**UNIVERSITY OF PUNE, PUNE**

## Structure and Syllabus

**FOR**

# M. E. Mechanical Engineering (Energy Engineering)
# 2013-Course

**UNDER FACULTY OF ENGINEERING**

**EFFECTIVE FROM JULY 2013**

# M.E. Mechanical Engineering (Energy Engineering) – (2013 Course)

## SEMESTER – I

| CODE | SUBJECT | TEACHING SCHEME | EXAMINATION SCHEME | | | | | CREDITS |
|---|---|---|---|---|---|---|---|---|
| | | Lect. / Pr | Paper | | TW | Oral/ Presentation | Total | |
| | | | In Sem. Assessment | End Sem. Assessment | | | | |
| **507101** | Advanced Mathematics and Numerical Methos | 4 | 50 | 50 | - | - | 100 | 4 |
| **502502** | Advanced Thermodynamics | 4 | 50 | 50 | - | - | 100 | 4 |
| **502103** | Advanced Fluid Mechanics | 4 | 50 | 50 | - | - | 100 | 4 |
| **502504** | 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/ Presentation | Total | |
| | | | In Sem. Assessment | End Sem. Assessment | | | | |
| **502107** | Advanced Heat Transfer | 4 | 50 | 50 | - | - | 100 | 4 |
| **502508** | Energy Conversion Systems | 4 | 50 | 50 | - | - | 100 | 4 |
| **502509** | Energy Management | 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 Programmes**

**SEMESTER III**

| CODE | SUBJECT | TEACHING SCHEME | EXAMINATION SCHEME | | | | | CREDITS |
|---|---|---|---|---|---|---|---|---|
| | | Lect./ Pr | Paper | | TW | Oral/ Presentation | Total | |
| | | | In Semester Assessment | End Semester Assessment | | | | |
| **602513** | Nuclear Materials and Reactor Fundamentals | 4 | 50 | 50 | - | - | 100 | 4 |
| **602514** | Energy Systems Modelling and Analysis | 4 | 50 | 50 | - | - | 100 | 4 |
| **602515** | Elective III | 5 | 50 | 50 | - | - | 100 | 5 |
| **602516** | Seminar II | 4 | - | - | 50 | 50 | 100 | 4 |
| **602517** | Project 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** | Project Work Stage II | 20 | - | 150 | 50 | 200 | 20 |
| **Total** | | **25** | **-** | **200** | **100** | **300** | **25** |

**Lab Practice 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.

**PROJECT WORK**:

The project work shall be based on the knowledge acquired by the student during the coursework 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.

**Project Work Stage – I**

Project work Stage – I is the integral part of the project Work. In this, the student shall complete the partial work of the Project that will consist of problem statement, literature review, project overview, scheme of implementation (UML/ERD/block diagram/ PERT chart, etc.) and Layout & Design of the Set-up. The candidate shall deliver a presentation as a part of the progress report of Project work Stage-I, on the advancement in Technology pertaining to the selected dissertation topic.

The student shall submit the progress report of Project work Stage-I in standard format duly certified for satisfactory completion of the work by the concerned guide and head of the department/Institute.

**Project Work Stage - II**

In Project Work Stage – II, the student shall complete the balance part of the Project that will consist of fabrication of set up required for the project, conducting experiments and taking results, analysis & 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.

**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.

# Semester – I
# Advanced Mathematics and Numerical Methods [507101]

| CODE | TEACHING SCHEME | EXAMINATION SCHEME | | | | | CREDITS |
|---|---|---|---|---|---|---|---|
| | Lect/Week | Paper | | TW | Oral/ Presentation | Total | |
| | | In Semester Assessment | End Semester Assessment | | | | |
| 507101 | 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, Bairstow's Method, Convergence and stability

**2. Regression Analysis:**
i) Linear regression, multiple linear regressions, polynomial regression.
ii) Non linear regression – Gauss – Newton method, multiple non linear regression.
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. Non linear 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, Iyangar Jain, New Age International Publishers
6. Numerical methods in Engineering and Science, Dr. B.S. Grewal, Khanna Publishers.


# Semester - I
# 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

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

3. **Laws of thermodynamics**:
   Second law Analysis for Engineering Systems, Entropy flow & Entropy generation, Increase of Entropy Principle, Entropy change of Pure substance, T - ds relations, Entropy generation, Thermo electricity, Onsager Equation. Exergy analysis of Thermal Systems, Decrease of Exergy Principle and Exergy Destruction.

