



SAVITRIBAI PHULE PUNE UNIVERSITY

Structure and Syllabus

FOR

M. E. Mechanical Engineering (Energy Engineering)

2017-Course

UNDER FACULTY OF ENGINEERING

EFFECTIVE FROM JULY 2017

M.E. Mechanical Engineering (Energy Engineering) – (2017 Course)

SEMESTER - I

CODE	SUBJECT	TEACHING SCHEME	EXAMINATION SCHEME					CREDITS
		Lect. / Pr	Paper		TW	Oral/ Presentation	Total	
			In Sem. Assessment	End Sem. Assessment				
502501	Advanced Mathematics and Numerical Methods	4	50	50	-	-	100	4
502502	Advanced Thermodynamics	4	50	50	-	-	100	4
502503	Non-Conventional Energy Sources	4	50	50	-	-	100	4
502104	Research Methodology	4	50	50	-	-	100	4
502505	Elective I**	5	50	50	-	-	100	5
502506	Lab Practice I	4			50	50	100	4
Total		25	250	250	50	50	600	25

SEMESTER – II

CODE	SUBJECT	TEACHING SCHEME	EXAMINATION SCHEME					CREDITS
		Lect./Pr	Paper		TW	Oral/ Present- ation	Total	
			In Sem. Assessment	End Sem. Assessment				
502507	Advanced Heat Transfer	4	50	50	-	-	100	4
502508	Energy Conversion and Environment	4	50	50	-	-	100	4
502509	Advanced Fluid Mechanics	4	50	50	-	-	100	4
502510	Elective II	5	50	50	-	-	100	5
502511	Lab Practice II	4	-	-	50	50	100	4
502512	Seminar I	4	-	-	50	50	100	4
Total		25	200	200	100	100	600	25

Elective I**: Common to All M.E. Mechanical Specializations

SEMESTER III

CODE	SUBJECT	TEACHING SCHEME	EXAMINATION SCHEME					CREDITS
		Lect./ Pr.	Paper		TW	Oral/ Presentation	Total	
			In Semester Assessment	End Semester Assessment				
602513	Energy Management	4	50	50	-	-	100	4
602514	Energy Systems Modeling and Optimization	4	50	50	-	-	100	4
602515	Elective III	5	50	50	-	-	100	5
602516	Seminar II	4	-	-	50	50	100	4
602517	Dissertation Stage I	08	-	-	50	50	100	8
Total		25	150	150	100	100	500	25

SEMESTER – IV

CODE	SUBJECT	TEACHING SCHEME	EXAMINATION SCHEME				CREDITS
		Lect. /Pr	Paper	TW	Oral/ Presentation	Total	
602518	Seminar III	5	-	50	50	100	5
602519	Dissertation Stage II	20	-	150	50	200	20
Total		25	-	200	100	300	25

Elective I (502505) [Elective I Common to All M.E. Mechanical Specializations]

Modules of 2 Credits (Select any Two)			
Code No.	Title	Code No.	Title
ME2I – M1	Energy Audit and Management	ME2I – M6	Operation Management
ME2I – M2	Financial Management	ME2I – M7	Engineering Economics
ME2I – M3	Financial Costing	ME2I – M8	Technology Forecasting
ME2I – M4	Project Management	ME2I – M9	Technology Transfer
ME2I – M5	Energy Efficient Technologies in Electrical Systems	ME2I – M10	Human Rights
Modules of 1 Credit (Select any One)			
Code No.	Title	Code No.	Title
ME1I- M11	Environmental Pollution and Control	ME1I – M12	Intellectual property Rights

Elective II (502510)

Modules of 2 Credits (Select any Two)			
Code No.	Title	Code No.	Title
EE2II-M1	Process Optimization	EE2II-M7	Green Building
EE2II- M2	Design of Feedback Controllers	EE2II- M8	EURO VI IC Engine Technologies
EE2II- M3	Reactor System Modeling and Control	EE2II- M9	Fluidized Bed Technology
EE2II- M4	Insulating Materials and Refractories	EE2II- M10	Fuel Cell Technology
EE2II- M5	Solar Thermal Systems	EE2II- M11	Radiation Safety and Shielding
EE2II- M6	Energy Measurements	EE2II- M12	Nano Materials
Modules of 1 Credit (Select any One)			
Code No.	Title	Code No.	Title
EE1 II- M13	Nuclear Plant Operation	EE1 II- M16	Alternative Fuels for I.C. Engines
EE1 II- M14	Energy Regulatory Frameworks	EE1 II- M17	Electromechanical and Reactor Systems
EE1 II- M15	Microfluidics	EE1 II- M18	Thermal Energy Storage(TES)

Elective III (602515)

Modules of 2 Credits (Select any Two)			
Code No.	Title	Code No.	Title
EE2III-M1	Energy Resources and Economics	EE2III-M7	Process Integration
EE2III- M2	Processing Storage and Disposal of Nuclear Waste	EE2III- M8	Modern Sensors
EE2III- M3	Energy and Climate	EE2III- M9	Cryogenic Engineering
EE2III- M4	Nuclear Waste Management	EE2III- M10	Boilers
EE2III- M5	HVAC Testing, Adjusting and Balancing (TAB)	EE2III- M11	Turbulent Jets
EE2III- M6	Industrial Burners	EE2III- M12	Adsorption Technology
Modules of 1 Credit (Select any One)			
Code No.	Title	Code No.	Title
EE1 III-M13	Fluid Sealing Technology	EE1 III-M16	Nuclear Fuel Cycle Economics
EE1 III-M14	Radiation Measurement Techniques	EE1 III-M17	Radiation Detectors
EE1 III-M15	Combustion Applications	EE1 III-M18	Radiation protection quantities

LAB PRACTICES I & II:

The laboratory work will be based on completion of assignments confined to the courses of that semester.

SEMINAR:

The student shall deliver the seminar on a topic approved by authorities.

Seminar I: Shall be on state of the art topic of student's own choice approved by authority. The student shall submit the seminar report in standard format, duly certified for satisfactory completion of the work by the concerned Guide and head of the department/institute.

Seminar II: Shall be on the topic relevant to latest trends in the field of concerned branch, preferably on the topic of specialization based on the electives selected by him/her approved by authority. The student shall submit the seminar report in standard format, duly certified for satisfactory completion of the work by the concerned Guide and head of the department/institute.

Seminar III: shall be extension of **seminar II**. The student shall submit the seminar report in standard format, duly certified for satisfactory completion of the work by the concerned Guide and head of the department/institute.

DISSERTATION WORK:

The dissertation shall be based on the knowledge acquired by the student during the course work and preferably it should meet and contribute towards the needs of the society. The project aims to provide an opportunity of designing and building complete system or subsystems based on area where the student likes to acquire specialized skills.

Dissertation Stage- I

Dissertation Stage- I is the integral part of the dissertation. In this, the student shall complete the partial work of the dissertation that shall consist of problem statement, literature review, project overview, scheme of implementation, mathematical modeling, theoretical analysis, design of the set-up, layout of the set-up etc. The candidate shall deliver a presentation as a part of the progress report of dissertation stage-I, on the advancement in technology pertaining to the selected dissertation topic. The student shall submit the progress report of dissertation stage-I in standard format duly certified for satisfactory completion of the work by the concerned guide and head of the department/institute.

Dissertation Stage- II

In dissertation stage- II, the student shall complete the balance part of the dissertation that will consist of fabrication of set up required for the project, conducting experiments and taking results, analysis and validation of results and conclusions. The student shall prepare the final report of project work in standard format duly certified for satisfactory completion of the work by the concerned guide and head of the department/Institute. The dissertation stage- II must result into the publication of at least one research paper in reputed International Journal/conference recommended by the guide of the dissertation. BoS supported MECH-PGCON event for paper presentation and participation is compulsory to all students. MECH-PGCON participation certificate, comments received by the journal/MECH-PGCON reviewers and plagiarism-testing result can be attached in the dissertation report and shall be made available during dissertation presentation/viva to the examiners.

Note: Institute must submit the list of candidates, guide and project details (title, area, problem definition, abstract-clearly indicating objectives and scope, sponsorship details-if any) to the university **within month** of commencement of third semester. The guide must be approved/qualified teacher of the institute. A guide can guide at the most 8 students per year.

Examination: (For Lab. Practice I and II, Seminar I, II, and III, Project Work Stage-I)

The assessment for Term work and Oral/Presentation should be carried out as per rules R1.4 and R1.5 from PG Rules and Regulations published by Savitribai Phule Pune University.

Advanced Mathematics and Numerical Methods [502501]

CODE	TEACHING SCHEME	EXAMINATION SCHEME					CREDITS
	Lect. /Week	Paper		TW	Oral/ Presentation	Total	
		In Semester Assessment	End Semester Assessment				
502501	4	50	50	-	-	100	4

1. Linear Algebraic Equations:

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

2. Regression Analysis:

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

3. Differentiation & Integration:

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

4. Eigen Values & Eigen Vectors of Matrices:

Faddeev- Laeverrier’s method, Power Method, Householder & Given’s method.

