheme (Theory)** **Teacher Assessment Examination:-** NIL **Class Assessment Examination:** NIL **End Semester Examination:** -NIL	**Examination Scheme (Laboratory)** **Continuous Assessment:** 50 Marks **External Assessment:** 50 Marks
Credit	**03**	

Hrs.

Unit – I : Seminar Writing **7**

Selection of seminar, literature survey, outcomes and scope discussion based on literature, writing formats, summery and reference writing format. Case studies-based on the other's seminar presentation.

Unit – II : Dissertation Writing **7**

Selection of dissertation area, literature survey, outcomes and scope discussion based on literature, writing formats, summery and reference format. Case studies-based on the other's presentation. Discussion to write conclusion and appendix.

Unit – III : Assignment based on Software Tools and Techniques 8

a) Use technical writing software for seminar.
b) Use technical writing software for dissertation.
c) Use of Latex and its different capabilities.

NOTE: Journal and Report Writing,

Student is required to give the presentation based on report of a, b, and c and writing report on Research proposal and Patent drafting/filing at the end of semester.

MHPP602-SEMINAR-I		
Teaching Scheme: **Lectures:** NIL **Tutorials:** NIL **Practical:** 04 hrs.	**Examination Scheme (Theory)** **Teacher Assessment Examination:** NIL **Class Assessment Examination:** NIL **End Semester Examination:** NIL	**Examination Scheme (Laboratory)** **Continuous Assessment:** 50 Marks **External Assessment:** 50 Marks
Credit	**04**	

It is important that the procedures listed below be carefully followed by all the students of MTech. (Mechanical Engineering).

1. Prepare 3 COPIES of your manuscript.
2. Limit your project report to preferably

a) 15-20 manuscript pages for Seminar I

b) 20-25 manuscript pages for Seminar II

c) 25-30 manuscript pages for Seminar III

3. The footer must include the following:

Institute Name, MTech. Mechanical (Heat Power Engineering) Times New Roman 10 pt. and centrally aligned.

4. Page number as second line of footer, Times New Roman 10 Pt, centrally aligned.
5. Print the manuscript using

a) Letter quality computer printing.

b) The main part of manuscript should be Times New Roman 12 pt. and justified.

c) Use 1.5 line spacing.

d) Entire report shall be one chapter. No chapters for Seminar I, II and III.

e) Seminar I shall not have last section as Conclusions, it will be summary only.

6. Use the paper size 8.5'' × 11'' or A4 (210 × 197 mm). Please follow the margins given below.

Margin Location	**Paper 8.5'' × 11''**	**Paper A4 (210 × 197 mm)**
Top	1''	25.4 mm
Left	1.5''	37 mm
Bottom	1.25''	32 mm
Right	**1''**	**25.4 mm**

7. All paragraphs will be 1.5 line spaced with a one blank line between each paragraph. Each paragraph will begin without any indentation.
8. Section titles should be bold with 14 pt typed in all capital letters and should be left aligned.
9. Sub-Section headings should be aligning at the left with 12 pt, bold and Title Case (the first letter of each word is to be capitalized).

10. Illustrations (charts, drawings, photographs, figures) are to be in the text. Use only illustrations really pertinent to the text. Illustrations must be sharp, clear, black and white. Illustrations downloaded from internet are not acceptable.

a) Illustrations should not be more than two per page. One could be ideal

b) Figure No. and Title at bottom with 12 pt

c) Legends below the title in 10 pt

d) Leave proper margin in all sides

e) Illustrations as far as possible should not be Xeroxed.

11. Photographs if any should be of glossy prints

12. Please use SI system of units. If students would like to add the equivalent in inch-pound (British) units, they must be stated in parenthesis after the SI units. In case the final result comes out in any other units (say due to empirical formula etc.) covert the unit to SI unit.

13. Please number the pages on the front side, centrally below the footer

14. References should be either in order as they appear in the thesis or in alphabetical order by last name of first author

15. Symbols and notations if any should be included in nomenclature section only

16. Following will be the order of report

i. Cover page and Front page as per the specimen on separate sheet

ii. Certificate from the Institute as per the specimen on separate sheet

iii. Acknowledgement

iv. List of Figures

v. List of Tables

vi. Nomenclature

vii. Contents

viii. Abstract (A brief abstract of the report not more than 150 words. The heading of abstract i.e. word "Abstract" should be bold, Times New Roman, 12 pt and should be typed at the centre. The contents of abstract should be typed on new line without space between heading and contents. Try to include one or two sentences each on motive, method, key-results and conclusions in the Abstract)

ix. Section: Introduction

x. References

17. All section headings and subheadings should be numbered. For sections use numbers 1, 2, 3, …. and for subheadings 1.1, 1.2, …. etc and section subheadings 2.1.1, 2.1.2, …. etc.

18. References should be given in the body of the text and well spread. No verbatim copy or excessive text from only one or two references. If figures and tables are taken from any reference then indicate source of it. Please follow the following procedure for references

19.Reference Books Collier, G. J. and Thome, J. R., Convective boiling and condensation, 3rd ed., Oxford University Press, UK, 1996, pp. 110 – 112.

20. Papers from Journal or Transactions Jung, D. S. and Radermacher, R., Transport properties and surface tension of pure and mixed refrigerants, ASHRAE Trans, 1991, 97 (1), pp. 90 – 98.
Bansal, P. K., Rupasinghe, A. S. and Jain, A. S., An empirical correction for sizing capillary tubes, Int. Journal of Refrigeration, 1996, 19 (8), pp.497 – 505.
Papers from Conference Proceedings Colbourne, D. and Ritter, T. J., Quantitative assessment of flammable refrigerants in room air conditioners, Proc. of the Sixteenth International Compressor Engineering Conference and Ninth International Refrigeration and Air Conditioning Conference, Purdue University, West Lafayette, Indiana, USA, 2002, pp. 34 – 40.
Reports, Handbooks etc. United Nations Environmental Programme, Report of the Refrigeration, Air Conditioning and Heat Pumps, Technical Option Committee, 2002, Assessment - 2002. ASHRAE Handbook: Refrigeration, 1994 (Chapter 44)
Patent, Patent no, Country (in parenthesis), date of application, title, year.
Internet www.(Site) [Give full length URL]

Format for front page and Certificate

A Seminar I / II / III on (TNR, 16pt, centrally aligned)

Title (TNR, 27pt, Bold, Centrally Aligned, Title Case)

By (TNR, 16pt, Centrally Aligned)

Mr. Student's Name (TNR, 16pt, Centrally Aligned)

Guide (TNR, 16pt, Centrally Aligned)

Guide's Name (TNR, 16pt, Centrally Aligned)

Institute

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Department of Mechanical Engineering

Name of the Institute

[2015-16](TNR, 22pt, Title Case Centrally Aligned)

Name of the Institute

Institute
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C E R T I F I C A T E

This is to certify that *Mr. ABCDEF.*, has successfully completed the seminar-I/II/III entitled "Performance analysis of……." under my supervision, in the partial fulfillment of Master of Technology - Mechanical Engineering (Heat Power Engineering) of University of Pune.

Date :

Place :

Guide's Name
Guide

Guide's Name
Guide

Head of Department and
Institute Name

External Examiner

Seal Principal,
Institute Name

MHPP603: DISSERTATION PHASE-I		
Teaching Scheme: **Lectures:** -NIL **Tutorials:** -NIL **Practical:** -08 hrs.	**Examination Scheme (Theory)** **Teacher Assessment Examination:**-NIL **Class Assessment Examination:** NIL **End Semester Examination:** -NIL	**Examination Scheme (Laboratory)** **Continuous Assessment:** 100Marks **External Assessment:** 100 Marks
Credit	**08**	

INSTRUCTIONS FOR DISSERTATION WRITING

It is important that the procedures listed below be carefully followed by all the students of MTech. (Mechanical Engineering).

1. Prepare Three Hard Bound Copies of your manuscript.
2. Limit your Dissertation report to 80 – 120 pages (preferably)
3. The footer must include the following: Institute Name, MTech. Mechanical (Heat Power Engineering) Times New Roman 10 pt. and centrally aligned.
4. Page number as second line of footer, Times New Roman 10 Pt, centrally aligned.
5. Print the manuscript using a. Letter quality computer printing.

b. The main part of manuscript should be Times New Roman 12 pt. with alignment - justified.

c. Use 1.5 line spacing.

d. Entire report shall be of 5- 7 chapters.

6. Use the paper size 8.5'' × 11'' or A4 (210 × 197 mm). Please follow the margins given below.

Margin Location	Paper 8.5'' × 11''	Paper A4 (210 × 197 mm)
Top	1''	25.4 mm
Left	1.5''	37 mm
Bottom	1.25''	32 mm
Right	1''	25.4 mm

7. All paragraphs will be 1.5 line spaced with a one blank line between each paragraph. Each paragraph will begin with without any indentation.
8. Section titles should be bold with 14 pt typed in all capital letters and should be left aligned.
9. Sub-Section headings should be aligning at the left with 12 pt, bold and Title Case (the first letter of each word is to be capitalized).
10. Illustrations (charts, drawings, photographs, figures) are to be in the text. Use only illustrations really pertinent to the text. Illustrations must be sharp, clear, black and white. Illustrations downloaded from internet are not acceptable.

a. Illustrations should not be more than two per page. One could be ideal

b. Figure No. and Title at bottom with 12 pt

c. Legends below the title in 10 pt

d. Leave proper margin in all sides

e. Illustrations as far as possible should not be photo copied.

11. Photographs if any should of glossy prints

12. Please use SI system of units only.

13. Please number the pages on the front side, centrally below the footer

14. References should be either in order as they appear in the thesis or in alphabetical order by last name of first author

15. Symbols and notations if any should be included in nomenclature section only

16. Following will be the order of report

i. Cover page and Front page as per the specimen on separate sheet

ii. Certificate from the Institute as per the specimen on separate sheet

iii. Acknowledgements

iv. List of Figures

v. List of Tables

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vii. Contents

viii. Abstract (A brief abstract of the report not more than 150 words. The heading of abstract i.e. word "Abstract" should be bold, Times New Roman, 12 pt and should be typed at the centre. The contents of abstract should be typed on new line without space between heading and contents. Try to include one or two sentences each on motive, method, key-results and conclusions in Abstract

1 Introduction (2-3 pages) (TNR – 14 Bold)

1.1 Problem statement (TNR – 12)

1.2 Objectives

1.3 Scope

1.4 Methodology

1.5 Organization of Dissertation

2 Literature Review (20-30 pages)

Discuss the work done so far by researchers in the domain area and their significant conclusions. No derivations, figures, tables, graphs are expected.

3 This chapter shall be based on your own simulation work (Analytical/ Numerical/FEM/CFD) (15-20 pages)

4 Experimental Validation - This chapter shall be based on your own experimental work (15-20 pages)

5 Concluding Remarks and Scope for the Future Work (2-3 pages)

References ANNEXURE (if any) (Put all mathematical derivations, Simulation program as Annexure)

17. All section headings and subheadings should be numbered. For sections use numbers 1, 2, 3, …. and for subheadings 1.1, 1.2, …. etc and section subheadings 2.1.1, 2.1.2, …. etc.

18. References should be given in the body of the text and well spread. No verbatim copy or excessive text from only one or two references. If figures and tables are taken from any reference then indicate source of it. Please follow the following procedure for references.

Reference Books Collier, G. J. and Thome, J. R., Convective boiling and condensation, 3rd ed., Oxford University Press, UK, 1996, pp. 110 – 112.

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Bansal, P. K., Rupasinghe, A. S. and Jain, A. S., An empirical correction for sizing capillary tubes, Int. Journal of Refrigeration, 1996, 19 (8), pp.497 – 505.

Papers from Conference Proceedings Colbourne, D. and Ritter, T. J., Quantitative assessment of flammable refrigerants in room air conditioners, Proc. of the Sixteenth International Compressor Engineering Conference and Ninth International Refrigeration and Air Conditioning Conference, Purdue University, West Lafayette, Indiana, USA, 2002, pp. 34 – 40.

Reports, Handbooks etc. United Nations Environmental Programme, Report of the Refrigeration, Air Conditioning and Heat Pumps, Technical Option Committee, 2002, Assessment - 2002. ASHRAE Handbook: Refrigeration, 1994 (Chapter 44)

Patent Patent no, Country (in parenthesis), date of application, title, year.