4. **Thermodynamic Property Relations:**
   Partial Differentials, Maxwell relations, Clapeyron equation, general relations for du, dh, ds, and Cv and Cp, Joule Thomson Coefficient, $\Delta h$, $\Delta u$, $\Delta s$ of real gases.

5. **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 Kp of Ideal Gas Mixtures, Fugacity and Activity, Simultaneous Relations, Variation of Kp with Temperature, Phase Equilibrium, Gibb's Phase Rule, Third Law of Thermodynamics, Nerst Heat Theorem and Heat Death of Universe.

6. **Gas Mixtures and Statistical Thermodynamics :**
   Dalton's Law of Partial Pressure, Amagat's Law, Kay's Rule. Fundamentals, Equilibrium Distribution, Significance of Lagrangian Multipliers, Partition Function for Canonical Ensemble, Partition Function for an Ideal Monatomic Gas, Equipartition of Energy, Bose Einstein Statistics, Fermi-Dirac Statistics.

## Exercises/ Assignments for Laboratory Practice (Any four):

1. Computer Aided Energy Analysis of Steady Flow Cyclic System
2. Study of Mixture of Gases, Gas and Vapor, Estimation of Properties and Preparation of charts
3. Analysis of Ideal Gas System using Statistical Thermodynamic Techniques.
4. Study of Behavior of Pure substance with change in Pressure and Temperature
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.)
6. To find the Calorific Value of Fuels (Solid/ liquid/ gaseous)

**Reference Books:**


1. Bejan, Advanced Thermodynamics, John Wiley, Inc.
2. Van Wylen & Sontag: thermodynamics, John Wiley & Sons, Inc., USA
3. Howell & Dedcius: Fundamentals of engineering Thermodynamics, McGraw Hill, Inc, USA.
4. Holman, Thermodynamics, 4th edition, McGraw Hill.
5. Zimmansky & Dittman, Heat and Thermodynamics, 7th edition, TMH.
6. Jones and Hawkings: engineering Thermodynamics, john Wiley & Sons, Inc.USA.
7. Wark, Advanced Thermodynamics, McGraw Hill.
8. Nag P.K., Basic & Applied Thermodynamics, TMH, New Delhi.
9. Jones & Dugan, Advanced Thermodynamics, Prentice Hall Int.
10. Cengel, Thermodynamics, TMH.
11. M. M. El-Wakil: Power Plant Technology, McGraw Hill, 1985.
12. W. Culp Jr: Principles of Energy Conversion, McGraw Hill, 2001.
13. H. A. Sorensen: Energy Conversion Systems, J. Wiley, 1983

# Semester – I

# Advanced Fluid Mechanics [502103]

| CODE | TEACHING SCHEME | EXAMINATION SCHEME | | | | | CREDITS |
|---|---|---|---|---|---|---|---|
| | Lect. /Week | Paper | | TW | Oral/ Presentation | Total | |
| | | In Semester Assessment | End Semester Assessment | | | | |
| 502103 | 4 | 50 | 50 | - | - | 100 | 4 |

**1. Governing Equations:**

**Review of Fluid Mechanics: -** Definition and properties of Fluids, Fluid as continuum, Continuum model, Flow kinematics:- Langragian 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-ε), 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 Chaim Gutfinger, Cambridge Press

# Semester - I
# Research Methodology [502504]

| CODE | TEACHING SCHEME | EXAMINATION SCHEME | | | | | CREDITS |
|---|---|---|---|---|---|---|---|
| | Lect/Week | Paper | | TW | Oral/ Presentation | Total | |
| | | In Semester Assessment | End Semester Assessment | | | | |
| 502504 | 4 | 50 | 50 | - | - | 100 | 4 |

**1. Research Problem:**

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

**2. 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 is collected data contains noise.

**3. Applied statistics:**

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

**4. Modeling and prediction of performance:**

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.