5. Ordinary differential equations

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

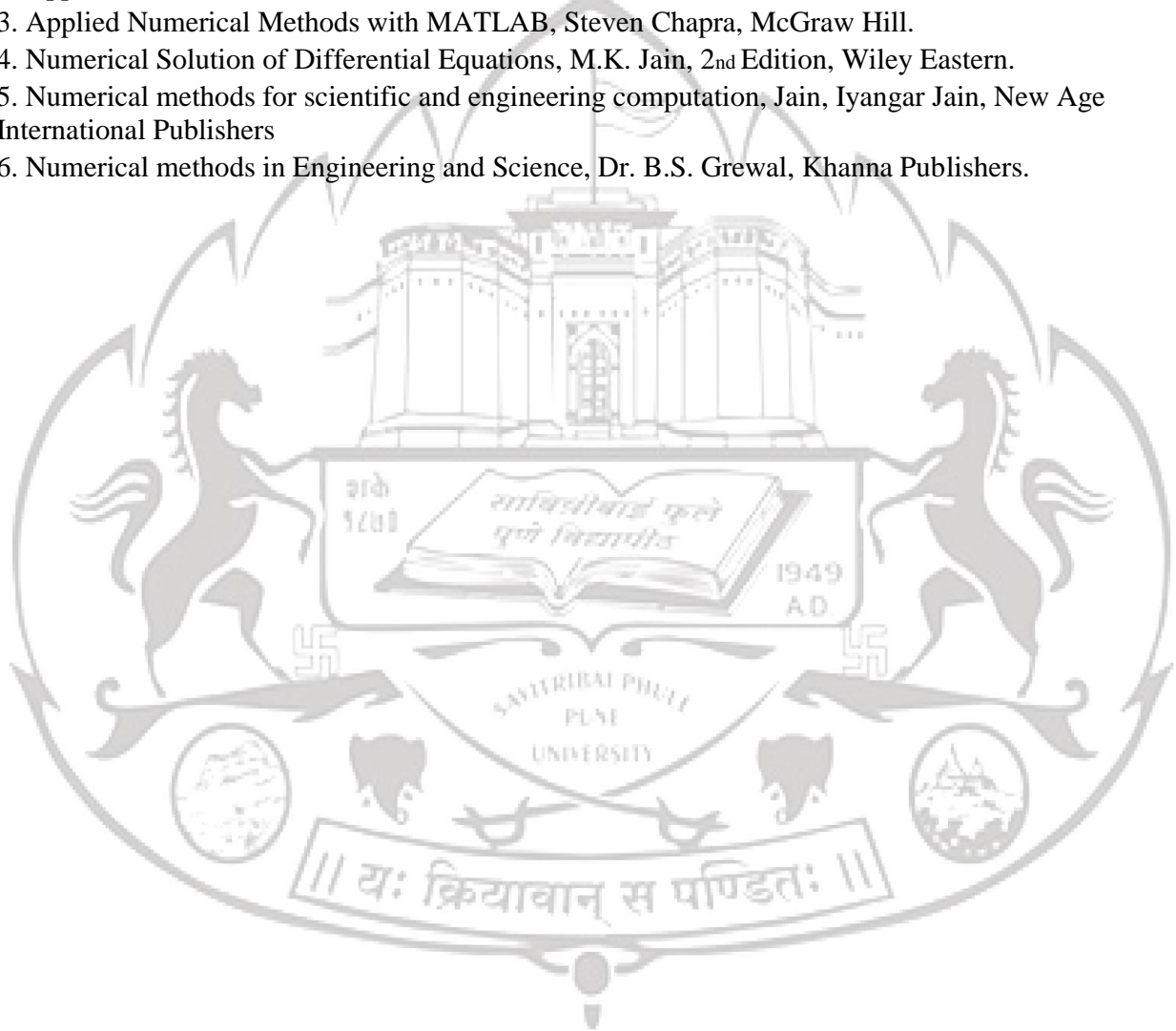
6. Partial Differential Equations:

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

Assignments: Solve Any Three assignments based on each of the above mentioned unit with programming

Reference Books:

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.
5. Numerical methods for scientific and engineering computation, Jain, Iyengar Jain, New Age International Publishers
6. Numerical methods in Engineering and Science, Dr. B.S. Grewal, Khanna Publishers.



Advanced Thermodynamics [502502]

CODE	TEACHING SCHEME	EXAMINATION SCHEME					CREDITS
	Lect. /Week	Paper		TW	Oral/ Presentation	Total	
		In Semester Assessment	End Semester Assessment				
502502	4	50	50	-	-	100	4

1. Equation of State

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. Gas mixtures- mass and mole fractions, Dalton's law of partial pressure, Amagat's law, Kay's rule.

2. Properties of Pure Substances

Phase change process of pure substances, PVT surface, P-v & P- T diagrams, Use of steam tables and charts in common use, Phase equilibrium, Gibb's Phase Rule.

3. Laws of thermodynamics

Second law analysis for engineering systems, Entropy flow and entropy generation, Increase of entropy principle, Entropy change of pure substance, Tds relations, Entropy generation, Onsager equation. Third law of thermodynamics, Nerst heat theorem and Heat death of universe.

4. Exergy Analysis of Thermal Systems

Exergy, Decrease of exergy principle and exergy destruction. Physical and chemical exergy, exergy balance. Applications of exergy analysis, Exergy analysis of fluid flow system and heat transfer augmentation, Heat exchanger.

5. Thermodynamic Property Relations

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.

6. Chemical Thermodynamics

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 K_p of ideal gas mixtures, Fugacity and Activity, Simultaneous relations, variation of K_p with temperature.

Exercises/ Assignments for Laboratory Practice (Any Three):

1. Computer Aided Energy Analysis of Steady Flow Cyclic System
2. Exergy analysis of real devices (Heat Exchangers, Vapor Compression cycle, Compressors, Power plants etc.)

3. Study of Behavior of Pure substance with change in Pressure and Temperature.
4. Preparation of Computer Program to Study the effect of percentage of Theoretical air on Adiabatic Flame Temperature and Equilibrium Composition for a Hydrocarbon fuel. (Program to be run for variable input data.)
5. To find the Calorific Value of Fuels (Solid/ liquid/ gaseous)

Reference Books:

1. Advanced Thermodynamics, Bejan, John Wiley, Inc.
2. Thermodynamics, Van Wylen & Sontag John Wiley & Sons, Inc., USA
3. Howell & Dedcius: Fundamentals of engineering Thermodynamics, McGraw Hill, Inc, USA.
4. Thermodynamics, Holman, 4th edition, McGraw Hill.
5. Heat and Thermodynamics, Zimmansky & Dittman, 7th edition, TMH.
6. Engineering Thermodynamics, Jones and Hawkings, John Wiley & Sons, Inc. USA.
7. Advanced Thermodynamics, Wark, McGraw Hill.
8. Basic and Applied Thermodynamics, Nag P.K., TMH, New Delhi.
9. Fundamentals of Combustion, D. P. Mishra, PHI Learning Pvt. Ltd.
10. Thermodynamics-An engineering approach, Y. A. Cengel and M. A. Boles, TMH.
11. Power Plant Technology, M. M. El-Wakil, McGraw Hill, 1985.
12. Fundamentals of Combustion, D P Mishra, PHI Learning. 2008.
13. Energy Conversion Systems, H. A. Sorensen, J. Wiley, 1983
14. Heat Exchanger Network Synthesis: Process Optimization by Energy and Resource, U. V. Shenoy, Gulf Publishing Co., 1995.
15. Entropy Generation through Heat and Fluid Flow, Bejan, Wiley, 1982.

Non-Conventional Energy Sources [502503]

CODE	TEACHING SCHEME	EXAMINATION SCHEME					CREDITS
	Lect. /Week	Paper		TW	Oral/ Presentation	Total	
		In Semester Assessment	End Semester Assessment				
502503	4	50	50	-	-	100	4

Unit I: Energy Sources

Introduction, Energy Sources, Classification of Energy Sources, Conventional & Non-conventional (Renewable) Energy, Overview of World Energy Scenario, Fossil Fuel Reserves – Estimates. Energy needs of India and energy consumption patterns. Major Non-Conventional Energy Sources in India. Decentralization of energy sources-need and benefits.

Unit-II Solar Energy

Solar Energy: Introduction, Solar energy basics, solar energy principles and applications, Availability and limitations of solar energy – Measuring techniques and estimation of solar radiation. Solar thermal systems and efficiency. Solar heating/cooling of buildings. Solar thermal power generation,

Solar Photovoltaic Systems: Present status, Introduction to solar photovoltaic materials. Operating principles. Photovoltaic cell concepts. Characteristics of PV systems, equivalent circuit, Maximum power point tracking. Applications: Battery charging, Pumping, Lighting.

Unit-III Wind and Hydro Energy

Introduction, Wind patterns and wind data. Tidal and wind energy potential and conversion efficiency, Site selection. Types of windmills. Principles of wind energy conversion, Characteristics of wind generators, Load matching. Types of wind power conversion systems – Operation, maintenance and economics.

Mini/micro hydro power: classification of hydropower schemes, Turbine theory, Essential components of hydroelectric system, system efficiency. Microhydel Operating principles. Components of a microhydel power plant. Types and characteristics of turbines. Selection and modification. Load balancing.

Unit-IV Bio Derived Energy

Sources of biomass – Different species, Generation, Conversion of biomass into fuels – Energy through fermentation – Pyrolysis, gasification, Wood gasifier and combustion – Aerobic and anaerobic bio-conversion, Properties of biomass. Applications: Biogas, Wood stoves, Bio fuels for combustion engine.

Biogas plants – Types of plants – Design and operation. Aerobic and anaerobic bio-conversion processes, microbial reactions purification, properties of biogas. Storage and enrichment. Properties of bio-gas & bio-diesel. Application.

Unit-V Other Energy Resources

Geothermal: Geothermal regions, Types of geothermal sources, dry rock and hot aquifer analysis
Geothermal energy conversion technologies, System development and limitations, Ocean thermal energy conversion.

Wave Energy Systems, Shoreline systems. Near shore systems. Off shore systems.

Tidal energy –Scope and economics.

Unit-VI Hybrid Energy Resources

Need for hybrid systems. Range and type of hybrid systems. Case studies of solar-wind, wind – hydro, Diesel-PV, Wind-PV, Microhydel-PV, Biomass-Diesel systems. Fuel cell energy storage systems.

Assignments/ Lab work (Any Four)

1. Study of solar energy collectors
2. Case study of solar energy storage
3. Study of Energy from Biomass
4. Wind Power and Annual Energy Estimation from Wind Data.
5. Study of Geothermal energy
6. Study of Ocean and Tidal energy
7. Visit to any nonconventional power station.