Internet www.(Site) [Give full length URL]

A Project Stage-I Report on
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Title (TNR, 27pt, Bold, Centrally Aligned, Title Case)

By (TNR, 16pt, Centrally Aligned)
Mr. Student's Name (TNR, 16pt, Centrally Aligned)

Guide
Guide's Name (TNR, 16pt, Centrally Aligned)

Institute Logo

Department of Mechanical Engineering
Name of the Institute

[2015-16](TNR, 22pt, Title Case Centrally Aligned)

Name of the Institute

Logo

C E R T I F I C A T E

This is to certify that *Mr. ABCDE* ., has successfully completed the Dissertation entitled "Performance analysis of……." under my supervision, in the partial fulfillment of Master of Technology - Mechanical Engineering (Heat Power Engineering) of University of Pune.
Date:
Place:

Guide's Name
Guide

Head of Department and
Institute Name

External Examiner

Seal Principal,
Institute Name

MHPP604-SEMINAR-II		
Teaching Scheme: **Lectures:** NIL **Tutorials:** NIL **Practical:** 04 hrs.	**Examination Scheme (Theory)** **Teacher Assessment Examination:** NIL **Class Assessment Examination:** NIL **End Semester Examination:** -NIL	**Examination Scheme (Laboratory)** **Continuous Assessment:** 50 Marks **External Assessment:** 50 Marks
Credit	**04**	

MHPP605: DISSERTATION PHASE-II		
Teaching Scheme: **Lectures:** NIL **Tutorials:** NIL **Practical:** 20 hrs.	**Examination Scheme (Theory)** **Teacher Assessment Examination:-** NIL **Class Assessment Examination:** NIL **End Semester Examination:** -NIL	**Examination Scheme (Laboratory)** **Continuous Assessment**: 200 marks **External Assessment:** 150 Marks
Credit	**16**	

7. STRUCTURE M.TECH. (COMPUTER AIDED DESIGN, MANUFACTURING AND ENGINEERING)

M.Tech – Mechanical (CADME)

SEMESTER-I

Scheme of Examination for M. Tech. - Mechanical Engineering													
COMPUTER AIDED DESIGN, MANUFACTURE AND ENGINEERING													
Semester- I													
Course Code	Course Name	Teaching scheme (Weekly Load in hrs.)				Credits	Evaluation Scheme						ESE Duration (Hrs.)
							Theory			Practical		Total	
		Lecture	Tutorial	Practical	Total		TAE 20%	CAE 20%	ESE 60%	Cont. Ass.	Ext. Ass.		
MCDL501	Advanced Mathematics	3	1	--	4	4	20	20	60	--	--	100	3
MCDL502	Advanced Machine Design	3	1	--	4	4	20	20	60	--	--	100	3
MCDL503	Computer Aided Design	3	1	--	4	4	20	20	60	--	--	100	3
MCDL504	Research Methodology	3	1	--	4	4	20	20	60	--	--	100	3
MCDL505	Elective I	2	--	--	2	2	20	20	60	--	--	100	3
MCDP506	Modelling and Analysis Lab-I	--	--	4	4	2	--	--	--	50	50	100	--
MSDP501	Advance Skill Development	--	--	2	2	AU	--	--	--	--	--	--	--
	Total	14	4	6	24	**20**	100	100	300	50	50	**600**	--

MHPL505: Elective-I			
Modules of 2 Credits (Select any One)			
Course Code	**Course Name**	**Course Code**	**Course Name**
MCDL505A	Energy Audit and Management	MCDL505G	Operation Management
MCDL505B	Financial Management	MCDL505H	Engineering Economics
MCDL505C	Financial Costing	MCDL505I	Technology Forecasting
MCDL505D	Project Management	MCDL505J	Technology Transfer
MCDL505E	Energy Efficient Technologies in Electrical Systems	MCDL505K	Human Rights
MCDL505F	Environmental Pollution and Control	MCDL504L	Intellectual property Rights

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SEMESTER- II

Scheme of Examination for M.Tech. - Mechanical Engineering													
COMPUTER AIDED DESIGN, MANUFACTURE AND ENGINEERING													
Semester- II													
Course Code	Course Name	Teaching scheme (Weekly Load in hrs)				Credits	Evaluation Scheme						ESE Duration (Hrs)
							Theory			Practical		Total	
		Lecture	Tutorial	Practical	Total		TAE 20%	CAE 20%	ISE 60%	Cont. Ass.	Ext. Ass.		
MCDL507	Computer Integrated Manufacturing	3	1	-	4	4	20	20	60	--	--	100	3
MCDL508	Finite Element Analysis	3	1	-	4	4	20	20	60	--	--	100	3
MCDL509	Automated Manufacturing System Modelling	3	1	-	4	4	20	20	60	--	--	100	3
MCDL510	Elective II	3	-	-	3	3	20	20	60	--	--	100	3
MCDL511	Elective III	3	-	-	3	3	20	20	60	--	--	100	3
MCDP512	Simulation Lab-II	-	-	4	4	2	--	--	--	50	50	100	-
	Total	15	3	4	22	**20**	100	100	300	50	50	**600**	-

MCDL510: Elective-II			
Modules of 2 Credits (Select any One)			
Course Code	**Title**	**Code**	**Title**
MCDL510A	Iso-parametric Elements And Formulation of Plane Elasticity Problems	MCDL510I	Nonlinear Problems – Geometric, Material And Contact Problems
MCDL5104B	Dynamic Problems – Eigen Value and Time Dependent Problems	MCDL510J	Finite Difference Solutions
MCDL510C	Finite Volume Methods	MCDL510K	Advanced Materials
MCDL510D	Engineering Alloys	MCDL510L	Ceramics
MCDL510E	Composite Materials	MCDL510M	Data Models
MCDL510F	Distributed Database	MCDL510N	Web Languages
MCDL510G	J2EE Technologies:	MCDL510O	Solid - Based Rapid Prototyping Systems
MCDL510H	Tools For Customization	MCDL510P	Automated Solid Modeling Using Customization
Modules of 1 Credits (Select any One)			
MCDL510a	Plate Bending Problems – Plate And Shell Elements	MCDL510d	Turbulence Modeling
MCDL510b	Relational Database Design	MCDL510e	File & System Structure
MCDL510c	Computer-Based System Engineering	MCDL510f	Rapid Development / Solid Modelling Algorithms
MCDL510g	Robotics and its application		

Modules of 3 Credits (Select any One)			
Code No.	**Title**	**Code No.**	**Title**
MCDL511A	Open Elective	MCDL511D	Computational Fluid Dynamics
MCDL511B	Simulation Modelling	MCDL511E	Intelligent Manufacturing Systems
MCDL511C	Optimization Techniques	MCDL511F	Computer Aided Process Planning
MCDL511G	Industrial Product Design & Product Life Cycle Management		

SEMESTER- III

Scheme of Examination for M. Tech. - Mechanical Engineering													
COMPUTER AIDED DESIGN, MANUFACTURE AND ENGINEERING													
Semester- III													
Subject code	**Subject Name**	**Teaching scheme (Weekly Load in hrs)**				**Credits**	**Evaluation Scheme**						**ESE Duration (Hrs)**
							Theory			**Practical**		**Total**	
		Lecture	**Tutorial**	**Practical**	**Total**		**TAE 20%**	**CAE 20%**	**ISE 60%**	**Cont. Ass.**	**Ext. Ass.**		
MCDP601	Technical Writing	--	--	3	3	3	--	--	--	50	50	100	--
MCDP602	Seminar I	--	--	4	4	4	--	--	--	50	50	100	--
MCDP603	Dissertation Phase-I	--	--	8	8	8	--	--	--	100	100	200	--
	Total	--	--	15	15	**15**	--	--	--	200	200	**400**	--

SEMESTER- IV

Scheme of Examination for M .Tech. - Mechanical Engineering													
COMPUTER AIDED DESIGN, MANUFACTURE AND ENGINEERING													
Semester- IV													
Subject code	**Subject Name**	**Teaching scheme (Weekly Load in hrs.)**				**Credits**	**Evaluation Scheme**						**ESE Duration (Hrs.)**
							Theory			**Practical**		**Total**	
		Lecture	**Tutorial**	**Practical**	**Total**		**TAE 20%**	**CAE 20%**	**ISE 60%**	**Cont. Ass.**	**Ext. Ass.**		
MCDP604	Seminar II	--	--	4	4	4	--	--	--	50	50	100	--
MCDP605	Dissertation Phase-II	--	--	16	16	16	--	--	--	200	100	300	--
	Total	--	--	20	20	**20**	--	--	--	250	150	**400**	--

8. SYLLABUS OF M.TECH. COMPUTER AIDED DESIGN, MANUFACTURING AND ENGINEERING

MCDL501 ADVANCED MATHEMATICS		
Teaching Scheme: **Lectures:** 03hrs **Tutorials:** -01hr. **Practical:** -NIL	**Examination Scheme (Theory)** **Teacher Assessment Examination:**- 20 Marks **Class Assessment Examination:** 20 Marks **End Semester Examination:** 60 Marks	**Examination Scheme (Laboratory)** **Internal(TW):** -NIL **External(OR)**:-NIL **External(PR)** :-NIL
Credit :	**04**	

Course Objectives

1. The ability to identify reflects upon, evaluate, integrate, and apply different types of information and knowledge to form independent judgments. Analytical and logical thinking and the habit of drawing conclusions based on quantitative information.
2. The ability to assess and interpret complex situations, choose among several potentially appropriate mathematical methods of solution, persist in the face of difficulty, and present full and cogent solutions that include appropriate justification for their reasoning
3. The ability to communicate and interact effectively with different audiences, developing their ability to collaborate intellectually and creatively in diverse contexts, and to appreciate ambiguity and nuance, while emphasizing the importance of clarity and precision in communication and reasoning

Course Outcomes

1. Can able to use the basic rules of logic, including the role of axioms or assumptions.
2. Student can able to solve partial differential equations ,using Fourier Transform and Ordinary differential equation using Laplace Transform
3. Students can understand physical problems involving vibrations or heat conduction in cylindrical region.
4. Student can solve problems in dynamics of rigid bodies, optimization of orbits and vibration problems.

Course Contents **Hrs**

Unit – I: Inner Product Spaces, Orthogonality 6

Inner products, Cauchy-Schwartz inequality, Orthogonal projections, Gram-Schmidt orthogonalization, Matrix representation of inner product, Least square solutions.

Unit – II : Complex Analysis 6

Complex variables, Complex differentiation, Harmonic functions, conformal mapping, Complex Integration, Cauchy's integral formulae and Calculus of residues.

Unit – III : Transforms 6

Concept of transforms, Fourier transforms, Applications to partial differential equations,

Discrete Fourier transform, Laplace transforms and its inverse, Laplace transform of special functions: Unit step, Unit impulse, Periodic and Error. Applications to initial value problem and wave equation using transform techniques.

Unit – IV : Differential Equation 6

Series Solution of differential equations, Bessel's and Legendre's differential equations, Mass spring systems of multi degree freedom, Matrix formulation for differential equations in vibration theory, Normal mode solution, Numerical computation of Eigen value.

Unit – V : Numerical Analysis 6

Finite difference analysis, Explicit and Implicit finite difference scheme, Stability of finite difference method, Applications of finite difference analysis in boundary value problems, one dimensional diffusion equation, Wave equation, Laplace equation.

Unit – VI : Calculus of Variation 6

Introduction, Functional, Euler's equation, Isoperimetric Problem, Functional involving higher order derivative, Approximate solution of boundary value problem, Rayleigh –Ritz method , Galerkin's method, Lagrange's principal.

Text Books: (Book Title, Name of the author, name of the Publisher, edition, year of publication)

1. Advanced Engineering Mathematics, Erwin Kreyszig, Wiley India
2. Higher Engineering Mathematics, B. S. Grewal, Khanna Publishers Delhi
3. Linear Algebra, Jin Ho Kwak and Sungpyo Hong, Springer international edition
4. Mechanical Vibration, Singiresu S. Rao, Pearson Education, Inc
5. Applied Numerical Analysis, Curtis F.Gerald and Patrick O. Wheatley, Pearson Education, Inc
6. Essential Mathematical Methods for Physicists, Hans J. Weber and G. B. Arfken, Academic Press

MCDL502 ADVANCED MACHINE DESIGN		
Teaching Scheme: **Lectures:** - 03 hrs. **Tutorials:** -01 hr. **Practical:** -NIL	**Examination Scheme (Theory)** **Teacher Assessment Examination:**- 20 Marks **Class Assessment Examination:** 20 Marks **End Semester Examination:**- 60 Marks	**Examination Scheme (Laboratory)** **Internal(TW):** -NIL **External(OR)**:-NIL **External(PR)** :-NIL
Credit	**04**	

Prerequisite (If any):

1.Strength of material, Mathematics, Machine Design, Metallurgy

Course Objective:

1.To understand theory of elasticity, concepts of fatigue and creep

2.To use composite materials in practical applications

Course Outcome

1.Able to design components subjected to fatigue, fluctuating loads and creep

2. Ability to apply knowledge of composite material in industry.

3. Ability to Design industrial process equipments.

Course Contents **Hrs**

Unit – I : Theory of Elasticity 6

State of stress at a point, stress components on an arbitrary plane, principal stresses, plane stress, differential equations of equilibrium, boundary conditions. State of strain at a point, plane strain, compatibility conditions, generalized Hooke's Law, relations between elastic constants, displacement equations of equilibrium. Elasticity problems in two dimension and three Dimensions, Airy's Stress Function In Rectangular & Polar Coordinates.

Unit – II : Theories of Failure: 6

Maximum principal stress theory, maximum shear stress theory, maximum elastic strain theory, octahedral shearing stress theory, distortion energy theory, Mohr's theory, significance of theory of failure.

Unit – III : Energy Methods 6

Elastic strain energy, strain energy due to axial force, shear force, torsion, bending moment, Castigliano's theorems, theory of virtual work and energy, Raleigh-Ritz method and Galerkin's method

Unit – IV : Design For Fatigue, Brittle Fracture And Creep 6

Introduction, Fatigue strength, factors affecting fatigue behaviour, Influence of super imposed static stress, Cumulative fatigue damage, fatigue under complex stresses, Fatigue strength after over stresses, True stress and true strength. Design for brittle

fracture. Mechanism of creep of material at high temperature, Exponential creep law, hyperbolic sine creep law, stress relaxation, bending etc

Unit – V : Design issues of Composite laminates/plates 6

Composite materials and structures, classical lamination theory, elastic stress analysis of composite material, Fatigue strength improvement techniques, stresses, stress concentration around cut outs in composite laminates, stability of composite laminate plates and shells, Hybrid materials, applications

Unit – VI : Industrial Equipment's Design 6

Process Equipment Design: Storage vessels, reaction vessels, agitation and mixers, heat exchangers, filters and driers. Code practices, selection and specification procedures used in design. Selection of pumps, compressors, electrical equipments and auxiliary services, safety, etc.