**5. Developing a Research Proposal:**

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. 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

# Semester - I 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) | | | |
|---|---|---|---|
| **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. Books: 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. Books: Guide Books, Bureau of Energy Efficiency***

**ME2I – M3 Financial Costing**

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

***Ref. Books: 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. Books: 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. Books: 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. Books: 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. Books: 1) Gerard H. Gaynor, Hand Book of Technology Management, Mc Graw 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. Books: 1) Gerard H. Gaynor, Hand Book of Technology Management, Mc Graw 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. Books: 1) Satyawrat Ponkshe, The Management of Intellectual Property, by, Ponkshe & Bhate Publications, Pune.***

# Semester – I
# 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 [502107]

| CODE | TEACHING SCHEME | EXAMINATION SCHEME | | | | | CREDITS |
|---|---|---|---|---|---|---|---|
| | Lect/Week | Paper | | TW | Oral/ Presentation | Total | |
| | | In Semester Assessment | End Semester Assessment | | | | |
| 502107 | 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. **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

5. **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.

6. **Boiling and Condensation:**
   Boiling modes, the boiling curve, modes of pool boiling, correlations. 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

**7. 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 Mc Graw Hill.
3. Heat transfer - A basic approach, M.N. Ozisik, Mc Graw Hill Int.
4. Convective Heat transfer, A Bejan, John Wiley and sons.
5. Heat transfer, J.P. Holman, Mc Graw Hill
6. Heat transfer, S.P. Sukhatme, University Press

# Semester - II
# Energy Conversion Systems [502508]

| CODE | TEACHING SCHEME | EXAMINATION SCHEME | | | | | CREDITS |
|---|---|---|---|---|---|---|---|
| | Lect/Week | Paper | | TW | Oral/ Presentation | Total | |
| | | In Semester Assessment | End Semester Assessment | | | | |
| 502508 | 4 | 50 | 50 | - | - | 100 | 4 |

1. **Introduction:**
   Classification of Energy SourcesClassification of Energy Sources, Principle Fuels for Energy Conversion: Fossil Fuels, Nuclear Fuels. Conventional & Renewable Energy, Energy Sources: Prospecting, Extraction and Resource Assessment and their Peculiar Characteristics. Direct use of Primary Energy Sources, Conversion of Primary into Secondary Energy Sources such as Electricity, Hydrogen, Nuclear energy etc.Energy Conversion through Fission and Fusion, Nuclear Power Generation etc.

2. **Thermal and Mechanical Energy:**
   Conversion of Thermal Energy to Mechanical energy & Power. Steam Turbines, Hydraulic Turbines, Gas Turbine Combined Cycle Analysis – Inter- cooling, Reheating and Regeneration-Gas Turbine Cooling.
   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. **Thermal and Mechanical Energy Utility systems:**
   Boilers -Types, Combustion in Boilers, Performance Evaluation, Analysis of Losses, Feed Water Treatment, Blow down. FBC Boilers: Introduction, Mechanism of Fluidized Bed Combustion, Advantages,Types of FBC Boilers, Operational Features, Retrofitting FBC system to Conventional Boilers, Refrigeration and Air Conditioning: Vapor Compressor Refrigeration Cycle, Refrigerants, Coefficient of Performance, Capacity, Factors Affecting Refrigeration and Air Conditioning System Performance, Vapor Absorption Refrigeration Systems: Working principle, Type and Comparison with Vapor Compressor System.

4. **Co-generation, Tri-generation & Waste Energy Recovery:**
   Co-generation & Tri-generation: Definition, Need, Application, Advantages, Classification, Saving Potential.
   **Waste Heat Recovery:** Concept of Conversion Efficiency, Energy Waste, Waste Heat Recovery Classification, Advantages and Applications, Commercially Viable Waste Heat Recovery Devices.

5. **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.

**6. 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.

**Assignments/ Lab work (Any Four):**

1. Study of Energy Sources
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

**References:**


1. Principles of Energy Conversion : A.W.Culp ( McGraw-Hill International)
2. Industrial Furnaces (Vol I & II) and M.H. Mawhinney, (John Wiley Publications).
3. Refractories – F.H. Nortan,(John Wiley Publication)
4. Domestic and Commercial Oil Burners Charles H. Burkhadt ( McGraw Hill Publication)
5. Boilers – Types, Characteristics and Functions – Carl D. Shields (McGraw Hill book )
6. Principles of Refrigeration R.J. Dossat (Wiley Estern Limited.)
7. Stoichiometry – Bhatt, Vora ( Tata McGraw Hill)
8. Practical Heat Recovery – Boyen J.L. (John Wiley, New York, USA1976)
9. Instrument Engineers Handbook ( VolI,II,III)– B.G. Liptak Chintan Book Comp / CRC Publication
10. Analysis and Design of Energy Systems - Hogde B.K. (Prentice Hall, 1988)
11. Energy Management and Control System – Vol-I, II –M.C. Macedo (John Wiley)
12. Energy Conservation Guide book Patrick / Fardo (Prentice Hall1993)
13. Books, Bureau of Energy Efficiency.