References

1. Renewable Energy Resources, J.Twidell and T.Weir, Taylor and Francis Group 2007.
2. Solar Engineering and Thermal Processes, J.A.Duffie and WA Beckman, & sons. 2001
3. Renewable Energy Resources Basic Principles and Application, G.N.Tiwari and M. K.Ghosal, Narosa Publishing House 2005.
4. Non-conventional Energy Systems-Principles, K.M. Mittal, Progress and Prospects, Wheeler Publications, 1997.
5. Non-Conventional Energy Sources, G. D. Rai, Khanna Publishers, 2003.
6. Solar Energy - Principles of thermal collection and storage, S. P. Sukhatme, second edition, Tata McGraw-Hill, New Delhi, 1996
7. Principles of Solar Engineering, D. Y. Goswami, F. Kreith and J. F. Kreider, Taylor and Francis, Philadelphia, 2000
8. Biomass Regenerable Energy, D. D. Hall and R. P. Grover, John Wiley, New York, 1987.
9. Solar Photovoltaics Fundamentals, Technologies and Applications, Chetan Singh Solankhi, PHI Learning.

Research Methodology [502104]

CODE	TEACHING SCHEME	EXAMINATION SCHEME					CREDITS
	Lect. /Week	Paper		TW	Oral/ Presentation	Total	
		In Semester Assessment	End Semester Assessment				
502104	4	50	50	-	-	100	4

1. Introduction

Meaning of Research, Objectives of Research, Motivation in Research, Types of Research, Research Approaches, Significance of Research, Research Methods versus Methodology, Research and Scientific Method, Criteria of Good Research

2. Research Problem and Research Design:

Definition of good research problem, Feasibility study of research problem, Importance of research problem, Sources of research problem, Criteria of good research problem, Meaning of Hypothesis, Characteristics of Hypothesis, Errors in selecting a research problem, Concept & need of research design, Meaning of variable, Selection of variables

3. Mathematical Modelling and prediction of performance:

Steps in Setting up a computer model to predict performance of experimental system, Validation of results, Multi-scale modelling 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 analysis.

4. Basic instrumentation:

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, Good measurement practice.

5. Applied statistics:

Regression analysis, curve fitting and developing Correlation, 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 and methods to reduce errors in research process.

6. Research report writing and Publication

Research Report: Dissemination of research findings, outline and structure of research report, different steps and precautions while writing research report, methods and significance of referencing

Publishing Research work: Selection of suitable journal for publishing research work, Open access Vs Subscription Journals, Identifying indexing of selected journals, Impact factor of the journal, structure of research paper, Check for plagiarism of the article, Research paper submission and review process.

Lab Practice:

1. Write Sample research proposal of the planned research topic giving details of topic, significance, funding required etc.
2. Write a research paper on review of at least 5 research papers for a research topic (Language, formatting and authors guidelines to be strictly followed from standard Springer or Elsevier Journals and referred journal details to be mentioned in the Lab practice file) and verify the research article for plagiarism and attach the plagiarism report.

Reference Books:

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

Elective I [502505]
[Elective I Common to All M.E. Mechanical Courses]

CODE	TEACHING SCHEME	EXAMINATION SCHEME					CREDITS
	Lect. /Week	Paper		TW	Oral/ Presentation	Total	
		In Semester Assessment	End Semester Assessment				
502505	5	50	50	-	-	100	5

Modules of 2 Credits (Select any Two)			
Modules of 2 Credits (Select any Two)			
Code No.	Title	Code No.	Title
ME2I – M1	Energy Audit and Management	ME2I – M6	Operation Management
ME2I – M2	Financial Management	ME2I – M7	Engineering Economics
ME2I – M3	Financial Costing	ME2I – M8	Technology Forecasting
ME2I – M4	Project Management	ME2I – M9	Technology Transfer
ME2I – M5	Energy Efficient Technologies in Electrical Systems	ME2I – M10	Human Rights
Modules of 1 Credit (Select any One)			
Code No.	Title	Code No.	Title
ME1I- M11	Environmental Pollution and Control	ME1I – M12	Intellectual property Rights

Note: For e.g., ME2I-M1 indicates

ME – Common to all M.E. Mechanical Course, 2 – 2 Credits, I – Elective I, M1 – Module 1

For e.g., ME1I-M11 indicates

ME – Energy Engineering, 1 – 1 Credit, I – Elective I, M11 – Module 11

ME2I – M1 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.

Ref. Book: Guide Books, Bureau of Energy Efficiency

ME2I – M2 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).

Ref. Book: Guide Books, Bureau of Energy Efficiency

ME2I – M3 Financial Costing

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

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

ME2I – M4 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.

Ref. Book: Guide Books, Bureau of Energy Efficiency

ME2I – M5 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.

Ref. Book: Guide Books, Bureau of Energy Efficiency

ME2I – M6 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

Ref. Books:

1) *Operations Management - An Integrated Approach, Danny Samson and Prakash J.Singh: Cambridge University Press.*

2) *Modern production/Operations Management, 8th Edition, E.S.Buffa and R. K. Sarin, John Wiley & Sons.*

ME2I – M7 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

Ref. Book: Economics, Samuelson Nordhaus, Tata McGraw Hill

ME2I – M8 Technology Forecasting

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

Ref. Book: Gerard H. Gaynor, Hand Book of Technology Management, McGraw Hill.

ME2I – M9 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.

Ref. Book: Gerard H. Gaynor, Hand Book of Technology Management, McGraw Hill.

ME2I – M10 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

Ref. 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*

ME1I – M11 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.

Ref. 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*

ME1I – M12 Intellectual property Rights

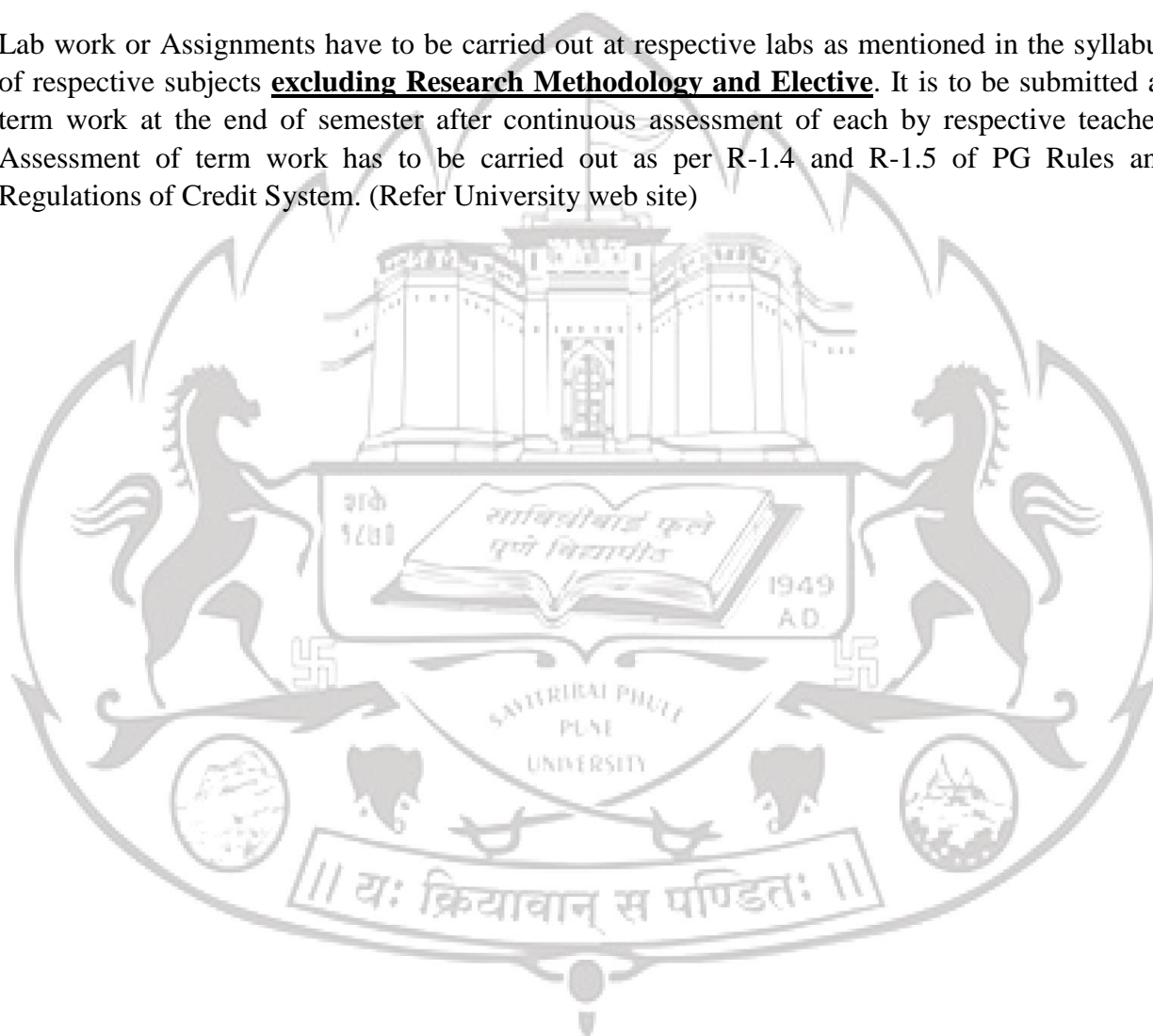
Patentable and non-patentable inventions, statutory exceptions, Persons entitled to apply for patents.

Ref. Book: Satyawrat Ponkshe, The Management of Intellectual Property, by, Ponkshe & Bhate Publications, Pune.