Text Books: (Book Title, Name of the author, name of the Publisher, edition, year of publication)

1. L S Srinath, Advanced Solid Mechanics, Tata McGraw-Hill.
2. S P Timoshenko, J N Goodier, Theory of Elasticity (Third Edition), McGraw- Hill.
3. M.F. Spotts & T.E. Shoup, Design of Machine Elements, Pearson Education.
4. Joseph E. Shigley & Chales R. Mischke Mechanical Engineering Design, McGraw Hill
5. George B. Dieter, Engineering Design, McGraw Hill.
6. Arhur H. Burr & John B. Chetham, Mechanical Analysis & Design, Prentice Hall India.
7. Robert C. Juvinall & Kurt, M. Marshel, Fundamentals of Machine Component Design, John Wiley & Sons.
8. Robert L. Norton, Machine Design, An Integrated Approach, Pearson Education.
9. M. F. Spotts, Mechanical Design Analysis, Prentice-Hall.
10. A.M. Wahl, Mechanical Springs, McGraw-Hill Inc .
11. D. Hull and T.W. Clyne, An Introduction to Composite Materials, Cambridge Solid State Science Series .
12. D. W. Dudley, Handbook of Practical Gear Design, Mc Graw-Hill Book Co.

MCDL503 COMPUTER AIDED DESIGN		
Teaching Scheme: **Lectures-** 03hrs **Tutorials:** -01 hr. **Practical:** -NIL	**Examination Scheme (Theory)** **Teacher Assessment Examination:**- 20 Marks **Class Assessment Examination:** 20 Marks **End Semester Examination:** 60 Marks	**Examination Scheme (Laboratory)** **Internal(TW):** -NIL **External(OR)**:-NIL **External(PR)** :-NIL
Credit	**04**	**-**

Prerequisite (If any):

1. CAD
2. CAM

Course Objective:

1. The use of CAD software to generate computer models and technical drawings is presented and supported by computer-based tutorials.
2. Fluent application of engineering techniques, tools and resources.
3. Effective oral and written communication in professional and lay domains.

Course Outcome:

1. Can apply CAD software to engineering design and drawing
2. Apply the skills attained from 2D and 3D modeling to design working drawings by using CAD software
3. Can apply CAD tools for mechanical components manufacturing
4. Can able to generate 2D & 3D CAD including its application to digital fabrication
5. Can utilize computers effectively to solve complex technical problems

Course Contents **Hrs**

Unit – I : CAD Tools 6

Definition of CAD Tools, Types of system, CAD/CAM system evaluation Criteria, Graphics standards, functional areas of CAD, Modeling and viewing, software documentation, efficient use of CAD software,

Wire frame modeling -Types of mathematical representation of curves, wire frame models, wire frame entities, parametric representation of synthetic curves - Hermite cubic splines, Bezier curves, B-Splines, rational curves – NURBS

Unit – II : Surface Modeling 6

Mathematical representation of surfaces, Surface model, Surface entities, surface representation, Parametric representation of surfaces, plane surface, ruled surface, surface of revolution, Tabulated surface..

Unit – III : Parametric Representation Of Synthetic Surfaces

Hermite Bicubic surface, Bezier surface, B-Spline surface, COONs surface, Blending surface, Sculptured surface, Surface manipulation - Displaying, Segmentation, Trimming, Intersection, 6

Transformations - 2D and 3D, Orthogonal and Perspective transformations

Unit – IV : Solid Modeling 6

Solid Representation - Boundary Representation (B-rep), Constructive Solid Geometry (CSG) and other methods, Design Applications: Mechanical tolerances, Mass property calculations, CAD database structure.

CAD/CAM Data Exchange: Evaluation of data- exchange formats, IGES data representations and structure, STEP Architecture, implementation, ACIS & DXF.

Unit – V : Advanced Modeling Concepts: 6

Feature Based Modeling, Assembly Modeling, Behavioral Modeling, Conceptual Design & Top-down Design. Techniques for visual realism - hidden line - Surface removal - Algorithms for shading and Rendering. Parametric and variational modeling, Feature recognition, Design by features, Assembly and Tolerance Modeling, Tolerance representation - specification, analysis and synthesis, AI in Design..

Unit – VI : Collaborative Engineering: 6

Collaborative Design, Principles, Approaches, Tools, Design Systems. Product Data Management (PDM).

Text Books: (Book Title, Name of the author, name of the Publisher, edition, year of publication)

1. Ibrahim Zeid, CAD/CAM Theory and Practice, McGraw Hill international.
2. P. N. Rao, CAD/CAM Tata McGraw Hill.
3. Foley, Van Dam, Feiner and Hughes, Computer Graphics Principles and Practice, second edition, Addison–Wesley, 2000.
4. Martenson, E. Micheal, Geometric Modelling, John Wiley & Sons, 1995.
5. Hill Jr, F.S., Computer Graphics using Open GL, Pearson Education, 2003.
6. Singeresu S. Rao, Engineering Optimization-Theory and Practice, New Age International Limited Publishers, 2000.
7. Johnson Ray, C. Optimum Design of Mechanical Elements, Wiley, John & Sons, 1981.
8. P. Radhakrishnan, S. Subramanyam, CAD/CAM/CIM, New Age International.
9. V. Ramamurti, Computer Aided Mechanical Design and Analysis, Tata Mc Graw Hill-1992

Software Documentation, tutorials, manuals of following software

1. UG/Nx
2. Solid Works
3. Catia
4. Autodesk Inventor Professional
5. AutoCAD
6. Open CASCADE
7. ANSYS Design Modelle
8. Pro/E

MCDL504 Research Methodology		
Teaching Scheme: **Lectures:** 03 hrs. **Tutorials:** -01 hr. **Practical:** -NIL	**Examination Scheme (Theory)** **Teacher Assessment Examination:-** 20 Marks **Class Assessment Examination:** 20 Marks **End Semester Examination:** -60Marks	**Examination Scheme (Laboratory)** **Internal(TW):** -NIL **External(OR)**:-NIL **External(PR)** :-NIL
Credit	**04**	

Course Objective:

1. Will provide an opportunity for participants to establish or advance their understanding of research through critical exploration of research language, ethics, and approaches.
2. The course introduces the language of research, ethical principles and challenges, and the elements of the research process within quantitative, qualitative, and mixed methods approaches
3. Participants will use these theoretical underpinnings to begin to critically review literature relevant to their field or interests and determine how research findings are useful in informing their understanding of their environment (work, social, local, global).

Course Outcome:

1. Can able to formulate and define research problems
2. Students should be able to distinguish a purpose statement, a research question or hypothesis, and a research objective
3. Apply statistical tools to solve engineering problems
4. Can able to model and predict the performance of engineering systems
5. Can use advanced optimization techniques to solve engineering problems

Course Contents **Hrs**

Unit – I : Research Problem 6

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

Unit – II : Basic Instrumentation 6

Instrumentation schemes, Static and dynamic characteristics of instruments used in experimental set up, Performance under flow or motion conditions, Data collection using a digital computer system, Linear scaling for receiver and fidelity of instrument, Role of DSP is collected data contains noise

Unit – III : Applied Statistics 6

Regression analysis, Parameter estimation, Multivariate statistics, Principal component analysis, Moments and response curve methods, State vector machines and uncertainty

analysis, Probable errors in the research, Error analysis, simple numerical..

Unit – IV : Modeling And Prediction of Performance 7

Setting up a computing model to predict performance of experimental system, Multi-scale modeling and verifying performance of process system, Nonlinear analysis of system and asymptotic analysis, Verifying if assumptions hold true for a given apparatus setup, Plotting family of performance curves to study trends and tendencies, Sensitivity theory and applications and simple numerical.

Unit – V : Developing A Research Proposal 7

Format of research proposal, Individual research proposal, Institutional proposal, Proposal of a student – a presentation and assessment by a review committee consisting of Guide and external expert only, Other faculty members may attend and give suggestions relevant to topic of research

Reference Books:

1. Stuart Melville and Wayne Goddard, Research methodology: An Introduction for Science & Engineering students.
2. Dr. C. R. Kothari, Research Methodology: Methods and Trends
3. Wayne Goddard and Stuart Melville, Research Methodology: An Introduction
4. Ranjit Kumar Research Methodology: A Step by Step Guide for Beginners, 2nd Edition
5. Pressman, Software Engineering

MCDL505 ELECTIVE-I		
Teaching Scheme: **Lectures:**- 02 hr. **Tutorials:** -NIL **Practical:** -NIL	**Examination Scheme (Theory)** **Teacher Assessment Examination:**- 20 Marks **Class Assessment Examination:** 20 Marks **End Semester Examination:** -60Marks	**Examination Scheme (Laboratory)** **Internal(TW):** NIL **External(OR)**: NIL **External(PR)** : NIL
Credit	**02**	

MCDL505: ELECTIVE-I			
Modules of 2 Credits (Select any One)			
Code No.	**Title**	**Code No.**	**Title**
MCDL505A	Energy Audit and Management	MCDL505G	Operation Management
MCDL505B	Financial Management	MCDL505H	Engineering Economics
MCDL505C	Financial Costing	MCDL505I	Technology Forecasting
MCDL505D	Project Management	MCDL505J	Technology Transfer
MCDL505E	Energy Efficient Technologies in Electrical Systems	MCDL505K	Human Rights
MCDL505F	Environmental Pollution and Control	MCDL504L	Intellectual property Rights

MCDL505A: Energy Audit and Management

Definition, Energy audit- need, Types of energy audit, Energy management (audit) approach-understanding energy costs, Bench marking, Energy performance, Matching energy use to requirement, Maximizing system efficiencies, Optimizing the input energy requirements, Fuel and energy substitution, Energy audit instruments

Reference Books: 1. Guide Books, Bureau of Energy Efficiency

MCDL505B: Financial Management

Investment-need, Appraisal and criteria, Financial analysis techniques- Simple payback period, Return on investment, Net present value, Internal rate of return, Cash flows, Risk and sensitivity analysis, Financing options, Energy performance contracting and role of Energy Service Companies (ESCOS).

Reference Books: 1. Guide Books, Bureau of Energy Efficiency

MCDL505C: Financial Costing Significance, Traditional absorption costing, Marginal costing, Contract costing, Activity based costing, Process costing.

Reference Books: Cost Accounting, N K Prasad, Book Syndicate Pvt. Ltd.

MCDL505D: Project Management

Definition and scope of project, Technical design, Financing, Contracting, Implementation and performance monitoring. Implementation plan for top management, Planning Budget, Procurement Procedures, Construction, Measurement & Verification.

MCDL505E: Energy Efficient Technologies in Electrical Systems

Maximum demand controllers, Automatic power factor controllers, Energy efficient motors, Soft starters with energy saver, Variable speed drives, Energy efficient transformers, Electronic ballast, Occupancy sensors, Energy efficient lighting controls.

Reference Books: Guide Books, Bureau of Energy Efficiency

MCDL505G: Operation Management

Introduction, Importance, Operating systems models, key decisions, Planning and controlling, Strategic approach, Processes and systems, supply chain or network approach, Technology and knowledge management, Quality Management, Operations - Challenges, Opportunities, Excellence, risk management and sustainability, Case studies

Reference Books: 1. Operations Management - An Integrated Approach, Danny Samson and Prakash J. Singh, Cambridge, Universal Press. 2. Modern production/Operations Management, 8th Edition, E.S. Buffa and R. K. Sarin, John Wiley & Sons.

MCDL505H: Engineering Economics

Fundamentals, Markets and Government in a Modern economy, Basic Elements of Supply and Demand, Demand and Consumer Behaviour, Analysis of Perfectly Competitive Markets, Unemployment, Inflation and Economic policy

Reference Books: Economics, Samuelson Nordhaus, Tata McGraw Hill

MCDL505I: Technology Forecasting

Approaches, Technology Performance Parameters, Use of Experts in Technology Forecasting, Planning, Technology Progress. Morphological Analysis of a Technology System.

Reference Books: 1) Gerard H. Gaynor, Hand Book of Technology Management, Mc Graw Hill.

MCDL505J: Technology Transfer

Definition, Source of Technology Transfer [TT], Model of TT with Public and Private Enterprises, Success and Failure Factors in Technology Transfer. The concepts of Invention and Innovation, Definition and classifications of Research and Development, New Product Development, Challenges in Commercializing Research Results.

Reference Books: 1. Gerard H. Gaynor, Hand Book of Technology Management, Mc Graw Hill.

MCDL505K: Human Rights

Human Rights – Concept, Development, Evolution, Philosophical, Sociological and Political debates, Benchmarks of Human Rights Movement. Human Rights and the Indian Constitution Human Rights & State Mechanisms, Police & Human Rights, Judiciary & Human Rights, Prisons & Human Rights, National and State Human Rights Commissions, Human Rights of the Different Sections and contemporary issues, Citizens' Role and Civil Society, Human Rights and the international scene Primary Information with reference to Engineering Industry

Reference Books: 1)Study material on UNESCO,UNICEF web site, 2)HUMAN RIGHTS IN INDIA A MAPPING,Usha Ramanathan, 3)Introduction to International Humanitarian Law by Curtis F. J. Doebbler - CD Publishing , 2005 .This book is an introductory text on international humanitarian law

(the laws of war) that provides the basics of law, including excerpts from some of the leading treaty texts. Perfect for a short course in the law -- one to five weeks, 4) Freedom of Information by Toby Mendel - UNESCO , 2008

MCDL505F: Environmental and Pollution control

Pollution and Environmental Ethics, Air pollution, Water pollution, Soil pollution, Marine pollution, Noise pollution, Thermal pollution, Nuclear hazards Environmental impact and economic aspects, Emission standards and regulations for Automobiles.