# Semester - II
# Energy Management [502509]

| CODE | TEACHING SCHEME | EXAMINATION SCHEME | | | | | CREDITS |
|---|---|---|---|---|---|---|---|
| | Lect/Week | Paper | | TW | Oral/ Presentation | Total | |
| | | In Semester Assessment | End Semester Assessment | | | | |
| 502509 | 4 | 50 | 50 | - | - | 100 | 4 |

1. **Introduction:**
   Importance of Energy Management Need of Energy Management and Scope of Energy Management.
2. **Energy auditing:**
   Methodology, Analysis of Past Trends (Plant Data), Closing the Energy Balance, Laws of Thermodynamics, Measurements, Portable and On Line Instruments.

3. **Steam Systems:**
   Boiler – Efficiency Testing, Excess Air Control, Steam Distribution & Use - Steam Traps, Condensate Recovery, Flash Steam Utilization, Thermal Insulation.

4. **Electrical Systems:**
   Demand Control, Power Factor Correction, Load Scheduling/Shifting, Motor Drives-Motor Efficiency Testing, Energy Efficient Motors, Motor Speed Control, Lighting - Lighting Levels, Efficient Options, Fixtures, day Lighting, Timers, Energy Efficient Windows. Energy Conservation in Pumps, Fans (Flow Control), Compressed Air Systems, Refrigeration & Air Conditioning Systems.

5. **Waste heat recovery:**
   Recuperators, Regenerators, Heat Pipes, Heat Pumps, Cogeneration - Concept, Options (Steam/Gas Turbines/Diesel Engine based), Selection Criteria, Control Strategy. Heat Exchanger Networking - Concept of Pinch, Target Setting, Problem Table Approach, Composite Curves, Demand Side Management.

6. **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.

**Assignments/ Lab Work (Any Four):**

1. Wind Power and Annual Energy Estimation from Wind Data.
2. Energy Audit of Small Scale Industry.
3. Pay back Analysis, Financial Work sheet of a Renewable Energy Project.
4. Study of Waste Heat Recovery System
5. Determination of COP of Cooling Towers.
6. Nuclear Techniques in Environmental Studies.

**References:**

1. Industrial Energy Conservation Manuals, MIT Press, Mass, 1982.
2. I.G.C.Dryden, Butterworths, The Efficient Use of Energy, London, 1982
3. W.C.Turner, Wiley, Energy Management Handbook, New York, 1982.
4. Technology Menu for Efficient energy use- Motor drive systems, Prepared by National Productivity Council and Center for & Environmental Studies- Princeton Univ 1993.

# Semester – II
# Elective – II [502510]

| CODE | TEACHING SCHEME | EXAMINATION SCHEME | | | | | CREDITS |
|---|---|---|---|---|---|---|---|
| | Lect. /Week | Paper | | TW | Oral/ Presentation | Total | |
| | | In Semester Assessment | End Semester Assessment | | | | |
| 502510 | 5 | 50 | 50 | - | - | 100 | 5 |

| Modules of 2 Credits (Select any Two) | | | |
|---|---|---|---|
| **Code No.** | **Title** | **Code No.** | **Title** |
| **EE2II-M1** | Process Optimization | **EE2II-M7** | Biomass Technology |
| **EE2II-M2** | Design of Feedback Controllers | **EE2II-M8** | Geothermal Technology |
| **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 Energy | **EE2II-M11** | Radiation Safety and Shielding |
| **EE2II-M6** | Wind Energy | **EE2II-M12** | Nano materials |
| **Modules of 1 Credit (Select any One)** | | | |
| **Code No.** | **Title** | **Code No.** | **Title** |
| **EE1II-M13** | Nuclear Plant operation | **EE1II-M16** | Alternative Fuels for I.C. Engines |
| **EE1II-M14** | Energy Regulatory Frameworks | **EE1II-M17** | Electromechanical and Reactor Systems |
| **EE1II-M15** | Microfluidics | **EE1II-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, Aue Books, New Delhi in India and CRC Press in the rest of the world.***
2. ***Design and Optimization of Thermal Systems,Y .Jaluria, Mc Graw Hill,***
3. ***Introduction to Optimum Design, J.S.Arora, Mc Graw Hill***
4.