Lab Practice I [502506]

CODE	TEACHING SCHEME	EXAMINATION SCHEME					CREDITS
	Lect. /Week	Paper		TW	Oral/ Presentation	Total	
		In Semester Assessment	End Semester Assessment				
502506	6	-	-	50	50	100	4

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)



SEMESTER – II
Advanced Heat Transfer [502507]

CODE	TEACHING SCHEME	EXAMINATION SCHEME					CREDITS
	Lect. /Week	Paper		TW	Oral/ Presentation	Total	
		In Semester Assessment	End Semester Assessment				
602507	4	50	50	-	-	100	4

1. Introduction to Modes and Laws of Heat Transfer:

Simultaneous Heat Transfer Mechanism, Steady and Transient Heat Transfer, Multidimensional Heat Transfer, Thermal Conductivity, Thermal diffusivity, Various Boundary and Initial Conditions, General Heat Conduction Equation, Thermal Resistance, Generalized Thermal Resistance Networks, Thermal Contact Resistance.

2. Transient Heat Conduction:

Lumped capacitance and its validity, General lumped capacitance analysis, spatial effects. Problems related with conventional geometries.

3. Principle of Fluid flow and Convective heat transfer:

Concept of velocity and thermal boundary layers: Laminar and Turbulent flow. Navier-stokes equations and convection equation. Boundary layer approximations and special conditions. Boundary layer similarity. The normalized convection transfer equations. Dimensionless parameters & physical significance. Reynolds analogy, Chilton-Colburn analogy.

4. Convection:

Forced Convection: External Forced Convection, Parallel flow over Flat plates, Flow across cylinders and spheres, Flow across tube banks.

Internal Forced Convection: Entrance region, Constant surface heat flux, Constant surface temperature, Laminar and Turbulent flow in tubes.

Natural Convection: Physical Mechanism, Equation of motion and Grashof Number, Natural Convection over surfaces, Natural convection from finned surfaces and PCBs, Natural Convection inside enclosures (Rectangular, Cylinder and Sphere), Combined Natural Convection and Radiation, Combined Natural and Forced Convection.

5. Boiling and Condensation:

Boiling modes, the boiling curve, Forced convection boiling. Two phase flow.

Condensation: Physical mechanisms, laminar film condensation on a vertical plate. Turbulent film condensation, film condensation on radial systems, film condensation in horizontal tubes, on banks of tubes, Dropwise condensation correlations.

6. Thermal Radiation:

Thermal radiation, Blackbody radiation, Radiation intensity, Radiation properties, Atmospheric and Solar radiation, Shape factor, Radiation heat transfer in two surface enclosures, Radiation shields, Radiation exchange between Emitting and Absorbing gases.

Assignments (Any Three):

1. Transient Heat Conduction using Heisler and Grober charts
2. Numerical method in heat conduction & convection.
3. Combined Natural and Forced Convection heat transfer.
4. Assignment on Boiling and Condensation
5. Radiation Heat Transfer in Two Surface Enclosures
6. Heat transfer augmentation techniques.

Reference books:

1. Fundamentals of Heat and Mass Transfer, Incropera, Dewitt, John Wiley and sons.
2. Heat and Mass Transfer, Yunus Cengel, Afshin Ghajar, Tata McGraw Hill.
3. Heat transfer - A basic approach, M.N. Ozisik, McGraw Hill Int.
4. Convective Heat transfer, A Bejan, John Wiley and sons.
5. Heat transfer, J.P. Holman, McGraw Hill
6. Heat transfer, S.P. Sukhatme, University Press.

Energy Conversion and Environment [502508]

CODE	TEACHING SCHEME	EXAMINATION SCHEME					CREDITS
	Lect. /Week	Paper		TW	Oral/ Presentation	Total	
		In Semester Assessment	End Semester Assessment				
602508	4	50	50	-	-	100	4

1. INTRODUCTION

Energy Conversion, Series of Energy Conversions, Conversion of Chemical Energy of Fuel to Heat, On-road and off-road power sources. Thermal Efficiency of Energy Conversions, Ideal Fluid-Flow Energy Conversions, Lost Work, Efficiency of Mechanical Conversions, Wind Electricity, Geothermal Electricity and Ocean Thermal Energy Conversion. Conversion of Thermal Energy to Mechanical energy and Power. Steam Turbines (Velocity analysis-multistage with numerical treatment).

2. THERMAL AND MECHANICAL ENERGY

IC Engines - Lean Burn engine, Different approaches to lean burn, LHR engine, Surface ignition concept, catalytic ignition, homogenous charge compression ignition (HCCI) in diesel engines, variable valve timing.

Design for High Temperature - Combined Cycles with Heat Recovery Boiler, Combined Cycles with Multi-Pressure Steam, STAG combined Cycle Power Plant, Influence of component efficiencies on cycle performance.

3. NUCLEAR ENERGY

Environmental Aspects of Nuclear Power Generation, Release of Radioactivity into the Environment, Formulation of standards for radiation protection Basics of Nuclear Physics and Reactor Physics. Atomic and Nuclear Models, Nuclear Reactions, Nuclear Fission, Radioactive Decay, Neutron Interactions.

4. MECHANICAL ENERGY UTILITY SYSTEMS-I

Compressed Air System: Types of Air Compressors, Compressors Efficiency, Efficient Compressors Operation, Compressed Air System Components, Capacity Assessment and Leakage Test, Factors Affecting the Performance.

Fans and Blowers: Types, Performance Evaluation, Efficient System Operation, Flow Control Strategies.

5. MECHANICAL ENERGY UTILITY SYSTEMS-II

Pumps and Pumping Systems: Types, Performance Evaluation, Efficient System Operation, Flow Control Strategies, Variable Speed Drives.

Cooling Towers: Types and Performance Evaluation, Efficient System Operations, Flow Control Strategies, Assessment of Saving Opportunities,

Diesel Generating Systems: Factors affecting selection, Energy Performance Assessment of Diesel Conservation Avenues.

6. ENERGY AND ENVIRONMENTAL MANAGEMENT IN INDUSTRY

Introduction, Energy Use by Industrial Operations, Environmental Impacts of Industrial Operations, End Use Energy Efficiency, Efficiency of Using Raw Materials, Global Energy Policy Framework, Energy and Environmental Policies, Industries' Self-Motivation for Effective Energy and Environmental Performance, Environmentally Responsible Investing, Options for Energy and Environmental Performance Improvements. ...

Assignments/ Lab work (Any Four):

1. Case study on performance assessment of on-road/off-road power system.
2. Trial on Hydraulic Turbine to find the Operating and Main Characteristic Curves
3. Trial on Boiler to find Equivalent Evaporation and Energy Balance Sheet
4. Performance Evaluations of HVAC Systems
5. Case Study on Waste Heat Recovery Systems
6. Performance Evaluation of an Air Compressor

Text/References

1. Energy-Production, Conversion, Storage, Conservation, and Coupling, Yaşar Demirel, Springer-Verlag London (2012)
2. Steam and Gas Turbines, R.Yadav, Central Publishing House, Allahabad.
3. Guide to Energy Management, B. Capehart, W.C. Turner, W.J. Kennedy.
4. Energy Conversion and Management Principles and Applications, Giovanni Petrecca, Springer International Publishing.
5. Applied industrial energy and environmental management, Zoran Morvay, Dušan Gvozdenac, Wiley IEEE Press (2008).
6. Radiation protection- A guide for scientists, regulators and physicians, Shapiro J., Harvard (2002)
7. Bureau of Energy Efficiency (published data).

Advanced Fluid Mechanics [502509]

CODE	TEACHING SCHEME	EXAMINATION SCHEME					CREDITS
	Lect. /Week	Paper		TW	Oral/ Presentation	Total	
		In Semester Assessment	End Semester Assessment				
602509	4	50	50	-	-	100	4

1. Governing Equations

Review of Fluid Mechanics: Definition and properties of Fluids, Fluid as continuum, Continuum model, Flow kinematics:-Lagrangian and Eulerian description, Substantial or Total derivatives, Basic flow-analysis techniques, Flow Patterns: Streamlines, Streaklines, and Pathlines.

Integral Relations for a Control Volume: Reynolds transport theorem, Conservation of mass, Linear momentum equation, Energy equation, Frictionless flow, Bernoulli equation.

Differential Relations for a Fluid Particle: Acceleration field of a fluid, Differential equation of mass conservation, Differential Equation of linear momentum, Differential equation of Energy, Boundary Conditions for the basic equations, Velocity Potential, Stream Function, Vorticity

2. Navier-Stokes Equations:

Generalized form of NSE, Special forms: Euler equations, Bernoulli equation, Exact solutions: fully developed flow in channel, pipe, flow between concentric rotating cylinders, Couette flow, Stokes First problem (unsteady flow), Creeping flow past a sphere, cylinder.

3. Potential Flows:

Elementary Plane-Flow Solutions: Circulation, Superposition of Plane-Flow Solutions: Irrotational vortex, Vortex flow, Doublet, Flow past a circular cylinder, Magnus effect; Kutta-Joukowski lift theorem; Concept of lift and drag.

4. Boundary Layers:

Boundary layer assumptions, equations, Flow over a flat plate, Similarity (Blasius) solution, Falkner-Skan equation, Momentum integral method, Flow separation.

5. Turbulent flow:

Introduction, characteristics of turbulence, laminar-turbulent transition, Correlation functions, Mean and fluctuations, Governing equations, Turbulent boundary layer, Boundary conditions, shear stress models, Prandtl's mixing length, Velocity profile over a flat plate and in pipes, Equations for free shear layers: mixing layer, plane and axisymmetric jet, and wake, two equation model ($k-\epsilon$), Large Eddy Simulation, Various Turbulent Models.

6. Compressible Flow:

One-dimensional flow: Speed of sound, Variable cross-section flow, Converging diverging nozzle, Fanno and Rayleigh curve, Normal shock relations, Introduction to oblique shocks, Prandtl-Meyer expansion waves.