Reference Books: 1) Environmental Pollution and Control, J. Jeffrey Peirce, P Aarne Vesilind, Ruth Weiner, Butterworth-Heinemann, 2) Environmental Pollution Control Engineering, C.S. Rao, New Age International

MCDL505L: Intellectual property Rights

Patentable and non-patentable inventions, statutory exceptions, Persons entitled to apply for patents.

Reference Books: 1) Satyawrat Ponkshe, The Management of Intellectual Property, by, Ponkshe & Bhate Publications, Pune.

MCDP506: MODELLING AND ANALYSIS LAB-I		
Teaching Scheme: **Lectures:** -NIL **Tutorials:** -NIL **Practical:** 04-hr.	**Examination Scheme (Theory)** **Teacher Assessment Examination:** NIL **Class Assessment Examination:** NIL **End Semester Examination:** -NIL	**Examination Scheme (Laboratory)** **Continuous Assessment:** 50 Marks **Eternal Assessment:** 50 Marks
Credit	**02**	

Lab. work or Assignments have to be carried out at respective labs as mentioned in the syllabus of respective subjects excluding Research Methodology and Elective. It is to be submitted as term work at the end of semester after continuous assessment of each by respective teacher. Assessment of term work has to be carried out as per R-1.4 and R-1.5 of PG Rules and Regulations of Credit System. (Refer University web site)

Geometric Modelling & Analysis:

Solid modelling, assembly modelling, drafting assignments using software like UNIGRAPHICS, Solid Works, CATIA, Pro/Engineer, I-DEAS, Autodesk Inventor, etc and study of the various facilities in these software's.

Finite Element Analysis Assignments using software's like ANSYS, Hyper Mesh Ls-Dyna, Abacus etc.

List of Assignments

1. Surface Modelling of Mechanical Components.
2. Solid Modeling of Mechanical Components.
3. Assembly modelling of Mechanical Components
4. Finite Element Analysis of Mechanical Components (2D elements)
5. Finite Element Analysis of Mechanical Systems (3-D components) .
6. Model analyses of simple automobile component

MSDP501: ADVANCE SKILL DEVELOPMENT		
Teaching Scheme: **Lectures:** -NIL **Tutorials:** -NIL **Practical:** 02 hrs.	**Examination Scheme (Theory)** **Teacher Assessment Examination:** NIL **Class Assessment Examination:** NIL **End Semester Examination:** -NIL	**Examination Scheme (Laboratory)** **Continuous Assessment:** NIL
Credit	**Audit Course (AU)**	

AUDIT COURSE			
The students must complete any one (A or B) of the following audit course for 20-25 hrs. and submit certificate			
A Certificate Course:		**B General Proficiency / Foreign Language:**	
I	Advanced CFD Tool	I	German
II	Industrial H.E. Design	II	Spanish
III	Energy audit of any process/Industry	III	French
IV	Optimization Tools	IV	Japanese
V	Mechanical CAE Simulation	V	Chinese
VI	Certification course in Quality and testing		

MCDL507 COMPUTER INTEGRATED MANUFACTURING		
Teaching Scheme: **Lectures:** 03 hrs. **Tutorials:** -01 hr. **Practical:** -NIL	**Examination Scheme (Theory)** **Teacher Assessment Examination:**- 20 Marks **Class Assessment Examination:** 20 Marks **End Semester Examination** -60Marks	**Examination Scheme (Laboratory)** **Internal(TW):** -NIL **External(OR)**:-NIL **External(PR)** :-NIL
Credit	**04**	

Prerequisite (If any):

To study this subject you should have the knowledge of CAD, manufacturing processes and the concepts of manufacturing systems

Course Objective:

1. Ability to apply knowledge of basic science and engineering fundamentals in depth technical competence in at least one engineering discipline.
2. Ability to undertake problem identification, formulation and solution
3. Ability to utilize a systems approach to design and operational performance
4. Ability to engage in design and execute designs to an appropriate professional standard

Course Outcome:

1. To Study and Explore the aspects of Manufacturing Automation and its applications
2. Can Understand of the social, cultural, global and environmental responsibilities of the professional Engineer, and the principles of sustainable design and development.
3. Ability to function effectively as an individual and in multi-disciplinary and multi-cultural teams, with the capacity to be a leader or manager as well as an effective team member.
4. Understanding of and commitment to professional and ethical responsibilities Expectation and capacity to undertake lifelong learning.

Course Contents **Hrs**

Unit – I : CNC and DNC in CIM

Introduction to CNC Types, Working and its Elements. DNC and its Types, Advantages. Adaptive control systems and advantages. Advanced Tools and softwares applications and CNC Programming. Activities in a CIM networked environment, CIM networking in a manufacturing company. 6

Unit – II : CIM and its Database

Introduction to CIM, Types of Manufacturing, CIM hardware and software, Elements of CIM, Product development through CIM Design Database requirements of CIM, Database, Database management, Database Models, EDM, Product Data Management (PDM), Advantage of PDM. Collaboration Engineering. 6

Unit – III : Work Cell & Flexible Manufacturing System

Manufacturing cell, Group Technology, Cellular Manufacturing. DNC system and transfer of program from PC to machine. Introduction to FMS, Manufacturing integration model, flexible manufacturing strategy, Components of Flexible Manufacturing-Pallets and fixtures, machining centers, inspection equipment, material handling stations, storage system, In-process storage, manually operated stations, allied operation centers — 6

Unit – IV : Integrative Manufacturing Planning And Control

Role of integrative manufacturing in CAD/CAM integration, Over view of production control - Forecasting, Master production schedule, Capacity planning, M.R.P., Order release, Shop-floor control, Quality assurance, Planning and control systems, Cellular manufacturing, JIT manufacturing philosophy. — 6

Unit – V : Web Based Manufacturing

Integrating process with web, Process management and control through web, Applications of web based manufacturing, casting, machining, forming & forging. — 6

Unit – VI : Future Trends In Manufacturing Systems

Lean Manufacturing: Definition, Principles of Lean Manufacturing, Characteristics of Lean Manufacturing, Value of Product, Continuous Improvement, Focus on Waste, Relationship of Waste to Profit, Four Functions of Lean Production, Performance Measures, The Supply Chain, Benefits of Lean Manufacturing. Introduction to Agile and Web Based Manufacturing systems. — 6

Text Books: (Book Title, Name of the author, name of the Publisher, edition, year of publication)

1. Groover, M.P., (2004), Automation, Production Systems & Computer Integrated Manufacturing second edition, Pearson Education ISBN: 81-7808-511-9.
2. Y. Narahari and N. Vishwadham, performance modeling of automated manufacturing systems, PRENTICE HALL, Englewood Cliffs, New Jersey 07632.
3. Richard N. Shover, An Analysis of CAD/CAM Application with Introduction to C.I.M. Prentice hall.

Reference Books

1. Paul G. Ranky, The Design and Operation of FMS, I.F.S. Publications 1983.
2. Harrington J, Computer Integrated Manufacturing Krieger Publications 1979.
3. David Bedworth et.al Computer Integrated Design and Manufacturing McGraw hill 1991.
4. Scolz B. Reiter C.I.M Interfaces Chapman & Hall 1992.
5. David L. Goetsch, Fundamental of CIM Technology, Delmar Publication 1988.

MCDL508: FINITE ELEMENT ANALYSIS		
Teaching Scheme: **Lectures:** 3 Hrs/Week **Tutorials:** 1 Hrs/Week **Practical:** Nil	**Examination Scheme (Theory)** **Teachers Assessment:** 20 Marks **In-Sem Examination:** 20 Marks **End Sem Examination:** 60 Marks	**Examination Scheme (Laboratory)** **Internal(TW):** Nil **External(OR)**: Nil **External(PR)** : Nil
Credit	4	-

Prerequisite (If Any):

1. Mathematics and Physics
2. SOM and design
3. Computer Graphics and Numerical Methods

Course Objective:

1. To familiarize students with the displacement-based finite element method for displacement and stress analysis and to introduce related analytical and computer tools.
2. It provides a bridge between hand calculations based on mechanics of materials and machine design and numerical solutions for more complex geometries and loading states.
3. To study approximate nature of the finite element method and convergence of results are examined.

Course Outcome:

1. Can derive and use 1-D and 2-D element stiffness matrices and load vectors from various methods to solve for displacements and stresses.
2. Can apply mechanics of materials and machine design topics to provide preliminary results used for testing the reasonableness of finite element results.
3. Can apply finite element code for linear stress, displacement, temperature and modal analysis.

Course Contents **Hrs**

UNIT-I : Introduction of FEA

Introduction– Brief History of FEM, Finite Element Terminology, General FEM procedure, Applications of FEM in various fields, P & h formulation, Advantages and disadvantages of FEM. Consistent units system. Review of Solid Mechanics Stress equilibrium equations, Strain-Displacement equations, Stress-Strain Temperature Relations, Plane stress, plane strain and axi-symmetric problems, Strain energy, Total potential energy. Essential and natural boundary conditions Review of Matrix Algebra 6

UNIT - II : 1D Elements

Types of 1D element. Displacement function, Global and local coordinate systems, Order of element, primary and secondary variables, shape functions and its properties. Formulation of elemental stiffness matrix and load vector for spring, bar, beam, truss and Plane frame. Transformation matrix for truss and plane frame, Assembly of global stiffness 6

matrix and load vector, Properties of stiffness matrix, Boundary conditions elimination method and penalty approach, Symmetric boundary conditions, Stress calculations.

UNIT - III : 2D Elements

Types of 2D elements, Formulation of elemental stiffness matrix and load vector for Plane stress/strain such as Linear Strain Rectangle (LSR), Constant Strain Triangles (CST), Pascal's triangle , primary and secondary variables, properties of shape functions. Assembly of global stiffness matrix and load vector, Boundary conditions, solving for primary variables (displacement), Overview of axi-symmetric elements — 6

UNIT - IV : Isoparametric Elements

Concept of isoparametric elements, super parametric and sub parametric. Isoparmetric formulation of bar element. Coordinate mapping - Natural coordinates, Area coordinates (for triangular elements), higher order elements (Lagrangean and serendipity elements). Convergence requirements- patch test, Uniqueness of mapping - Jacobian matrix. Numerical integration – 2 and 3 point Gauss Quadrature, full and reduced integration. Sub-modeling, sub-structuring. — 6

UNIT - V : 1D Steady State Heat Transfer Problems

Introduction, Governing differential equation, steady-state heat transfer formulation of 1D element for conduction and convection problem, boundary conditions and solving for temperature distribution. — 8

UNIT - VI : Dynamic Analysis

Types of dynamic analysis, General dynamic equation of motion, point and distributed mass, lumped and Consistent mass, Mass matrices formulation of bar and beam element. Undamped-free vibration- Eigenvalue problem, Evaluation of eigenvalues and eigenvectors (natural frequencies and mode shapes). — 8

Text Books: (Book Title, Name of the author, name of the Publisher, edition, year of publication)

1. Daryl L. Logan., A First Course in the Finite Element Method
2. R. D. Cook, Concepts and Applications of Finite Element Analysis, Wiley, India

Reference Books

1. Chandrupatla T. R. and Belegunda A. D., ―Introduction to Finite Elements in Engineering‖, Prentice Hall India.
2. David V. Hutton, Fundamental of Finite Element Analysis, Tata McGraw-Hill
3. Seshu P.,Text book of Finite Element Analysis‖, PHI Learning Private Ltd. New Delhi, 2010.

MCDL509 -AUTOMATED MANUFACTURING SYSTEM MODELING		
Teaching Scheme: **Lectures:** 03 hrs. **Tutorials:** -01 hr. **Practical:** -NIL	**Examination Scheme (Theory)** **Teacher Assessment Examination:-** 20 Marks **Class Assessment Examination:** 20 Marks **End Semester Examination** -60Marks	**Examination Scheme (Laboratory)** **Internal(TW):** -NIL **External(OR)**:-NIL **External(PR)** :-NIL
Credit	**04**	

Prerequisite (If any):

1. MP-I, MP-II and AMP
2. CAD-CAM, Optimization Tools

Course Objective:

1. Recent engineering and technology graduates who have decided to move into manufacturing and related disciplines.
2. Established manufacturing engineers working in industry and faced with the challenge of new areas of responsibility.
3. Professionals from engineering, technology or appropriate business backgrounds working in advisory, consultancy or research roles, who need to familiarize themselves with advanced manufacturing systems.

Course Outcome:

1. Can able to analyze the automated manufacturing systems to improve its performance
2. Can use Markov Chain Models to study and analyze the manufacturing systems and processes
3. Can solve real industrial problems using Petri Net Models and Queuing Models

Course Contents **Hrs**

Unit – I : Introduction 6

Modelling Automated Manufacturing Systems, Performance Modelling Tools development – S-curve, new product development, Simple numericals.

Unit – II : Automated Manufacturing Systems 6

Introduction, Manufacturing Systems, Performance Measures, Computer-Controlled Machines, Material Handling Systems, Plant Layout, Flexible Manufacturing Systems, Computer Control Systems, Simple numericals.

Unit – III : Markov Chain Models 6

Memory less Random Variables, Stochastic Processes in Manufacturing, Discrete Time Markov Chain Models, Continuous Time Markov Chain Models, An Examples Markov Model of a Transfer Line, Birth and Death Processes in Manufacturing, Time Reversible Markov Chains in Manufacturing, Semi-Markov Processes in Manufacturing, Simple

numericals.

Unit – IV : Queuing Models 6

Queues, Notation and Examples, The M/M/1 Queue, The M/M/m Queue, Batch Arrival Queuing Systems, Queues with General Distributions, Queues with Breakdowns, Analysis of a Flexible Machine Centre, Queuing Networks, Open Queuing Networks, Closed Queuing, Simple numericals.