**E2II-M2 Design of Feedback Controllers**

Response Characteristics of Dynamic Systems, System Transfer Function, Various Controls 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: Reactor systems 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 Energy**

The Solar spectrum, Semiconductors, p-n junction, Solar photocells, Efficiency of solar cells, Commercial solar cells, Solar panels, economics of photovoltaic, environmental impact of photovoltaic, Solar thermal power plants

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

**EE2II-M6 Wind energy**

Source of wind energy, Global wind patterns, Principles of wind turbine, Modern wind turbines, Wind turbine blade design, Turbine control and operation, Power output of wind turbine, environmental impact and public acceptance, Economics of wind power

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

**EE2II-M7 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***

**EE2II-M8 Geothermal Technology**

Resources of Geothermal Energy, Hydrothermal resources, Hot dry rock resource, High enthalpy Geothermal Aquifers, Low enthalpy reserves, Wet and dry steam systems. Comparison with conventional plant, Advantages and disadvantages/limitations, Materials for Geothermal plants, Environmental problems

***Ref. Books: 1) Renewable Energy Sources, Tasneem Abbasi, S.A.Abbasi, PHI, 2) Non Conventional Energy Resources, G.S. Sawhney, PHI, 3)Renewable energy Resources –John Twidell and Tony Weir, Taylor & Francis***

**EE2II-M9 Fluidized Bed Technology**

Principal of Fluidized bed combustion, Advantages of fluidized bed combustion, Circulati ng 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. Books:1) Prabir Basu, Combustion and gasification in Fluidized bed, CRC press, Taylor and Francis, 2) 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.***

**EE2III-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.***

**EE1II-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***

**EE1II-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)

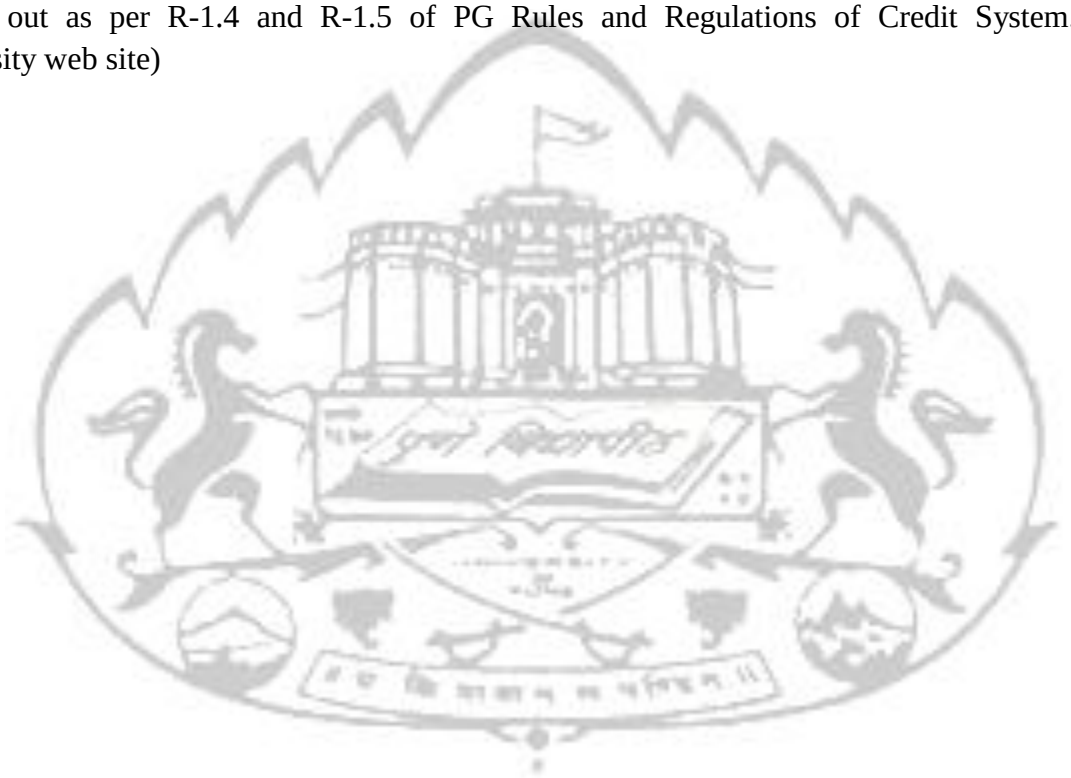
Basic Principle, Benefits, Criteria for TES Evaluation, TES Market Considerations, TES Heating and Cooling Applications, TES Operating Characteristics, ASHRAE TES Standards, Sensible and Latent TES, Energy Conservation with TES: Planning and Implementation, Recent Advances in TES Methods