Lab Experiments / Assignments (Any Three):

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

Reference Books:

1. Advanced Fluid Mechanics, G. Biswas and K. Muralidhar, Narosa Publisher
2. Viscous Fluid Flow, F. M. White, Tata McGraw Hill
3. Boundary Layer Theory, H. Schlichting, Springer
4. Fluid Mechanics, Cengel, Tata McGraw Hill
5. Fluid Mechanics, F.M. White, Tata McGraw Hill Int.
6. Mechanics of Fluid, Merle C. Potter, David C. Wiggert, Bassem Ramadan, Tom I-P. Shih, Cengage Learning, Publisher, Global Engineering: Christopher M. Shortt.
7. Fluid Mechanics, David Pnueli and ChaimGutfinger, Cambridge Press

Elective II [502510]

CODE	TEACHING SCHEME	EXAMINATION SCHEME					CREDITS
	Lect. /Week	Paper		TW	Oral/ Presentation	Total	
		In Semester Assessment	End Semester Assessment				
602510	5	50	50	-	-	100	5

Modules of 2 Credits (Select any Two)			
Code No.	Title	Code No.	Title
EE2II-M1	Process Optimization	EE2II-M7	Green Building
EE2II- M2	Design of Feedback Controllers	EE2II- M8	EURO VI IC Engine Technologies
EE2II- M3	Reactor System Modeling and Control	EE2II- M9	Fluidized Bed Technology
EE2II- M4	Insulating Materials and Refractories	EE2II- M10	Fuel Cell Technology
EE2II- M5	Solar Thermal Systems	EE2II- M11	Radiation Safety and Shielding
EE2II- M6	Energy Measurements	EE2II- M12	Nano materials
Modules of 1 Credit (Select any One)			
Code No.	Title	Code No.	Title
EE1 1I- M13	Nuclear Plant operation	EE1 1I- M16	Alternative Fuels for I.C. Engines
EE1 II- M14	Energy Regulatory Frameworks	EE1 1I- M17	Electromechanical and Reactor Systems
EE1 1I- M15	Microfluidics	EE1 1I- M18	Thermal Energy Storage(TES)

Note: For e.g., EE2II-M1 indicates

EE – Energy Engineering, 2 – 2 Credits, II – Elective II, M1 – Module 1

For e.g., EE1II-M13 indicates

EE – Energy Engineering, 1 – 1 Credit, II – Elective II, M13 – Module 13

EE2II-M1 Process Optimization

Introduction. Formulation of Optimization Problems – Examples. Search Methods – Concept of Interval of Uncertainty, Reduction Ratio, Reduction Ratios of Simple Search Techniques like Exhaustive Search, Dichotomous Search, Fibonacci Search and Golden Section Search-Numerical Examples, Method of Steepest Ascent / Steepest Descent Conjugates Gradient Method , Geometric Programming – Examples. Dynamic Programming – Examples.

Ref. Books:

1. *Essentials of Thermal System Design and Optimization*, Prof. C. Balaji, AueBooks, New Delhi in India and CRC Press in the rest of the world.
2. *Design and Optimization of Thermal Systems*, Y. Jaluria, McGraw Hill,
3. *Introduction to Optimum Design*, J.S. Arora, McGraw Hill

EE2II-M2 Design of Feedback Controllers

Response Characteristics of Dynamic Systems, System Transfer Function, Various Control Actions, Design Methods for Proportional - Integral Controllers, Example of Application to a Water Level Control Problem, Temperature Control Laboratory.

Ref. Books:

- 1) *Damian Flynn, Institution of Electrical Engineers, "Thermal Power Plant Simulation and Control"*.
- 2) *Samuel Glasstone, Alexander Sesonske, "Nuclear Reactor Engineering: Reactor systems engineering, Volume 2, Springer, 1994"*

EE2II-M3 Reactor System Modeling and Control

Point Reactor Kinetics Equations, Power Reactor Dynamics and Feedback Effects, Modeling Reactor Core Dynamics and Simulation, Primary System Model of a PWR, SIMULINK Model of a PWR Plant, Control Strategies in a PWR, Control Rod Reactivity Estimation.

Ref. Books:

- 1) *Damian Flynn, Institution of Electrical Engineers, "Thermal Power Plant Simulation and Control"*.
- 2) *Samuel Glasstone, Alexander Sesonske, "Nuclear Reactor Engineering: Reactorsystems engineering, Volume 2, Springer, 1994"*

EE2II-M4 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*

EE2II-M5 Solar Thermal Systems

Solar Heating Systems- Calculations of Heating and Hot-Water Loads in Buildings, Solar Water-Heating Systems, Liquid-Based Solar Heating Systems for Buildings, Solar Air-Heating Systems,

Methods of Modeling and Design of Solar Heating Systems, Long-Term Performance of Solar Heating Systems.

Solar Cooling and Dehumidification- Solar Space Cooling and Refrigeration, Solar Desiccant Dehumidification

Ref. Books:

- 1) *Goswami, D. Yogi-Principles of Solar Engineering, Third Edition-CRC Press (2015)*
- 2) *Soteris Kalogirou-Solar Energy Engineering_ Processes and Systems-Academic Press (2009)*

EE2II-M6 Energy Measurements

Measurements and error analysis (introduction and errors in measurement). Measurements of Temperature- Thermoelectric thermometry, Resistance thermometry, Stagnation, Bulk mean temperature. Measurement of Heat Flux, Heat Transfer Coefficient, Measurement of Pressure, Fluid velocity, Volume flow rate, Stagnation and Bulk mean temperatures. Measurement of thermo-physical properties- Conductivity, Transient method, Heat capacity. Radiation properties of surfaces (Measurement of emissivity and reflectivity).

Ref. Book: Mechanical Measurement, S. P. Venkateshan, John Wiley and Sons Ltd.

EE2II-M7 Green Building

Design and Development of Green Building - Site selection, Water and Energy management, Materials and Resource for green building, Indoor Environmental issues,

Costs of Green Buildings -Cost Drivers for Green Buildings, Additional Cost Considerations, Controlling Costs in LEED Projects, High Performance on a Budget, Summary of Cost Influences, Green Building Cost Studies, Integrated Design for cost reduction.

Ref. Books:

1) *Jerry Yudelson-Green Building Through Integrated Design-McGraw-Hill Professional (2008)*

2) *Jerry Yudelson, Green building A to Z, Understanding the buildings, 2008.*

EE2II-M7 EURO VI IC Engine Technologies

Euro VI norms for diesel, petrol and natural gas. Technology trends in diesel engine-turbocharging, fuel system, after treatment (DPF, SCR, LNT etc.), EGR system, fuel economy (FE) norms. Technology trends in petrol and natural gas engine-fuel system (premixed, direct injection), EGR, aftertreatment (three way catalyst). Hybrid system-series.

Ref. Book: Importing EU Norms: Conceptual frame work and empirical findings, Annika, John Leslie, Springer.

EE2II-M9 Fluidized Bed Technology

Principal of Fluidized bed combustion, Advantages of fluidized bed combustion, Circulating fluidizing bed (CFB) and Bubbling Fluidized bed (BFB) combustion, Categories of FBC, Fuel requirements of FBC. Fluidized bed Boilers, Applications, Advantages of Fluidized bed Boilers, Regimes of fluidization, Fast Fluidized bed, Hydrodynamic structures of Fast fluidized beds, axial voidage profile, lateral Distribution of voidage on fast bed, Gas Solid mixing, gas solid slip velocity, dispersion, stages of combustion, Factors affecting on Combustion Efficiency, Combustion in CFB and BFB, Biomass combustion. Emission of FBC equipments.

Ref. Book: Prabir Basu, Combustion and gasification in Fluidized bed, CRC press, Taylor and Francis Black and Veatch, Power Plant Engineering, CBS Publication and distribution.

EE2II-M10 Fuel Cell Technology

Principle of Fuel Cell, Efficiency, Types – Polymer Electrolyte Membrane, Alkaline, Molten Carbonate, Solid oxide, Regenerative, Performance Limiting factors of Fuel Cell, losses, advantages and limitations, applications, Microbial Fuel Cells.

Ref. Books:

1) *Fuel Cell Technology, N. Sammes, Springer.*

2) *Non Conventional Energy Resources, G.S. Sawhney, PHI.*

EE2II-M11 Radiation Safety and Shielding

Radiation Safety and Environmental Aspects of Nuclear Power Generation, Radiation interaction, Photon Attenuation, Radiation Shielding, Internal and External Dose Evaluation, Reactor Effluents and Release of Radioactivity into the Environment, Transportation and Disposal of Radioactive Waste. Protection against Radiation Exposure, Nuclear Power Plant Safety Requirements

Ref. Books: 1. E.E. Lewis, Nuclear Power Reactor Safety, Wiley Inter-science, 1977

2. Jacob Shapiro, Radiation Protection: A Guide for Scientists, Regulators, and Physicians, Editorial, UPR, 2002.

EE2II-M12 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.

EE1III-M13 Nuclear Plant operation

Major systems in a Pressurized Water Reactor (PWR), Major Systems in a Boiling Water Reactor (BWR), CANDU (Canadian-Deuterium-Uranium) Pressured Heavy Water Reactor (PHWR), High-Temperature Gas-Cooled Reactor (HTGR).

Ref. Books:

1. Damian Flynn, Institution of Electrical Engineers, "Thermal Power Plant Simulation and Control", IET (2003).

2. Samuel Glasstone, Alexander Sesonske, "Nuclear Reactor Engineering: Reactor systems engineering, Volume 2, Springer, 1994.