Unit – V : Petri Net Models 6

Classical Petri Nets, Stochastic Petri Nets, Generalized Stochastic Petri Nets, GSPN Modeling of Kanban Systems, Deadlock Analysis Using Petri Nets, Extended Classes of Timed Petri Nets, Integrated PRQN-GSPN Models

Text Books: (Book Title, Name of the author, name of the Publisher, edition, year of publication)

1. Narahari Y., Viswanadham N., Performance Modelling Of Automated Manufacturing Systems, Prentice-Hall India.
2. Alan A. Desrochers, Modelling and Control of Automated Manufacturing Systems IEEE Computer Society Press 1990.
3. Paul M. Stanfield, Performance Modelling of Automated Manufacturing Systems, Institute of Industrial Engineers, Inc.

MCDL510 -ELECTIVE-II		
Teaching Scheme: **Lectures:** 03 hrs. **Tutorials:** -NIL **Practical:** -NIL	**Examination Scheme (Theory)** **Teacher Assessment Examination:**- 20 Marks **Class Assessment Examination:** 20 Marks **End Semester Examination:** -60Marks	**Examination Scheme (Laboratory)** **Internal(TW):** -NIL **External(OR)**:-NIL **External(PR)** :-NIL
Credit	**03**	

MCDL510: ELECTIVE-II			
Modules of 2 Credits (Select any One)			
Code No.	**Title**	**Code No.**	**Title**
MCDL510A	Iso-parametric Elements And Formulation of Plane Elasticity Problems	MCDL510I	Nonlinear Problems – Geometric, Material And Contact Problems
MCDL5104B	Dynamic Problems – Eigen Value and Time Dependent Problems	MCDL510J	Finite Difference Solutions
MCDL510C	Finite Volume Methods	MCDL510K	Advanced Materials
MCDL510D	Engineering Alloys	MCDL510L	Ceramics
MCDL510E	Composite Materials	MCDL510M	Data Models
MCDL510F	Distributed Database	MCDL510N	Web Languages
MCDL510G	J2EE Technologies:	MCDL510O	Solid - Based Rapid Prototyping Systems
MCDL510H	Tools For Customization	MCDL510P	Automated Solid Modeling Using Customization
Modules of 1 Credits (Select any One)			
MCDL510a	Plate Bending Problems – Plate And Shell Elements	MCDL510d	Turbulence Modeling
MCDL510b	Relational Database Design	MCDL510e	File & System Structure
MCDL510c	Computer-Based System Engineering	MCDL510f	Rapid Development / Solid Modelling Algorithms
MCDL510g	Robotics and its application		

MCDL510A: Isoparametric Elements and Formulation of Plane Elasticity Problems

Introduction, shape functions – linear & quadratic, displacement function – criteria for the choice of the displacement function, polynomial displacement functions, displacement function in terms of nodal parameters, strain-nodal parameter relationship, stress-strain relationship, element stiffness matrix, convergence of isoparametric elements, numerical integration – Trapezoidal rule, Simpson's 1/3 rule, Newton-Cotes Formula, Gauss Quadrature formula, Guass Quadrature in two and three dimensions.

MCDL510a: PLATE BENDING PROBLEMS – PLATE AND SHELL ELEMENTS

Introduction, thin and thick plates – Kirchhoff theory, Mindlin plate element, triangular and rectangular, conforming and nonconforming elements, degenerated shell elements, reduced and selective integration, shear locking and hour glass phenomenon.

MMECDL1204I: Nonlinear Problems – Geometric, Material and Contact Problems

Introduction to non-linear analysis, formulation for geometrical, material and contact nonlinear problems, Nonlinear equation solving procedure - direct iteration, Newton-Raphson method, modified Newton-Raphson method, incremental techniques.

MCDL510B: Dynamic Problems – Eigen Value and Time Dependent Problems

Formulation of dynamic problems, consistent and lumped mass matrices Solution of Eigen value problems – transformation methods, Jacobi method, Vector Iteration methods, subspace iteration method Forced vibration – steady state and transient vibration analysis, modelling of damping, the mode superposition scheme, direct integration methods – implicit and explicit numerical integration.

Reference Books:

1. Seshu P., Text book of Finite Element Analysis, PHI Learning Private Ltd., New Delhi, 2010.

2. Mukhopadhyay M and Sheikh A. H., Matrix and Finite Element Analyses of Structures, Ane Books Pvt. Ltd., 2009.

3. Bathe K. J., Finite Element Procedures, Prentice-Hall of India (P) Ltd., New Delhi.

4. Cook R. D., Finite Element Modeling for Stress Analysis, John Wiley and Sons Inc, 1995

5. Chandrupatla T. R. and Belegunda A. D., Introduction to Finite Elements in Engineering, Prentice Hall India.

6. Liu G. R. and Quek S. S. The Finite Element Method – A Practical Course, Butterworth-Heinemann, 2003.

7. Reddy, J. N., An Introduction to The Finite Element Method, Tata McGraw Hill, 2003.

8. Reddy, J. N., An Introduction to Nonlinear Finite Element Analysis, Oxford University Press, 2010.

9. Dixit U. S., Finite Element Methods for Engineers, Cengage Learning India Pvt. Ltd., 2009.

MCDL510J: Finite Difference Solutions

Parabolic PDEs – Euler, Crank Nicholson, Implicit methods, Elliptic PDEs – Jacobi, Gauss Seidel, ADI, methods. FD- solution for Viscous incompressible flow using Stream function – Vorticity method & MAC method.

MCDL510C: Finite Volume Methods

Introduction to finite volume method, finite volume formulations for diffusion equation, convection diffusion equation. Solution algorithm for pressure velocity coupling in steady flows. Use of staggered grids simple algorithm.

MCDL510d: Turbulence Modeling

Turbulence energy equation- one-equation model, the k-ω model, the k- ε model

Reference Books:

1. John D Anderson, Computational Fluid Dynamics – The Basics with Applications, McGraw Hill, New Delhi, 1995.

2. Muralidhar K and Sundararajan T, Computational Fluid Flow and Heat Transfer, Narosa Publications, 2003.

3. Chung T J, Computational Fluid Dynamics, Cambridge University Press, London, 2002.

4. David C Wilcox, Turbulence Modeling for CFD, DCW Industries, Inc., 1993.

5. Versteeg H K and Malalasekara W, An Introduction to Computational Fluid Dynamics - The Finite Volume Method, Longman, 1995.

6. Pradip Niyogi, Chakrabartty SK, Laha M.K., Introduction to Computational Fluid Dynamics, Pearson Education, 2005.

7. Patankar, S.V, Numerical Heat Transfer and Fluid flow, Hemisphere Publishing Company, New York, 1980.

MCDL510K: Advanced Materials

HSLA steels, tool and die materials, alloy cast irons, stainless steels, PH and maraging steels, materials for low temperature applications, refractory metals and super alloys, Hadfield steels, ball bearing steels and bearing metals.

MCDL510D: Engineering Alloys

Automobile alloys and aerospace alloys, Inter metallics, Ni and Ti Aluminides - Smart materials, shape memory alloys -Metallic glass - Quasi crystal and nano Crystalline materials.

MCDL510L: Ceramics

Ceramic crystal structures – Binary ceramic structures: Rock salt, Fluorite, Rutile and Silica structures. Ternary ceramic structures. Introduction to phase equilibria in ceramics, Phase equilibrium diagrams and composition calculations. Thermal, Electrical, magnetic and optical behavior of ceramics, Mechanical behavior of ceramics, Engineering ceramics and their applications, (Glass and Glass-ceramics, Aluminum oxide, Silicon nitride, Zirconia and zirconia-Toughned Aluminum, Sailons)

MCDL510E: Composite Materials

Fundamentals, Definition, classification of composite materials, laws of mixtures, factors affecting composite properties: interfacial bonding. Mechanical Behaviour of composite, Young's Modulus and strength considerations for continuous FRCs & short FRCs, Toughening Mechanisms in composites. Fabrication & Properties of fibers-Glass fibers, carbon fibers, Aramid fibers, Silicon Carbide Fibers & Metallic Glasses.

Reference Books:

1. R.S.Kurmi & R.S.Sedha, Material Science, S. Chand & company Ltd.

2. Thomas H. Courtney, Mechanical Behavior of Materials, McGraw-Hill.

3. Michael F. Ashby, Material Selection in Mechanical Design, Butterworth-Heinemann Ltd.

4. Flinn, R.A. and Trojan, P.K., Engineering Materials and their Applications**,** Wiley 1995.

MCDL510b: Relational Database Design

Relational model and relational database design: Structure of relational database, former query languages, commercial query languages. Modifying the database views. Pitfalls in relational database design and normalization.

MMECDL1204M: Data Models

Network data model and hierarchical data model: data structure diagram, the DBTCCODASYL. Model data retrieval Update and set processing facility, three structure diagram, data retrieval and update facility, virtual records.

MMECDL1204e: File & System Structure

File and System Structure, Indexing and Hashing: Physical storage media – file organization, buffer management, Mapping relations, networks and hierarchies to files – Index – sequential files. Bi-tree indexed files.

MCDL510F: Distributed Database

Distributed database, security and integrity: Design, transparency and autonomy, query processing, recovery, concurrency control, deadlock handling and coordinator selection. Security and integrity, near database application.

Reference Books:

1. Korth, H.F. Silbenhatz, A., Database Concepts, Mc Graw Hill, 1986.

2. Gio Wiederhold, Database Design, Mc Graw Hill, 1983.

3. Jefferey O Ullman, Principles of database systems.

4. C.J. Date, An Introduction to database systems, Addison Wisely, 1980.

5. Trembley and Soreson, An Introduction to Data structures with applications, Mc Graw Hills.

MCDL510N: Web Languages

Web: History of Web application, W3C, Introduction to various web building technologies. Mark up languages: Use of markup languages in building web applications, Hypertext Markup language (HTML), (Extensible mark-up Language) XML, XML Parsers: What is parsing, Types of parsers, benefits and limitations of each parser.

MCDL510G: J2ee Technologies

JSP- What is JSP, JSP architecture, Session in JSP, Cookies and use of cookies. Servlet- Introduction to Servlet technology, web container, Methods of Servlet, Lifecycle of a servlet, advantages of servlet, HTTP session listener and filters in servlet.

MCDL510O: Solid - Based Rapid Prototyping Systems

Laminated Object Manufacturing (LOM): Models and specifications, Process, working principle, Applications, Advantages and Disadvantages, Case studies. Fused Deposition Modelling (FDM): Models and specifications, Process, working principle, Applications, Advantages and Disadvantages, Case studies.Ajax- Introduction to framework, rule of ajax in enhancing user experience, ajax examples. Distributed Computing Concepts of Client-Server Architecture (2-Tier, 4-Tier, n-Tier).

MCDL5104H: Tools for Customization

Object Oriented Programming (OOP), OLE interfaces in CAD/CAM software; Use of General programming interfaces like VB, VBS, VC++, Open GL programming and System dependent programming interfaces like Visual LISP (AutoCAD), GRIP (Unigraphics), Pro-Programming (Pro/Engineer)

MCDL510c: Computer-Based System Engineering

System Engineering process, Software product development life cycle, software processes, software development project management, software prototyping.

Reference Books:

1. Ian Summerville, Software Engineering, Pearson Education.

2. Foley, van Dam, Computer Graphics, Pearson Education.

3. Mason Woo, et al, OpenGL Programming Guide.

4. George Omura**,** Advanced AutoCAD.

5. Sham Tickoo, Customizing AutoCAD, Thomson learning

MCDL510f: Rapid Development

Core issues in rapid development, rapid development languages, lifecycle planning and customer oriented development.

Reference Books:

1. Steve McConnell, Rapid development, Microsoft Press.

MCDL510P: Automated Solid Modeling Using Customization:

Creating 2D, 3D and solid entities through API, Editing 2D, 3D and solid entities through API, Design and development of user interfaces - icons, menus, dialog boxes, Integrating databases with CAD; creating BOM or part lists, Automated Assembly modelling through customization, Automated drafting and dimensioning using customization, Creating Automated Animations using API and animation software.

Reference Books:

1. Martti Mantilya, Solid Modelling, Computer Science Press.

MCDL510g: Robotics and its application

Specifications of Robots- Classifications of robots – Work envelope - Flexible automation versus. Robotic technology – Applications of Robots, Robot drive, hydraulic – electric – servomotor- stepper motor - pneumatic drives. Construction of Manipulators, Manipulator Dynamic and Force Control, Electronic and Pneumatic, Manipulators. Classification of End effectors – Tools as end effectors. Drive system for grippers-Mechanical adhesive-vacuum-magnetic-grippers. Hooks & scoops. Gripper force analysis and gripper design, Active and passive grippers. Robot applications in manufacturing, assembly, and testing, welding and metallurgical applictions.

Reference Books:

1. Deb S. R. and Deb S., “Robotics Technology and Flexible Automation”, Tata McGraw Hill Education Pvt. Ltd, 2010.
2. John J.Craig , “Introduction to Robotics”, Pearson, 2009.
3. Mikell P. Groover et. al., "Industrial Robots - Technology, Programming and Applications", McGraw Hill, New York, 2008.