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

# Semester – II
# Lab. Practice – II [502511]

| CODE | TEACHING SCHEME | EXAMINATION SCHEME | | | | | CREDITS |
|---|---|---|---|---|---|---|---|
| | Lect. /Week | Paper | | TW | Oral/ Presentation | Total | |
| | | In Semester Assessment | End Semester Assessment | | | | |
| 502511 | 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 | EXAMINATION SCHEME | | | | | CREDITS |
|---|---|---|---|---|---|---|---|
| | Lect. /Week | Paper | | TW | Oral/ Presentation | Total | |
| | | In Semester Assessment | End Semester Assessment | | | | |
| 502512 | 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 Heat Power Engineering
   Institute Name, Mechanical (Heat Power Engineering) Times New Roman 10 pt. and centrally alined.
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 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

Logo

Department of Mechanical Engineering

Name of the Institute

[2013-14](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. 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
# Nuclear Materials and Reactor Fundamentals [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. Nuclear Materials I:**
Introduction to Properties and Selection of Materials for Nuclear Steam Supply Systems and Radiation Effects on Materials, Implications of Radiation Damage to Reactor Materials and Materials Problems in Nuclear Engineering.

**2. Nuclear Materials II:**
Overview of Nuclear Steam Supply Systems, Crystal Structure and Defects, Dislocation Theory, Mechanical Properties, Radiation Damage, Hardening and Embrittlement due to Radiation Exposure, Problems concerned with Fission and Fusion materials.

**3. Radiation and reactor fundamentals:**
Basics of Nuclear Physics and Reactor Physics. Atomic and Nuclear Models, Nuclear Reactions, Nuclear Fission, Radioactive Decay, Neutron Interactions.

**4. Nuclear Reactors:**
Nuclear Reactors, Neutron Diffusion in On-Multiplying and Multiplying Systems, and Basic Nuclear Reactor Kinetics.

**5. Nuclear Fuel cycle:**
Processing of Nuclear Fuel with Description of Mining, Milling, Conversion, Enrichment, Fabrication, Irradiation, Shipping, Reprocessing and Waste Disposal.

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

**Assignments/ Lab Work(Any Four) :**

1. Study of Nuclear Materials
2. Study Fission and Fusion of Nuclear Reactions
3. Study of Nuclear Radiations and their Impact on Environment
4. Study of Processing of Nuclear Fuels
5. Study of Nuclear Fuel Cycle
6. Economic Analysis of Nuclear Fuel

**Reference Books:**

1. Nuclear Reactor Engineering, vol. 1 & 2, by GLASSTONE SAMUEL; SESONSKE ALEXANDER, 2010.
2. DOE Fundamentals Handbook Nuclear Physics and Reactor Theory FSC-6910 (Volume 1 and by department of energy (DOE), USA, 2010.

3. M. M. El-Wakil: Nuclear Power Engineering, McGraw Hill, 1962.
4. R. H. S. Winterton: Thermal Design of Nuclear Reactors, Pergamon Press, 1981.
5. R. L. Murray: Introduction to Nuclear Engineering, Prentice Hall, 1961.
6. Olander, Donald R., "Fundamental Aspects of Nuclear Reactor Fuel Elements," ID-26711-P1, Technical Information Center, Springfield, Virginia, March 1985.
7. Smith, Charles, O., "Nuclear Reactor Materials," Addison-Wesley, Reading, MA, 1967.