EE1III-M14 Energy Regulatory Frameworks

Energy Policies of India - Supply Focus Approach and its Limitations - Energy Paradigms – DEFENDUS Approach - End Use Orientation - Energy Policies and Development – Case Studies on the Effect of Central and State Policies on the Consumption and Wastage of Energy - Critical Analysis - Need for Renewable Energy Policies in India. Legislation, Rules and Regulations for Safe Electricity Generation: The Factories Act 1948, Applicable AERB Safety Codes, Guides and Technical Specifications, The Atomic Energy Act 1962, The Indian Electricity Act 1910, The Environmental Protection Act 1986, The Air (Prevention and Control of Pollution) Act 1981, The Water (Prevention and Control of Pollution) Act 1974, The Boiler Act.

Ref. Books:

1. J. Goldemberg, T.B. Johansson, A.K.N. Reddy and R.H. Williams: Energy for a Sustainable World, Wiley Eastern, 1990.

2. IEEE Bronze Book: Energy Auditing, IEEE Publications, 1996.

3. P. Chandra: Financial Management Theory and Practice, Tata McGraw Hill, 1992.

4. Annual Energy Planning Reports of CMIE, Govt. of India.

EE1II-M15 Microfluidics

Introduction: Scaling issues, Applications, Derivation of Navier-Stokes equations Two-phase flows: Flow regimes and their modeling. Heat Transfer: Forced convection with slip, Thermal effects at micro scales, Heat transfer with liquids. Mixing: Introduction to mixing, Challenges at micro scales, Chaotic mixing, acoustic and electrically induced mixing.

Ref. Books:

- 1) *Karniadakis G. E. and Beskok A., Microflows and Nanoflows: Fundamentals and Simulation, Springer.*
- 2) *Panton R.L., Incompressible Flow, John Wiley.*

EE1II-M16 Alternative Fuels for I.C. Engines

Solid fuels, liquid fuels, gaseous fuels, Properties and specifications, Material Compatibility, Storage and Dispensing, Refueling Facility, Safety and Protection norms

Ref. Books:

- 1) *Alternate fuels Guidebook, Richard L. Bechtold, SAE International,*
- 2) *Automotive fuels and fuel systems, Vol. I & II, T. K. Garret, SAE International*

EE1II-M17 Electromechanical and Reactor Systems

Introduction to Electromechanical Systems with Emphasis on Modeling, Analysis, Design, and Control Techniques. Design of Electric Machines (Standard Motors, Linear Actuators, Magnetic Bearings etc). Maxwell's Equations, Electromechanical Energy Conversion, Finite Element Analysis, Design and Control Techniques. Nuclear Power Plant Systems: PWR, BWR and Advanced Concepts, Design Criteria, Design Parameters, Economics, Primary and Secondary Loops. Safety Systems, Reactor Control and Protection Systems.

Ref. Books:

1. *Elmer Lewis, Fundamentals of Nuclear Reactor Physics”, Elsevier, 2008.*
2. *Austin Hughes, Don MacLoud, “Electric Motors and Drives Fundamentals, Types and Applications”, Elsevier, 2005.*

EE1II-M18 Thermal Energy Storage (TES)

Basic Principle, Benefits, Criteria for TES Evaluation, TES Market Considerations, TES Heating and Cooling Applications, TES Operating Characteristics, ASHRAE TES Standards, Sensible and Latent TES, Energy Conservation with TES: Planning and Implementation, Recent Advances in TES Methods

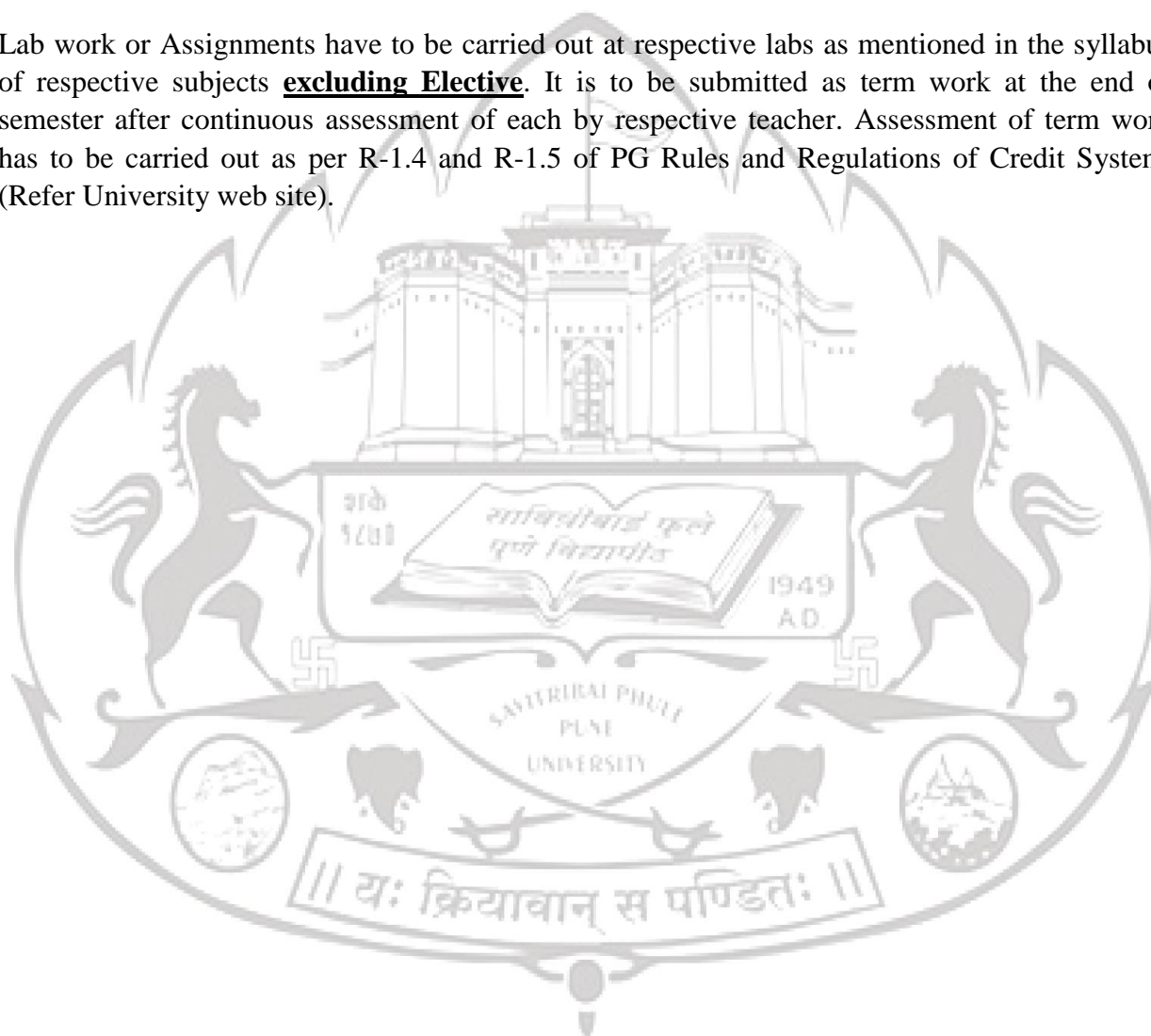
Ref. books:

- 1) *ASHRAE Handbook – Application.*
- 2) *Ibrahim Dincer and Marc A. Rosen, Thermal Energy Storage- Systems and Applications, Wiley Publication.*

Lab Practice II [502511]

CODE	TEACHING SCHEME	EXAMINATION SCHEME					CREDITS
	Lect. /Week	Paper		TW	Oral/ Presentation	Total	
		In Semester Assessment	End Semester Assessment				
602511	6	-	-	50	50	100	4

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).



Seminar – I, II and III [502512, 602516, 602518]

CODE	TEACHING SCHEME Lect. /Week	EXAMINATION SCHEME					CREDITS
		Paper		TW	Oral/ Presentation	Total	
		In Semester Assessment	End Semester Assessment				
602512	4	-	-	50	50	100	4
602516	4	-	-	50	50	100	4
602518	5	-	-	50	50	100	4

Assessment of Seminar has to be carried out as per R-1.4 and R-1.5 of PG Rules and Regulations of Credit System.

INSTRUCTIONS FOR SEMINAR REPORT WRITING

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

1. Prepare 3 **COPIES** of your manuscript.
2. Limit your project report to preferably
 - a) 15-20 manuscript pages Seminar I
 - b) 20-25 manuscript pages Seminar II
 - c) 25-30 manuscript pages Seminar III
3. The footer
For Energy Engineering
Institute Name, Mechanical (Energy 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 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 xeroxed.
11. **Photographs** if any should 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 specimen on separate sheet
 - ii. **Certificate** from institute as per 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 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 Rademacher, 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 Compress or 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

Logo

Department of Mechanical Engineering

Name of the Institute

[2013-14] (TNR, 22pt, Title Case Centrally Aligned)

Name of the Institute

Institute

Logo

CERTIFICATE

This is to certify that *Mr. Lele M.M.*, has successfully completed the seminar – I/II/III entitled “Performance analysis of.....” under my supervision, in the partial fulfillment of Master of Engineering - Mechanical Engineering (Energy Engineering) of University of Pune.

Date :

Place :

Guide's Name
Guide

Head
Department and
Institute Name

External Examiner Seal Principal, Institute Name

SEMESTER III

Energy Management [602513]

CODE	TEACHING SCHEME	EXAMINATION SCHEME					CREDITS
	Lect. /Week	Paper		TW	Oral/ Presentation	Total	
		In Semester Assessment	End Semester Assessment				
602513	4	50	50	-	-	100	4

1. Introduction

Objectives of energy management, the need for energy management, Energy Monitoring, Targeting and Reporting- key Steps, Principles of Energy Monitoring, Setting Performance Targets, Controlling Performance, Reporting, Savings Verification.