MCDL51: ELECTIVE-III			
Modules of 3 Credits (Select any One)			
Code No.	**Title**	**Code No.**	**Title**
MCDL511A	Open Elective	MCDL511D	Computational Fluid Dynamics
MCDL511B	Simulation Modelling	MCDL511E	Intelligent Manufacturing Systems
MCDL511C	Optimization Techniques	MCDL511F	Computer Aided Process Planning
MCDL511G	Industrial Product Design & Product Life Cycle Management		

MCDL511A: OPEN ELECTIVE		
Teaching Scheme: **Lectures:** 03 hrs. **Tutorials:** NIL **Practical:** NIL	**Examination Scheme (Theory)** **Teacher Assessment Examination:** 20 Marks **Class Assessment Examination:** 20 Marks **End Semester Examination:** 60Marks	**Examination Scheme (Laboratory)** **Internal(TW):** NIL **External(OR)**: NIL **External(PR)** : NIL
Credits :	**03**	
Note: Student is expected to select one open elective subject (other departments). They will inform course name in begging of the semester to the respective department.		

MCDL511B: SIMULATION MODELLING		
Teaching Scheme: **Lectures:** 3 hrs. **Tutorials:** -NIL **Practical:** -NIL	**Examination Scheme (Theory)** **Teacher Assessment Examination:** 20 Marks **Class Assessment Examination:** 20 Marks **End Semester Examination:** 60Marks	**Examination Scheme (Laboratory)** **Internal(TW):** - NIL **External(OR)**: -NIL **External(PR)** : -NIL
Credit	**3**	

Course Objective:

1. Define basic concepts in modeling and simulation (M&S).
2. Classify various simulation models and give practical examples for each category.
3. Construct a model for a given set of data and motivate its validity
4. Generate and test random number variates and apply them to develop simulation models

Course Outcome:

1. Can able to create simulation models of various types.
2. Can able to apply numerical mathematics, probability and statistics, and basics of programming.
3. Can use principal of simulation and modeling techniques to improve engineering system efficiency

Course Contents **Hrs**

Unit – I : Introduction To Simulation

Definition – history - nature of computer Modelling and simulation, limitations of simulation, areas of application. System and environment**:** Components of a system – types of simulation - discrete and continuous systems. Modelling approaches – simulation examples - manual simulation using event scheduling, single channel queue, two server queue, simulation of inventory problem — 6

Unit – II : Random Number Generation And Testing

Techniques for generating random numbers – mid square method – mid product method - constant multiplier technique - additive congruential method - linear congruential method – combined linear congruential generators – feedback shift register generators - tests for random numbers – frequency test - the Kolmogorov-Smirnov test, the chi-square test. Independence test – runs up and runs down, runs above and below the mean, autocorrelation, — 6

Unit – III : Random Variable Generation

Inverse transform technique - exponential distribution, uniform distribution, Weibull distribution, Triangular distribution. Empirical continuous distribution - generating approximate normal variates - Erlang distribution. Empirical discrete distribution - discrete — 6

uniform distribution-poisson distribution - geometric distribution - acceptance - rejection technique for poisson distribution - gamma distribution.

Unit – IV : Stages In Model Building

Input modelling – data collection, identifying the distribution with data, parameter estimation, goodness of fit tests, selecting input models without data, models of arrival processes. Verification and validation of simulation models – variance reduction techniques, antithetic variables, calibration and validation of models. output analysis – stochastic nature of output data, measures of performance and their estimation, output analysis for terminating simulation. 6

Text Books: (Book Title, Name of the author, name of the Publisher, edition, year of publication)

1. Jerry Banks, John S, Carson II, Barry L Nelson and David M Nicol, "Discrete Event System Simulation", Prentice Hall Inc., 2006.
2. Law A M, "Simulation Modeling and Analysis", Tata McGraw Hill Companies Inc, 2008.
3. Gordon G, "Systems Simulation", Prentice Hall Ltd., 2006.
4. Narsingh Deo, "System Simulation with Digital Computer", Prentice Hall of India, 2007.
5. Francis Neelamkovil, "Computer Simulation and Modeling", John Wiley and Sons, 1987.

MCDL511C-OPTIMIZATION TECHNIQUES		
Teaching Scheme: **Lectures:** 03hrs. **Tutorials:** NIL **Practical:** NIL	**Examination Scheme (Theory)** **Teacher Assessment Examination:** 20 Marks **Class Assessment Examination:** 20 Marks **End Semester Examination:** 60Marks	**Examination Scheme (Laboratory)** **Internal(TW):** NIL **External(OR)**: NIL **External(PR)** : NIL
Credit	**3**	

Course Objective:

1. The course is spent on discussing evolutionary multi-objective optimization (EMO) methods in details. Strengths and weaknesses of each method are highlighted.
2. The course also discusses a number of current research issues, besides discussing a number of interesting case studies.
3. This course where students get an exposure to both theory and numerical optimization methodologies involving classical and evolutionary methods

Course Outcome:

1. Can formulate engineering design problems as mathematical optimization problems.
2. Can apply linear programing for solving engineering problems
3. Can solve One Dimensional and multi-Dimensional engineering problems

Course Contents	**Hrs**
Unit – I : Introduction To Optimization Introduction to optimization, formulation of optimization problem, Classification of optimization problems, Optimum design of components like pins, beams, columns, shafts, spur gears, pressure vessels, etc queue, simulation of inventory problem.	6
Unit – II : Linear Programming Linear programming, simplex method and duality in linear programming, sensitivity or post-optimality analysis, Karmarkar's method.	6
Unit – III : One Dimensional Optimization One dimensional minimization, optimality criterion, minimum bracketing methods like exhaustive search method, bounding phase method; optimum seeking methods like interval halving, golden section search, successive quadratic estimation, Newton Raphson, bisection, secant, cubic search method.	6
Unit – IV : Multi-Dimensional Optimization Multivariable unconstrained optimization, optimality criteria, direct search methods Powell's conjugate direction method; gradient search methods like Cauchy's method, Newton's method, conjugate gradient method and variable metric method.	6

Text Books: (Book Title, Name of the author, name of the Publisher, edition, year of publication)

1. S. S. Rao, Engineering Optimization Theory and Practice, New age international (P) Ltd., reprint 2003
2. Kalyanmoy Deb, Optimization for Engineering Design, PHI, New Delhi, 2005
3. J. S. Arora, Introduction to Optimum Design, McGraw Hill, New York, 1989.

Reference Books:

1. S. S. Stricker, Optimizing Performance of Energy Systems, Battelle Press, New York, 1985.
2. R.C. Johnson, Optimum Design of Mechanical Elements, Willey, New York, 1980.
3. L.C.W. Dixon, Non-Linear Optimization - Theory and Algorithms, Birkhauser, Boston, 1980.
4. R.J. Duffin, E.L. Peterson and C. Zener, Geometric Programming-Theory and Applications, Willey, New York, 1967.
5. G.B. Dantzig Linear Programming and Extensions Princeton University Press, Princeton, N. J. 1963.

MCDL511D, COMPUTATIONAL FLUID DYNAMICS		
Teaching Scheme: **Lectures:** 03 hrs. **Tutorials:** NIL **Practical:** NIL	**Examination Scheme (Theory)** **Teacher Assessment Examination:** 20-Marks **Class Assessment Examination:** 20-Marks **End Semester Examination:** 60-Marks	**Examination Scheme (Laboratory)** **Internal(TW):** NIL **External(OR)**: NIL **External(PR)** : NIL
Credits:	**03**	

Prerequisite (If any):

1. Mathematics
2. Fluid Mechanics
3. Heat Transfer

Course Objective:

1. To have a good understanding of the algorithms used in flow solvers
2. To be able to compare different algorithms

Course Outcome:

1. Can solve a fluid dynamics problem using computational methods
2. Can use governing equations to understand the behavior of engineering systems
3. Can analyze the consistency, stability and convergence of various discretization schemes for parabolic, elliptic and hyperbolic partial differential equations.
4. Can analyze various methods of grid generation techniques and application of finite difference and finite volume methods to various thermal problems

Course Contents **Hrs**

Unit – I : Introduction to CFD 6

Governing equations: the continuity equation, momentum equation and energy equations, convective forms of the equations and general description, Reynolds transport theorem. Classification of partial differential equations; physical examples of elliptic, parabolic and hyperbolic equations. Mathematical nature of the flow equations& their boundary conditions

Unit – II : Discretization: 6

Basic discretization techniques applied to model equations and systems of equations: finite difference, finite volume and finite element methods.

Finite difference methods: Taylor series expansion, different means for formulating finite difference equation; accuracy of finite difference method.

Finite Volume Methods: Finite volume methods; approximation of surface and volume integrals; interpolation methods; central, upwind and hybrid formulations and comparison for convection-diffusion problem.

Analysis of numerical schemes: concept of consistency, accuracy, stability and convergence; Error and stability analysis; some applications.

Unit – III : **Numerical Grid Generation:** 6

Introduction, Structured and Unstructured mesh generation techniques • Structured grid generation: a)Algebraic method, b) Elliptic generation systems. • Unstructured grid generation: a)Voronoi diagram and Delaunay triangulation; b) Advancing front grid generation.

Unit – IV : Solution to Eulers equations: 6

Formulations of Euler equations, Discretization methods for Euler equations. High resolution schemes and TVD.

Text Books:

1.Anderson, J.D. Computational Fluid Dynamics, McGraw Hill, 1995.

2.Anderson,D.A., Tannehill,J.C. and Pletcher,R.H., Computational Fluid Dynamics and Heat Transfer, McGraw Hill, 1984.

Reference Books:

1.Hirsch,C. Numerical Computation of Internal and External Flows, Vol.I, John Wiley, 1990.

2.Pradip Niyogi, S.K. Chakraborty, M.K. Laha, Introduction to Computational Fluid Dynamics, Pearson

MCDL511E: INTELLIGENT MANUFACTURING SYSTEMS

Teaching Scheme: **Lectures:** 03 hrs. **Tutorials:** NIL **Practical:** NIL	**Examination Scheme (Theory)** **Teacher Assessment Examination:** 20-Marks **Class Assessment Examination:** 20-Marks **End Semester Examination:** 60-Marks	**Examination Scheme (Laboratory)** **Internal(TW):** NIL **External(OR)**: NIL **External(PR)** : NIL
Credits:	**03**	

Unit – I : 6

Computer integrated manufacturing systems, structural and functional areas of CIM system, - CAD, CAPP, CAM, CAQC, ASRS. Advantages of CIM. Manufacturing communication systems – MAP/TOP, OSI Model, Data redundancy Top-down and Bottom-up approach. Volume of Information. Intelligent Manufacturing System Components, System Architecture and Data Flow, System Operation

Unit – II : 6

Component Knowledge Based Systems – Basic Components of Knowledge Base Systems, Knowledge Representation, Comparison of Knowledge Representation Schemes, Interference Engine, Knowledge Acquisition.

Unit – III : 6

Machine Learning – Concept of Artificial Intelligence, Conceptual Learning, Artificial Neural Networks Biological Neuron, Artificial Neuron, Types of Neural Networks, Applications in Manufacturing.

Unit – IV : 6

Automated Process Planning - Variant Approach, Generative Approach, Expert System for Process Planning, Feature Recognition, Phases of Process Planning, Knowledge Based System for Equipment Selection(KBSES) – Manufacturing System Design, Equipment Selection Problem, Modeling of Manufacturing Equipment Selection Problem, Problem Solving Approach in KBSES, Structure of The KBSES

Text Books:

1. Intelligent Manufacturing Systems by Andre Kusaic
2. Artificial Neural Networks by Yagna Narayana
3. Automation, Production Systems and CIM By Groover M.P.
4. Neural Networks by Wassarman.

MCDL511F: COMPUTER AIDED PROCESS PLANNING		
Teaching Scheme: **Lectures:** 03 hrs. **Tutorials:** NIL **Practical:** NIL	**Examination Scheme (Theory)** **Teacher Assessment Examination:** 20-Marks **Class Assessment Examination:** 20-Marks **End Semester Examination:** 60-Marks	**Examination Scheme (Laboratory)** **Internal(TW):** NIL **External(OR)**: NIL **External(PR)** : NIL
Credits:	**03**	

Course Contents **Hrs**

Unit – I : 6

Introduction to CAPP: Information requirement for process planning system, Role of process planning, advantages of conventional process planning over CAPP, structure of Automated process planning system, future recognition, methods.

Generative CAPP System: importance, principle of Generative CAPP system, automation of logical decisions, Knowledge based systems, Inference engine, implementation, benefits.

Unit – II : 6

Retrieval CAPP System: significance, group technology, structure, relative advantages, implementation and applications.Selection of manufacturing sequence: significance, alternative-manufacturing processes, reduction of total set-up cost for a particular sequence. Quantitative methods for optimal selection, examples

Unit – III : 6

Determination of machining parameters: reasons for optimal selection of machining parameters, effect of parameters on production rate, cost and surface quality, different approaches, advantages of mathematical approach over conventional approach, solving optimization models of machining processes.

Unit – IV : 6

Determination of manufacturing tolerances: design tolerances, manufacturing tolerances, methods of tolerance allocation, sequential approach, integration of design and manufacturing tolerances, advantages of integrated approach over sequential approach over sequential approach.

Text Books:

1. Automation Production Systems and Computer Integrated Manufacturing Systems – Mikell P Groover
2. Computer Design and Manufacturing – Dr. Sadhu Singh
3. Computer Engineering – David Bedworth

MCDL511G -INDUSTRIAL PRODUCT DESIGN AND PRODUCT LIFECYCLE MANAGEMENT		
Teaching Scheme: **Lectures:** 03 hrs. **Tutorials:** -01 hr. **Practical:** -NIL	**Examination Scheme (Theory)** **Teacher Assessment Examination:-** 20 Marks **Class Assessment Examination:** 20 Marks **End Semester Examination:** -60Marks	**Examination Scheme (Laboratory)** **Internal(TW):** -NIL **External(OR)**:-NIL **External(PR)** :-NIL
Credit	**03**	

Course Objective:

1. Demonstrate an understanding of PLM concepts, particularly product data management, change management, workflows and configurations.
2. Demonstrate literacy in the application of a PDM tool to support product development processes.
3. Integrate lifecycle management strategies and knowledge to develop new and/or formulate appropriate engineering design solutions in engineering environment.