# Semester - III
# Energy systems modeling and Analysis [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 and modeling:**
   System Concept: Systems and system environment, Components of a system, Discrete and continuous systems, Systems approach to problem solving, Types of system study, System analysis, system design and system postulation.

2. **System modeling:**
   Types of models-Analog Models, Mathematical models, Physical Models, Numerical Models, Interaction Between models. curve fitting exact Fit and best fit, Least square regression - theory, examples from linear regression with one and more unknowns - examples.

3. **System Simulation:**
   System Simulation: Technique of simulation, Comparison of simulation and analytical methods, Types of system simulation, Steps in simulation study, Monte Carlo simulation.

4. **Optimization I:**
   Introduction Formulation of optimization problems – examples, linear programming – two variable problem –graphical solution, Simplex tableau, sensitivity analysis, Geometric programming – examples. Dynamic programming Calculus techniques – Lagrange multiplier method – proof, examples.

5. **Search 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 Method of steepest ascent/ steepest descent, conjugate gradient method –examples.

6. **Applications and case studies:**
   Econometric Energy Demand Modeling - Overview of Econometric Methods, Case studies of optimization in Energy systems problems- Dealing with uncertainty probabilistic techniques –Trade-offs between capital and energy using Pinch analysis.

**Assignments/ Lab Work (Any Three) :**

1. Case Studies of Optimization in Energy Systems Problems
2. Case Study of Sensitivity Analysis
3. Study of Energy- Economy Models
4. Assignment on Quantitative Techniques
5. Assignment on Linear Programming.

**Reference Books:**

1. W. F. Stoecker Design of Thermal Systems, Mc Graw Hill, 1981.
2. S.S. Rao Optimisation Theory and Applications, Wiley Eastern, 1990.
3. yogesh jaluriya design and optimization of thermal systems, CRC press 2007
4. P. Meier Energy Systems Analysis for Developing Countries, Springer Verlag, 1984.
5. R de Neufville Applied Systems Analysis Mcgraw Hill International Edition 1990
6. Beveridge and Schechter,Optimisation Theory and Practice, Mcgraw Hill, 1970.

# Semester - III
# Elective – III [602515]

| CODE | TEACHING SCHEME | EXAMINATION SCHEME | | | | | CREDITS |
|---|---|---|---|---|---|---|---|
| | Lect. /Week | Paper | | TW | Oral/ Presentation | Total | |
| | | In Semester Assessment | End Semester Assessment | | | | |
| **602515** | 5 | 50 | 50 | - | - | 100 | 5 |

| **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** | Waste Heat Recovery and Cogeneration | **EE2III-M10** | Boilers |
| **EE2III-M5** | HVAC Testing, Adjusting and Balancing (TAB) | **EE2III-M11** | Turbulent Jets |
| **EE2III-M6** | Fuel Burning Devices | **EE2III-M12** | Adsorption Technology |
| **Modules of 1 Credit (Select any One)** | | | |
| **Code No.** | **Title** | **Code No.** | **Title** |
| **EE1III-M13** | Fluid Sealing Technology | **EE1III-M16** | Nuclear Fuel cycle Economics |
| **EE1III-M14** | Radiation Measurement Techniques | **EE1III-M17** | Radiation Detectors |
| **EE1III-M15** | Combustion Applications | **EE1III-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 Waste Heat Recovery and Cogeneration**

Waste Heat Recovery: Classification, Advantages and applications, commercially viable waste heat recovery devices, Saving potential
Cogeneration: Definition, Need, Application, Advantages, Classification, Saving potentials

***Ref. Books: Guide Books, Bureau of Energy Efficiency***

**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 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.***

**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 ΔTmin, 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**

Senor 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 efficienc y,

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

***Ref. Books: 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.***

# Project Stage – I and II [602117, 602119]

| CODE | TEACHING SCHEME | EXAMINATION SCHEME | | | | | CREDITS |
|---|---|---|---|---|---|---|---|
| | Lect. /Week | Paper | | TW | Oral/ Presentation | Total | |
| | | In Semester Assessment | End Semester Assessment | | | | |
| 602117 | 8 | - | - | 50 | 50 | 100 | 4 |
| 602119 | 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).
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 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

## C E R T I F I C A T E

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

## C E R T I F I C A T E

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