2. Energy Audit Process

Definition, types of energy audit, Energy Audit Procedure- Phase I (Preparation for Energy Audit), Phase II (Facility Inspection), Phase III (Implementation and Recommendations), Benchmarking and Energy Performance, Energy Audit Instruments,

3. Heating, Ventilation and Air-Conditioning

HVAC System Goals, surveying of existing HVAC system conditions, centralized control, Calculation of heating- cooling, and ventilating loads, Ventilation Requirements for Health, improvement the operation of the HVAC system, Inspection of HVAC systems. **Latest trend in HVAC.**

4. Heat Transfer Equipments

Heat exchangers- selection; shell and tube heat exchangers; double pipe heat exchangers **combustion and thermal efficiency**-combustion theory; flame temperature, thermal efficiency, thermal losses, thermal balance sheet, thermal balance diagrams, **steam plant**-Boiler plant, steam costs, steam distribution and utilization, condensate, desuperheaters. Pressure hot water and thermal fluid plants- pressure hot water, thermal fluids.

5. Waste Heat Recovery

Waste-Heat Survey, Classifying Waste-heat Quality, Storage of Waste Heat, Quantifying Waste Heat, Matching Waste Heat Source and Sink, Waste-heat Exchangers, Commercial

Options in Waste-heat-recovery Equipment, Emerging Technologies for Waste Heat Recovery.

Heat Exchanger Networking - Concept of Pinch, Target Setting, Problem Table Approach, Composite Curves, Demand Side Management.

6. ELECTRICAL ENERGY

Electric circuit theory, circuit impedances, power factor, multiphase circuits, Electrical measurements-ammeter, voltmeter, wattmeter, wattmeter, maximum demand meter, metering errors, electrical meter summary. Costs of electrical energy. Lightning – lamp lifetime, efficient lighting. Motive power and power factor improvement- power Factor improvement, capacitor rating, siting the capacitor, effects of power factor improvement. Optimum start control. Industrial heating- resistance heating, induction heating, arc heating, dielectric and microwave, atmosphere generators, radiant heating.

Assignments/ Lab Work (Any Four):

1. Energy Audit of Small Scale Industry.
2. Pay back Analysis, Financial Work sheet of a Renewable Energy Project.
3. Study of Waste Heat Recovery System
4. Determination of COP of Cooling Towers.
5. Nuclear Techniques in Environmental Studies.
6. Case study on household energy consumption measurement.

Text/References

1. B. Capehart, W.C. Turner, W.J. Kennedy, Guide to Energy Management.
2. Giovanni Petrecca, Energy Conversion and Management_Principles and Applications-Springer International Publishing.
3. Doty Steve, Turner, Energy_Management_Handbook, 7th Ed.
4. W.R. Murphy, G McKay, Energy Management, Elsevier.
5. Bureau of Energy Efficiency (published web data).

Energy Systems Modeling and Optimization [602514]

CODE	TEACHING SCHEME	EXAMINATION SCHEME					CREDITS
	Lect. /Week	Paper		TW	Oral/ Presentation	Total	
		In Semester Assessment	End Semester Assessment				
602514	4	50	50	-	-	100	4

1. Introduction to system Modeling

Basic considerations in design, morphology of design with a flow chart, concept of workable design, practical example on work able system and optimal design. Importance of modeling in design, types of models, mathematical modeling, physical modeling and dimensional analysis.

2. Regression and Curve Fitting

Need for regression in simulation and optimization, Concept of best fit and exact fit. Exact fit- Lagrange interpolation, Newton's divided difference -examples. Least square regression- theory, examples, linear regression with one and more unknowns-examples. Power law forms-examples. Gauss Newton method for nonlinear least squares regression-examples.

3. System simulation

Importance of simulation, types of simulation. Successive substitution method- examples. Newton-Raphson method- one unknown- examples. Newton-Raphson method- multiple unknowns- examples. Gauss Seidel method- examples. Rudiments of finite difference method for partial differential equations with an example.

4. Linear Programming and Classical Optimization Techniques

Classification of optimization problems, formulation of optimization problems, linear programming-graphical solution (two variable problems), simplextableau method, sensitivity analysis, Lagrange multiplier method- proof; examples.

5. One-Dimensional Minimization Methods

Search methods- Concept of interval of uncertainty, reduction ratio, reduction ratios of simple search techniques like exhaustive search, dichotomous search, Fibonacci search and Golden section search-numerical examples. Interpolation methods- quadratic interpolation method, cubic interpolation method.

6. Modern Optimization Techniques

Random search methods, grid search method, univariate method, steepest descent (cauchy) method, gradient direction(direction of steepest ascent) method. Geometric programming-examples. Dynamic programming- examples. Genetic algorithm and simulated annealing-examples, introduction to Bayesian framework for optimization.

Assignments/ Lab Work (Any Three) :

1. Simulation of Thermal System Using Computer Programing/Software.
2. Case Study of Sensitivity Analysis
3. Study of Energy- Economy Models
4. Solution of Optimization Problems Using Computer Programing/Software.
5. Assignment on Linear Programming.
6. Study of energy softwares like LEAP, HOMER, EnergyPLAN, RETScreenetc.

Reference Books:

1. Design and Optimization of Thermal Systems, Y. Jaluria, McGraw Hill, 1998.
2. Design of Thermal Systems, W.F.Stoecker, McGraw Hill, 1989.
3. Engineering Optimization-Theory and Practice, S. S. Rao Wiley Eastern, 2009.
4. Essentials of Thermal System Design and Optimization, C.Balaji, Ane Books, New Delhi, 2011.
5. Mathematical Modeling and Simulation-Introduction for Scientists and Engineers, Kai Velten, Wiley, 2009.
6. System Simulation, Geoffrey Gordon, Prentice Hall; 2 edition (June 1978)
7. Energy Systems Analysis for Developing Countries, P. Meier, Springer Verlag, 1984.
8. Simulation and Modeling Analysis, Averill M. Law, W. David Kelton, McGraw Hill.
9. Modeling and Problem Solving Techniques for Engineers, Laszlo Horvath, Imre J. Rudas, Elsevier Academic Press, 2004.

Elective III (602515)

Modules of 2 Credits (Select any Two)			
Code No.	Title	Code No.	Title
EE2III-M1	Energy Resources and Economics	EE2III-M7	Process Integration
EE2III- M2	Processing Storage and Disposal of Nuclear Waste	EE2III- M8	Modern Sensors
EE2III- M3	Energy and Climate	EE2III- M9	Cryogenic Engineering
EE2III- M4	Nuclear Waste Management	EE2III- M10	Boilers
EE2III- M5	HVAC Testing, Adjusting and Balancing (TAB)	EE2III- M11	Turbulent Jets
EE2III- M6	Industrial Burners	EE2III- M12	Adsorption Technology
Modules of 1 Credit (Select any One)			
Code No.	Title	Code No.	Title
EE1 III-M13	Fluid Sealing Technology	EE1 III-M16	Nuclear Fuel cycle Economics
EE1 III-M14	Radiation Measurement Techniques	EE1 III-M17	Radiation Detectors
EE1 III-M15	Combustion Applications	EE1 III-M18	Radiation protection quantities

Note: For e.g., EE2III-M1 indicates

EE – Energy Engineering, 2 – 2 Credits, III – Elective III, M1 – Module 1

For e.g., EE1III-M13 indicates

EE – Energy Engineering, 1 – 1 Credit, III – Elective III, M13 – Module 13

EE2III-M1 Energy Resources and Economics

Overview of World Energy Scenario – Dis-Aggregation by End-Use, By Supply. Fossil Fuel Reserves – Estimates. Duration Overview of India's Energy Scenario - Dis-Aggregation by End-Use, By Supply. Reserves Country Energy Balance Construction –Examples, Trends in Energy use Patterns, Energy and Development Linkage. Energy Economics - Simple Payback Period, Time Value of Money, IRR, NPV, Cost of Saved Energy, Cost of Energy Generated, Examples from Energy Generation and Conservation, Elements of Nuclear Power Plant Cost. Cash Flows Covering the Entire Life Cycle, Cost Estimation and Revision Methods Cost of Capital.

Ref. Books:

1. *Energy and the Challenge of Sustainability, World energy assessment, UNDP New York, 2000.*
2. *AKN Reddy, RH Williams, TB Johansson, Energy after Rio, Prospects and challenges, UNDP, United Nations Publications, New York, 1997.*

EE2III-M2 Processing Storage and Disposal of Nuclear Waste

Radioactivity, Radio Nuclides and Types of Radioactive Waste, Sources of Nuclear Waste. Nuclear Decay Law, Short-Lived and Long-Lived Waste Radio Nuclides. Characterization of Radioactive Waste Approaches to Nuclear Waste Management. Pre-Treatment of Radioactive wastes, Techniques of Nuclear Waste Processing. Performance and Safety Assessment Methods,

Radioactive Waste Recycling, Waste Minimization and Immobilization, Contaminants and Hazards. Background Radiation, Nuclear Waste Regulations, Treatment/Immobilization of Solid and Liquid Radioactive Wastes.

Ref. Books:

1. Warren S. Melfort, *Nuclear Waste Disposal: Current Issues and Proposals*, Nova Publishers, 2003.
2. Robert Noyes, *Nuclear Waste Cleanup Technologies and Opportunities*, Elsevier, 1995.
3. M. I. Ojovan, W. E. Lee; *An Introduction to Nuclear Waste Immobilisation*, Elsevier, 2005.

EE2III-M3 Energy and Climate

Energy Terms; Current Energy Scenario (World, US, India) Fossil Energy Vs Renewable Sources; Electricity; Future Projections; Externalities of Energy use. Carbon Cycle: Natural Systems –Autotrophs, Heterotrophs, Energy Flows, Pre-industrial Humanity; Photosynthesis-Efficiency of Natural Ecosystems, Forests and Various Crops; Respiration, Combustion and Other Oxidation Processes; Biomethanation. Climate Science Research: Climate History; Greenhouse Has Effect; Anthropogenic Climate Change; Role of Different Gases; Global Problem; Integrated Assessment Models; Impacts and Adaptation; Uncertainties; Precautionary Principle. Climate Policy: Kyoto Protocol; UNFCCC; IPCC; Geopolitics of GHG Control.