Course Outcome:

1. Exposit legal, social, economic, ethical and environmental interests, values, requirements and expectations of key stakeholders.
2. Identify and assess risks (including OH&S) as well as the economic, social and environmental impacts of engineering activities
3. Anticipate the consequences of intended action or inaction and understand how the consequences are managed collectively by your organization, project or team

Course Contents **Hrs**

Unit – I : Product Development 6

Quality function deployment-quality project approach and the problem solving process. Design creativity-innovations in design alternatives. Concurrent engineering, industrial design principles. Product development versus design, types of design and redesign, modern production development process, reverse engineering and redesign product development process, examples of product development process, scoping product development – S-curve, new product development.

Unit – II : Understanding Customer Needs & Generating Concepts 6

Gathering customer needs, organizing and prioritizing customer needs, establishing product function, FAST method, establishing system functionality. GENERATING CONCEPTS: Information gathering, brain ball, C-sketch/6-3-5 method, morphological analysis, concept selection, technical feasibility, ranking, measurement theory, DFMA, design for robustness

Unit – III : Product Tear Down and Experimentation 6

Tear down method, post teardown report, benchmarking and establishing engineering

specifications, product portfolios

Unit – IV : 4. Introduction to Product Life Cycle Management 6

Background, Overview, Need, Benefits, and Concept of Product Life Cycle, Components / Elements of PLM, Emergence of PLM, Significance of PLM, Customer Involvement,. Threads of PLM- computer aided design (CAD), engineering data management (EDM), Product data management (PDM), computer integrated manufacturing (CIM, comparison of PLM to Engineering resource planning (ERP). PLM characteristics -singularity, cohesion, traceability, reflectiveness

Unit – V : Product Life Cycle Environment 6

Product Data and Product Workflow, The Link between Product Data and Product Workflow, Key Management Issues around Product Data and Product Workflow, Developing a PLM strategy, Strategy identification and selection, PLM System Architecture (2tier/3tier/4tier etc)..

Text Books: (Book Title, Name of the author, name of the Publisher, edition, year of publication)

1. John W Gosnay and Christine M Mears, Business Intelligence with Cold Fusion, Prentice Hall India, New Delhi, 2000.
2. David S Linthicum, "B2B Application Integration", Addison Wesley, Boston, 2001.
3. Alexis Leon, Enterprise Resource Planning, Tata McGraw Hill, New Delhi, 2002.
4. David Ferry and Larry Whipple, Building and Intelligent e-business, Prima Publishing, EEE Edition, California, 2000.
5. David Bedworth, Mark Hederson and Phillip Wolfe, Computer Integrated Design and Manufacturing, McGraw Hill Inc., New York, 1991.
6. Kevin Otto and Kristin Wood, Product Design – Techniques in Reverse Engineering and New Product Development, Pearson Education, New Delhi, 2004.
7. Karl T Ulrich and Stephen D Eppinger, Product Design and Development, McGraw Hill, New York, 1994.
8. Grieves, Michael, Product Lifecycle Management, McGraw-Hill, 2006. ISBN 0071452303

MCDP1206 SIMULATION LAB-II		
Teaching Scheme: **Lectures:** -NIL **Tutorials:** -NIL **Practical:** -NIL	**Examination Scheme (Theory)** **Teacher Assessment Examination:**- NIL **Class Assessment Examination:** NIL **End Semester Examination** –NIL	**Examination Scheme (Laboratory)** **Continuous Assessment:** 50 Marks **External Assessment:** 50 Marks
Credit	**2**	

Lab. work or Assignments have to be carried out at respective labs as mentioned in the syllabus of respective subjects excluding Elective. It is to be submitted as term work at the end of semester after continuous assessment of each by respective teacher. Assessment of term work has to be carried out as per R-1.4 and R-1.5 of PG Rules and Regulations of Credit System. (Refer University web site)

SIMULATION & OPTIMIZATION

04- 06 Assignment on real life problems of manufacturing systems and manufacturing processes to be simulated using simulation software's as ARENA, FORGE, FASTFORM ADVANCED, PAMSTAMP, SIMUFACT FORMING etc. Assignments on optimization using any process/product optimization software.

Assignments:

1. Assignment on Finite Element Simulation of Cooling/Heating Process.
2. Assignment on Finite Element Simulation of Bending for stress analyses.
3. Assignment of Finite Element Simulation of Drawing/Forming for deformation and stresses.
4. Assignment on Tool Path Simulation of Turning/Milling of simple components.
5. Assignment on Process Optimization any one case study.
6. Write a case study of any production application for cost and time optimization based on survey or visit

MCDP601-TECHNICAL WRITING		
Teaching Scheme: **Lectures:** NIL **Tutorials:** -- NIL **Practical:** 03 hrs.	**Examination Scheme (Theory)** **Teacher Assessment Examination:-** NIL **Class Assessment Examination:** NIL **End Semester Examination:** -NIL	**Examination Scheme (Laboratory)** **Continuous Assessment:** 50 Marks **Eternal Assessment:** 50 Marks
Credit	**03**	

Hrs.

Unit – I : Seminar Writing **7**

Selection of seminar, literature survey, outcomes and scope discussion based on literature, writing formats, summery and reference writing format. Case studies-based on the other's seminar presentation.

Unit – II : Dissertation Writing **7**

Selection of dissertation area, literature survey, outcomes and scope discussion based on literature, writing formats, summery and reference format. Case studies-based on the other's presentation. Discussion to write conclusion and appendix.

Unit – III : Assignment based on Software Tools and Techniques 8

a) Use technical writing software for seminar.
b) Use technical writing software for dissertation.
c) Use of Latex and its different capabilities.

NOTE: Journal and Report Writing,

Student is required to give the presentation based on report of a, b, and c and writing report on Research proposal and Patent drafting/filing at the end of semester.

MCDS602: SEMINAR-I		
Teaching Scheme: **Lectures:** NIL **Tutorials:** -- NIL **Practical:** 04 hrs.	**Examination Scheme (Theory)** **Teacher Assessment Examination:-** NIL **Class Assessment Examination:** NIL **End Semester Examination:** -NIL	**Examination Scheme (Laboratory)** **Continuous Assessment:** 50 Marks **Eternal Assessment:** 50 Marks
Credit	**04**	

It is important that the procedures listed below be carefully followed by all the students of MTech. (Mechanical Engineering).

1. Prepare 3 **COPIES** of your manuscript.

2. Limit your project report to preferably

a) 15-20 manuscript pages for Seminar I

b) 20-25 manuscript pages for Seminar II

c) 25-30 manuscript pages for Seminar III

3. The footer must include the following:

Institute Name, MTech. Mechanical (Heat Power Engineering) Times New Roman 10 pt. and centrally aligned.

4. Page number as second line of footer, Times New Roman 10 Pt, centrally aligned.

5. Print the manuscript using

a) Letter quality computer printing.

b) The main part of manuscript should be Times New Roman 12 pt. and justified**.**

c) Use 1.5 line spacing.

d) Entire report shall be one chapter. No chapters for Seminar I, II and III.

e) Seminar I shall not have last section as Conclusions, it will be summary only.

6. Use the paper size **8.5'' × 11''** or **A4 (210 × 197 mm).** Please follow the margins given below.

Margin Location	**Paper 8.5'' × 11''**	**Paper A4 (210 × 197 mm)**
Top	1''	25.4 mm
Left	1.5''	37 mm
Bottom	1.25''	32 mm
Right	**1''**	**25.4 mm**

7. All paragraphs will be 1.5 line spaced with a one blank line between each paragraph. Each paragraph will begin without any indentation.

8. Section titles should be bold with 14 pt typed in all capital letters and should be left aligned.

9. Sub-Section headings should be aligning at the left with 12 pt, bold and Title Case (the first letter of each word is to be capitalized).

10. Illustrations (charts, drawings, photographs, figures) are to be in the text. Use only illustrations really pertinent to the text. Illustrations must be sharp, clear, **black and white. Illustrations downloaded from internet are not acceptable.**

a) Illustrations should not be more than **two** per page. One could be ideal

b) Figure No. and Title at bottom with **12 pt**

c) Legends below the title in **10 pt**

d) Leave proper margin in all sides

e) Illustrations as far as possible should not be Xeroxed.

11. **Photographs** if any should be of glossy prints

12. Please use **SI** system of units. If students would like to add the equivalent in inch-pound (British) units, they must be stated in parenthesis after the **SI** units. In case the final result comes out in any other units (say due to empirical formula etc.) covert the unit to **SI** unit.

13. Please **number the pages** on the front side, centrally below the footer

14. **References** should be either in order as they appear in the thesis or in alphabetical order by last name of first author

15. **Symbols** and **notations** if any should be included in nomenclature section only

16. Following will be the order of report

i. **Cover page** and **Front page** as per the specimen on separate sheet

ii. **Certificate** from the Institute as per the specimen on separate sheet

iii. **Acknowledgement**

iv. **List of Figures**

v. **List of Tables**

vi. **Nomenclature**

vii. **Contents**

viii. **Abstract** (A brief abstract of the report not more than **150 words**. The heading of abstract i.e. word "Abstract" should be **bold, Times New Roman, 12 pt** and should be typed at the **centre.** The contents of abstract should be typed on new line without space between heading and contents. Try to include one or two sentences each on **motive, method, key-results** and **conclusions** in the Abstract)

ix. Section: Introduction

x. References

17. All section headings and subheadings should be numbered. For sections use numbers **1, 2, 3, ….** and for subheadings **1.1**, **1.2**, **….** etc and section subheadings **2.1.1**, **2.1.2, ….** etc.

18. **References** should be given in the body of the text and well spread. No verbatim copy or excessive text from only one or two references. If **figures** and **tables** are taken from any reference then indicate source of it. Please follow the following procedure for references

Reference Books Collier, G. J. and Thome, J. R., Convective boiling and condensation, 3rd ed., Oxford University Press, UK, 1996, pp. 110 – 112.

Papers from Journal or Transactions Jung, D. S. and Radermacher, R., Transport properties and surface tension of pure and mixed refrigerants, *ASHRAE Trans*, 1991, 97 (1), pp. 90 – 98. Bansal,

P. K., Rupasinghe, A. S. and Jain, A. S., An empirical correction for sizing capillary tubes, *Int. Journal of Refrigeration*, 1996, 19 (8), pp.497 – 505.

Papers from Conference Proceedings Colbourne, D. and Ritter, T. J., *Quantitative assessment of flammable refrigerants in room air conditioners*, Proc. of the Sixteenth International Compressor Engineering Conference and Ninth International Refrigeration and Air Conditioning Conference, Purdue University, West Lafayette, Indiana, USA, 2002, pp. 34 – 40.

Reports, Handbooks etc. United Nations Environmental Programme, Report of the Refrigeration, Air Conditioning and Heat Pumps, Technical Option Committee, 2002, Assessment - 2002. ASHRAE Handbook: Refrigeration, 1994 (Chapter 44)

Patent Patent no, Country (in parenthesis), date of application, title, year.

Internet www.(Site) [Give full length URL]

Format for front page and Certificate

A Seminar I / II / III on (TNR, 16pt, centrally aligned)

Title (TNR, 27pt, Bold, Centrally Aligned, Title Case)

By (TNR, 16pt, Centrally Aligned)

Mr. Student's Name (TNR, 16pt, Centrally Aligned)

Guide (TNR, 16pt, Centrally Aligned)

Guide's Name (TNR, 16pt, Centrally Aligned)

Institute

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Department of Mechanical Engineering

Name of the Institute

[2015-16](TNR, 22pt, Title Case Centrally Aligned)

Name of the Institute

Institute
Logo

C E R T I F I C A T E

This is to certify that *Mr. ABCDEF.*, has successfully completed the seminar-I/II/III entitled "Performance analysis of……." under my supervision, in the partial fulfillment of Master of Technology - Mechanical Engineering (Heat Power Engineering) of University of Pune.

Date :

Place :

Guide's Name
Guide

Head Department
and Institute Name

External Examiner

Seal Principal,
Institute Name

MCDP603: DISSERTATION PHASE-I		
Teaching Scheme: **Lectures:** -NIL **Tutorials:** -NIL **Practical:** -08 hrs.	**Examination Scheme (Theory)** **Teacher Assessment Examination:-** NIL **Class Assessment Examination:** NIL **End Semester Examination:** -NIL	**Examination Scheme (Laboratory)** **Continuous Assessment:** 100 Marks **Eternal Assessment:** 50 Marks
Credit	**08**	

INSTRUCTIONS FOR DISSERTATION WRITING

It is important that the procedures listed below be carefully followed by all the students of MTech. (Mechanical Engineering).

1. Prepare **Three Hard Bound Copies** of your manuscript.

2. Limit your Dissertation report to 80 – 120 pages (preferably)

3. The footer must include the following: Institute Name, MTech. Mechanical (Heat Power Engineering) Times New Roman 10 pt. and centrally aligned.

4. Page number as second line of footer, Times New Roman 10 Pt, centrally aligned.

5. Print the manuscript using a. Letter quality computer printing.

b. The main part of manuscript should be Times New Roman 12 pt. with alignment - justified**.**

c. Use 1.5 line spacing.

d. Entire report shall be of 5- 7 chapters.