Ref. Books:

1. *Energies*; V Smil, MIT Press, Cambridge, 1999.
2. *Global Warming*; J Houghton, Cambridge University Press, New York, 1997.
3. *IPCC Special Report on Carbon Dioxide Capture and Storage*; B Metz et al (Eds).

EE2III-M4 Nuclear Waste Management

Scientific and Engineering Aspects of Nuclear Waste Management. Management of Spent Fuel, High-Level Waste, Uranium Mill Tailings, low-level waste and Decommissioning Wastes. Fundamental Processes and Governing Equations for the Evaluation of Waste Management Systems with Emphasis on the Safety Assessment of Waste Disposal Facilities. Regulations and Policy Issues.

Ref. Book: *Radioactive Waste Management*, Tang Y S; Saling James H, Hemisphere Publishing Corporation. 1990.

EE2III-M5 HVAC Testing, Adjusting and Balancing (TAB)

Need, Benefits of TAB, TAB Instruments, Standard TAB Procedures, Air Balancing, Hydronic balancing, TAB Reports.

- Ref. Books:** 1) *HVAC Testing, Adjusting and Balancing Manual*, John Gladstone and W. David Bevirt, Tata McGraw – Hill Publishing Co. Ltd.
2) *Testing and Balancing HVAC Air and Water Systems*, Samuel Sugarman, CRC Press.

EE2III-M6 Industrial Burners

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

EE2III-M7 Process Integration

Introduction to Process Intensification and Process Integration (PI). Areas of Application and Techniques available for PI, Onion Diagram. Pinch Technology-an overview: Introduction, Basic

Concepts, How it is Different from Energy Auditing, Roles of Thermodynamic Laws, Problems Addressed by Pinch Technology. Key steps of Pinch Technology: Concept of ΔT_{min} , Data Extraction, Targeting, Designing, Optimization-Super Targeting. Basic Elements of Pinch Technology: Grid Diagram, Composite Curve, Problem Table Algorithm, Grand Composite Curve.

Ref. Books:

1. *Shenoy U. V., Heat Exchanger Network Synthesis: Processes Optimization by Energy and Resource Analysis, Gulf Publishing Company, Houston, 1995.*
2. *Douglas J. M., Conceptual Design of Chemical Processes, McGraw-Hill, New York.*
3. *Mahmoud M. El-Halwagi, Process Integration, Academic Press, 2006.*

EE2III-M8 Modern Sensors

Sensor Characteristics, Types of sensors- Position, displacement, level, velocity, acceleration, force strain, Pressure, Flow, Acoustic, Humidity and moisture, Temperature. Applications, Sensor Material and technologies.

Ref. Books: 1) Handbook of Modern Sensors- physics, Designs and applications, J. Fraden, Springer

EE2III-M9 Cryogenic Engineering

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.*

EE2III-M10 Boilers

Types, Combustion in boilers, Performances evaluation, Analysis of losses, Feed water treatment, Blow down, Energy conservation opportunities, Design for high temperature - Combined cycles with heat recovery boiler – Combined cycles with multi-pressure steam -STAG combined cycle power plant - Influence of component efficiencies on cycle performance

Ref. Books:

- 1) *Guide Books, Bureau of Energy Efficiency.*
- 2) *Boilers and Burners: Design and Theory, Prabir Basu, Kefa Cen, Louis Jestin, Springer.*
- 3) *Process Heat Transfer – Hewitt , Shires & Bott, CRC Press.*

EE2III-M11 Turbulent Jets

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

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

EE2III-M12 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.*

EE1III-M 13 Fluid Sealing Technology

Introduction, Rotary Seals, Reciprocating Seals, Flexible packings, Mechanical seals, Noncontact shaft seals, Static Seals, Bellows and Diaphragms.

Ref. Books: Fluid Sealing Technology – Principles and Applications, H.K. Muller & B.S. Nau, Marcel Dekker Inc.

EE1III-M14 Radiation Measurement Techniques

Background, Geometry, Statistics; Pulse Counting Scalars and Rate Meters; Discriminators; Resolution; Pulse Height Analysis – Coincidence and Anticoincidence; Pulse Shape Analysis; Computer Analysis of Spectra.

Ref. Books:

1. *Glenn F. Knoll, Radiation Detection and Measurement, John Wiley & Sons, 2010.*

2. *Michael Fiederle, Arnold Burger, Larry Franks, Nuclear Radiation Detection Materials– 2011, Materials Research Society, 2012.*

3. *Glenn F. Knoll, Radiation Detection and Measurement, John Wiley & Sons, 2010.*

EE1III-M15 Combustion Applications

Wood Burning Cook stove – Modeling considerations, reference stove specifications, effect of parametric variations, Vertical Shaft Brick Kiln – Modeling assumptions, parametric studies, Gas turbine combustion chamber – Combustor designs.

Ref. Book: Analytic Combustion, Anil W. Date, Cambridge University Press

EE1III- M16 Nuclear Fuel cycle Economics

Fuel Cycle Economics and Fuel Cost Calculation. In-Core and Out-of-Core Nuclear Fuel Management, Engineering Concepts and Methodology.

Ref. Books:

1. *Glenn F. Knoll, Radiation Detection and Measurement, John Wiley & Sons, 2010.*

2. *Michael Fiederle, Arnold Burger, Larry Franks, Nuclear Radiation Detection Materials – 2011, Materials Research Society, 2012.*

EE1III- M17 Radiation Detectors

Gas Filled Detectors Ionization Chambers with Current Measurements; Condenser Chambers;

Pressure Ionization Chamber; Extrapolation Chambers; Proportional Chambers; GM Tubes Scintillation Detectors Solid and Liquid Scintillators; Quenching Semiconductor Detectors Photographic Emulsions Thermoluminescent Detectors Nuclear Track Detectors Neutron Detectors Detectors using (n, λ) or (n,p) Reactions or Activation or Others Imaging Detectors Other Detectors: Electrets; Self-Powered Detectors; Thermally Stimulated Exoelectron Emission (TSEE); Radiophoto Luminescent Detectors (RPLD)

Ref. Books:

1. Glenn F. Knoll, *Radiation Detection and Measurement*, John Wiley & Sons, 2010.
2. Michael Fiederle, Arnold Burger, Larry Franks, *Nuclear Radiation Detection Materials – 2011*, Materials Research Society, 2012.
3. Glenn F. Knoll, *Radiation Detection and Measurement*, John Wiley & Sons, 2010.

EE1III-M18 Radiation Protection Quantities

Radiation Field; Fluence (rate); Energy Fluence (rate); Cross Section; Mass Attenuation Coefficient; Mass stopping Power. Equivalent Dose (rate); Radiation Weighting Factor(WR); Effective Dose, Tissue Weighting Factor (WT); Operational Quantities: Ambient Dose Equivalent; Directional Dose Equivalent; Personal Dose Equivalent; Intake; Committed Dose Lecture Notes. Equivalent Dose (rate); Radiation Weighting Factor (WR); Effective Dose, Tissue Weighting Factor (WT); Operational Quantities: Ambient Dose Equivalent; Directional Dose Equivalent; Personal Dose Equivalent; Intake; Committed Dose Lecture Notes.

Ref. Books:

1. Glenn F. Knoll, *Radiation Detection and Measurement*, John Wiley & Sons, 2010.
2. Michael Fiederle, Arnold Burger, Larry Franks, *Nuclear Radiation Detection Materials-2011*, Materials Research Society, 2012.
3. Glenn F. Knoll, *Radiation Detection and Measurement*, John Wiley & Sons, 2010

DISSERTATION WORK:- I and II [602117, 602119]

CODE	TEACHING SCHEME	EXAMINATION SCHEME					CREDITS
	Lect. /Week	Paper		TW	Oral/ Presentation	Total	
		In Semester Assessment	End Semester Assessment				
602517	8	-	-	50	50	100	4
602518	20	-	-	150	50	200	20

Assessment of Seminar has to be carried out as per R-1.4 and R-1.5 of PG Rules and Regulations of Credit System.

INSTRUCTIONS FOR DISSERTATION WRITING

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

1. Prepare 3 **COPIES** of your manuscript.
2. Limit your Dissertation report to 80 – 120 pages (preferably)
3. The footer
For Energy Engineering
Institute Name, Mechanical (Energy 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. i.e.
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).

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 andwhite**. **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 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 specimen on separate sheet
- ii. **Certificate** from institute as per specimen on separate sheet
- iii. **Acknowledgements**
- 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 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.

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]

Front page and Certificate format for Dissertation:
A Project Stage-I Report 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

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

Institute

Logo

Department of Mechanical Engineering

Name of the Institute

[2011-12] (TNR, 22pt, Title Case Centrally Aligned)

Name of the Institute

Institute

Logo

CERTIFICATE

This is to certify that *Mr. Lele M.M.*, has successfully completed the Project Stage – I entitled “Performance analysis of.....” under my supervision, in the partial fulfillment of Master of Engineering - Mechanical Engineering (Energy Engineering) of University of Pune.

Date :

Place :

Guide's Name
Guide

Head
Department and
Institute Name

External Examiner Seal Principal, Institute Name

A Dissertation 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

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

Institute

Logo

Department of Mechanical Engineering

Name of the Institute

[2011-12](TNR, 22pt, Title Case Centrally Aligned)

Name of the Institute

Institute

Logo

CERTIFICATE

This is to certify that *Mr. Lele M.M.*, has successfully completed the Dissertation entitled “Performance analysis of.....” under my supervision, in the partial fulfillment of Master of Engineering - Mechanical Engineering (Energy Engineering) of University of Pune.

Date :

Place :

Guide's Name
Guide

Head
Department and
Institute Name

External Examiner Seal Principal, Institute Name