6. Use the paper size **8.5'' × 11''** or **A4 (210 × 197 mm).** Please follow the margins given below.

Margin Location	Paper 8.5'' × 11''	Paper A4 (210 × 197 mm)
Top	1''	25.4 mm
Left	1.5''	37 mm
Bottom	1.25''	32 mm
Right	1''	25.4 mm

7. All paragraphs will be 1.5 line spaced with a one blank line between each paragraph. Each paragraph will begin with without any indentation.

8. Section titles should be bold with 14 pt typed in all capital letters and should be left aligned.

9. Sub-Section headings should be aligning at the left with 12 pt, bold and Title Case (the first letter of each word is to be capitalized).

10. Illustrations (charts, drawings, photographs, figures) are to be in the text. Use only illustrations really pertinent to the text. Illustrations must be sharp, clear, **black and white. Illustrations downloaded from internet are not acceptable.**

a. Illustrations should not be more than **two** per page. One could be ideal

b. Figure No. and Title at bottom with **12 pt**

c. Legends below the title in **10 pt**

d. Leave proper margin in all sides

e. Illustrations as far as possible should not be photo copied.

11. **Photographs** if any should of glossy prints

12. Please use **SI** system of units only.

13. Please **number the pages** on the front side, centrally below the footer

14. **References** should be either in order as they appear in the thesis or in alphabetical order by last name of first author

15. **Symbols** and **notations** if any should be included in nomenclature section only

16. Following will be the order of report

i. **Cover page** and **Front page** as per the specimen on separate sheet

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v. **List of Tables**

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vii. **Contents**

viii. **Abstract** (A brief abstract of the report not more than **150 words**. The heading of abstract i.e. word "Abstract" should be **bold, Times New Roman, 12 pt** and should be typed at the **centre.** The contents of abstract should be typed on new line without space between heading and contents. Try to include one or two sentences each on **motive, method, key-results** and **conclusions** in Abstract

1 Introduction (2-3 pages) (TNR – 14 Bold)

1.1 Problem statement (TNR – 12)

1.2 Objectives

1.3 Scope

1.4 Methodology

1.5 Organization of Dissertation

2 Literature Review (20-30 pages)

Discuss the work done so far by researchers in the domain area and their significant conclusions. No derivations, figures, tables, graphs are expected.

3 This chapter shall be based on your own simulation work (Analytical/ Numerical/FEM/CFD) (15-20 pages)

4 Experimental Validation - This chapter shall be based on your own experimental work (15-20 pages)

5 Concluding Remarks and Scope for the Future Work (2-3 pages)

References ANNEXURE (if any) (Put all mathematical derivations, Simulation program as Annexure)

17. All section headings and subheadings should be numbered. For sections use numbers **1, 2, 3, ….** and for subheadings **1.1**, **1.2**, **….** etc and section subheadings **2.1.1**, **2.1.2, ….** etc.

18. **References** should be given in the body of the text and well spread. No verbatim copy or excessive text from only one or two references. If **figures** and **tables** are taken from any reference then indicate source of it. Please follow the following procedure for references

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Papers from Journal or Transactions Jung, D. S. and Radermacher, R., Transport properties and surface tension of pure and mixed refrigerants, *ASHRAE Trans*, 1991, 97 (1), pp. 90 – 98. Bansal, P. K., Rupasinghe, A. S. and Jain, A. S., An empirical correction for sizing capillary tubes, *Int. Journal of Refrigeration*, 1996, 19 (8), pp.497 – 505.

Papers from Conference Proceedings Colbourne, D. and Ritter, T. J., *Quantitative assessment of flammable refrigerants in room air conditioners*, Proc. of the Sixteenth International Compressor Engineering Conference and Ninth International Refrigeration and Air Conditioning Conference, Purdue University, West Lafayette, Indiana, USA, 2002, pp. 34 – 40.

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Patent Patent no, Country (in parenthesis), date of application, title, year.

Internet www.(Site) [Give full length URL]

A Project Stage-I Report on
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Title (TNR, 27pt, Bold, Centrally Aligned, Title Case)

By (TNR, 16pt, Centrally Aligned)
Mr. Student's Name (TNR, 16pt, Centrally Aligned)

Guide
Guide's Name (TNR, 16pt, Centrally Aligned)

Institute Logo

Department of Mechanical Engineering
Name of the Institute

[2015-16](TNR, 22pt, Title Case Centrally Aligned)

Name of the Institute

Logo

C E R T I F I C A T E

This is to certify that *Mr. ABCDE* ., has successfully completed the Dissertation entitled "Performance analysis of……." under my supervision, in the partial fulfillment of Master of Technology - Mechanical Engineering (Heat Power Engineering) of University of Pune.
Date:
Place:

Guide's Name
Guide

Head
Department and
Institute Name

External Examiner

Seal

Principal,
Institute Name

MCDP604-SEMINAR-II		
Teaching Scheme: **Lectures:** NIL **Tutorials:** NIL **Practical:** 04 hrs.	**Examination Scheme (Theory)** **Teacher Assessment Examination:-** NIL **Class Assessment Examination:** NIL **End Semester Examination:** -NIL	**Examination Scheme (Laboratory)** **Continuous Assessment:** 50 Marks **External Assessment:** 50 Marks
Credit	**04**	

MCDP605 DISSERTATION PHASE-II		
Teaching Scheme: **Lectures:** -NIL **Tutorials:** -NIL **Practical:** -08 hrs.	**Examination Scheme (Theory)** **Teacher Assessment Examination:-** NIL **Class Assessment Examination:** NIL **End Semester Examination:** -NIL	**Examination Scheme (Laboratory)** **Continuous Assessment:** 250 Marks **External Assessment: 1**50 Marks
Credit	**16**	

9. RULES AND REGULATIONS

9.1 Registration of Postgraduate Engineering (M.Tech) students

The PG students shall be promoted to higher semester as per the conditions laid down below:-

Admission to	Candidates should have earned PASS grade in all the heads of the following examination	Candidates should have earned at least 50% credits of the following examination taken together
I Sem.	B.E/ B.Tech/ Equivalent Courses	---
II Sem.	--	---
III Sem.	--	I & II Sem.
IV Sem.	----	----

The minimum CGPA for award of degree shall be 5.5.

9.2 Semester System

There shall be two Semesters, namely Odd Semester and Even Semester in each academic year. Duration of semesters for different programs shall be as follows.

Duration:

i	B.Tech. Programme	8 Semesters
ii	MCA Programme	6 Semesters
iii	M.Tech Programme	4 Semesters

For the sections starting late, especially for First Year, provision of makeup classes shall be made to compensate for the loss of teaching. For Direct Second Year admissions, the provision of makeup classes shall be made.

9.3 Course Credit System/Structure

Number of credits for a course in any semester is generally calculated as follows.

Sr. No	Course	Hour	Credits for UG	Credits for PG
1	Lecture	1	1	1
2	Tutorial hour / week	1	1	1
3	Workshop / Laboratory/ Drawing	2	1	-
4	Laboratory	1	-	1
4	Project/Dissertation		*(As given below)	8
5	Project/ Dissertation		*(As given below)	20

9.4 Minimum requirement for award of Degree

M. Tech. Programs

- The minimum number of credits to be earned for M.Tech. Programs in a discipline shall not be less than 100 credit points.
- Completion of all audit courses
- The minimum CGPA for award of degree shall be 5.5

9.5 Class Assessment Examination (CAE):

This examination shall be conducted at the department in the scheduled week and the evaluated papers shall be shown to the students within three working days. There shall be three such examinations equi-spaced in the semester out of which one shall be online examination for UG. There shall be two such examinations equi-spaced in the semester for PG. However for the performance improvement of the student one additional examination shall be conducted at the end of the term (in case PG it should be online examination).

Criteria for Improvement Test:

- Student is absent any one OR both the CAE
- UG Student is having less than 8 marks in any one of CAE
- PG student is having less than 15 marks in any one of CAE

9.6 Teacher Assessment Examination (TAE):

It shall be evaluated by the teacher/forum in-charge based on the options like surprise test, quiz, seminar, paper reading, group discussion and the performance of the student in the co-curricular and extracurricular activities and his / her attentiveness in the class. There shall be total seven parameters, out of which best five will be consider.

TAE Parameters:

TAE Parameter	I/II Sem BE	III-VIII Sem BE	I/II Sem PG	III Sem PG
TAE - I	Quiz	Activity based learning	Delivery of technical topic without audio visual aid and backboard	Delivery of Seminar on latest Topic
TAE – II	Surprise Test	Technical	Chapter review	Demonstration of

TAE Parameter	I/II Sem BE	III-VIII Sem BE	I/II Sem PG	III Sem PG
		Presentations	from test book / reference book	Equipment / Lab
TAE – III	Home Assignment	Mini models/ Minor project	Mini Project	Review paper submitted in the Journal
TAE – IV	Attendance in Class	Attendance in Class	Attendance in Class	Attendance in Class
TAE – V	Seminar	Poster Presentation Seminar	Review of Journal Paper	Chapter review from test book / reference book
TAE – VI	Co-curricular & extra Curricular activates	Co-curricular & extra Curricular activates/CSIR	Poster presentation / Paper presentation / Seminar	Paper presentation
TAE - VII	Any Other	Attendance in two industrial visits and two guest lecturers / latest exposure advance facility in the lab	Attendance in two industrial visits and two guest lecturers	Attendance in two industrial visits and two guest lecturers Experiment Design / Kit Fabrication for UG

9.7 End Semester Examination (ESE) :

The Controller of Examinations shall conduct this examination after completion of the semester for which the date is given in the Academic Calendar. The time-table of the End Semester examination is prepared in the meeting of class representatives for each semester before one month before the start of examination. Each question paper shall have questions with choice upto 20 % and the student shall attempt all questions. The questions should be uniformly distributed from the entire syllabus of the subject. The duration of examination is 2 hours /3 hours/ 4 hours as per teaching scheme. All the question papers shall be audited by audit committee (comprising of senior most paper setter of respective subject as chairman and two teachers who have been appointed as paper setters as members) appointed by examination committee. The audit shall be done and completed in one sitting. The opinion of the subject teacher teaching the respective subject shall be sought before finalizing the question paper without disclosing the paper to the subject teacher. If there is shortage of paper sets, the audit committee shall prepare the required number of paper sets on spot. The audit shall be limited to maximum 20% for a particular set.

9.8 Exam From submission:

Every student has to fill online examination from as per the dates given in academic calendar through available portal

- Generate bank challan and online exam form
- Submit amount in bank through challan (within two days)
- Paste your current attested passport size photo on exam form.
- Submit challan and exam form to account section

9.9 M. Tech Project Report:

1. Topic selection of PG projects is done under the guidance of Industry expert/Experts from NITs. Due weight-age is given for project progress seminars and rubrics for the same are prepared by each department.
    a) Three seminar for Literature Review , project identification, topic finalization is conducted by Departmental Project Recognition Committee.
    b) Synopsis of topic to be submitted in standard format.
    c) RRC Committee is constituted by Dean(R and D).
    d) Changes, if any, suggested by RRC, to be incorporated in the synopsis.
    e) Title and scope of topic is finalized.

2. Three progress seminars based on Project work in M.Tech./M.E. III Semester.
3. Four progress seminars based on Project work in M.Tech./M.E. IV Semester.
4. Rigorous experimentation and analysis to be done in M.Tech./M.E. IV Semester.
5. Research paper based on Experimental work to be published by students in M.Tech./M.E. IV Semester.
6. Pre- Submission Seminar in front of Panel of eminent experts from NIT.
7. Suggestions, if any, suggested by Panel, to be incorporated in the work.
8. Write up of project report has to be in standard format prescribed by GHRCEM.
9. Submission of project report in standard format prescribed by GHRCEM.
10. Panel of Examiners from NIT, IIT constituted by Dean(R and D).
11. Final defense and viva conducted.

9.10 The Grading System

Students' performance/ progress shall be assessed by number of credits he/she has earned successfully. Based on course credits and grade points obtained by the student, semester grade point average and cumulative grade point average shall be calculated. The academic performance of a student shall be graded on a 10- Point Scale. This college shall adopt the relative grading system in the larger academic interest.

The grading system is produced below:

Grades	Grade points	Description
AA	10	Outstanding
AB	9	Excellent
BB	8	Very good
BC	7	Good
CC	6	Average
CD	5	Below Average
DD	4	Marginal
FF	0	Very Poor

As per AICTE CGPA may be converted into equivalent marks as

below: (C GPA – 0.75) x 10= Equivalent Percentage e.g

S.No.	CGPA	Class of degree awarded
1	≥7.75	First class with Distinction
2	≥6.75 or <7.75	First class
3	≥6.25 or < 6.75	Higher second class
4	≥5.5 or < 6.25	Second class

9.11 Guidelines for the Award of Grades:

The following are the general guidelines for the award of grades:

i. For each student, all evaluations in different components of a course shall be done in absolute marks considering the weightage in teaching scheme.
ii. The marks of various components shall be added to get total marks secured on a 10-points scale. The rounding off shall be done on the higher side.
iii. The relative grading system shall be used for award of grades.
iv. Examination committee shall appoint a sub-committee which shall be called as Grade
v. Moderation committee. (GMC) This committee shall be responsible for grade moderation. Dean academics shall be the convener of Under Graduate programs and PG Head for Post Graduate Programs. Grade shall be awarded by subject teachers and forward it to grade moderation committee through Head of concerned department. Grades shall be modified by the GMC based on the normal distribution.

9.11.1 Explanation:

'FF Grades

A student who was awarded "FF" grade in a core course has to repeat it compulsorily for getting passing grade is obtained.

For the elective courses in which 'FF' grade has been obtained, the student may take the same course or any other course from the same category.

Further, 'FF' grades secured in any course stay permanently on the grade card. The weightage of these grades is not counted in the calculation of the CGPA, however these are counted in the calculation of the SGPA.