Department of Mechanical Engineering
VBS Purvanchal University, Jaunpur

STUDY & EVALUATION
SCHEME WITH SYLLABUS

FOR

M. TECH. Thermal Engineering

MECHANICAL ENGINEERING

[Effective from Session: 2019-20]

M. Tech. Mechanical Engineering

Specialization: Thermal Engineering

Thermodynamics and Combustion

Subject Code: MEMTTE101

Teaching Scheme

Lectures: 3 hrs/week

Syllabus Contents:

- First law and State postulates, Second law and Entropy, Availability and Irreversibility, Transient flow analysis
- Nonreactive Ideal-Gas Mixture, PvT Behavior of Real gases and Real Gas mixture
- Generalized Thermodynamic Relationship
- Combustion and Thermo-chemistry, Second law analysis of reacting mixture, Availability analysis of reacting mixture,Chemical equilibrium
- Statistical thermodynamics, statistical interpretations of first and second law and Entropy,
- Third law of thermodynamics, Nerst heat theorem.

References:

1. Cengel, “Thermodynamics”, Tata McGraw Hill Co., New Delhi, 1980.
2. Howell and Dedcius, “Fundamentals of Engineering Thermodynamics”, McGraw Hill Inc., U.S.A.
3. Van Wylen& Sonntag, “Thermodynamics”, John Wiley and Sons Inc., U.S.A.
4. Jones and Hawkings, “Engineering Thermodynamics”, John Wiley and Sons Inc., U.S.A, 2004.
5. Holman, “Thermodynamics”, McGraw Hill Inc., New York, 2002.
6. Faires V.M. and Simmag, “Thermodynamics”, Macmillan Publishing Co. Inc., U.S.A.
7. Rao Y.V.C., “Postulational and Statistical Thermodynamics”, Allied Publishers Inc, 1994.

Advanced Fluid Dynamics

Subject Code: MEMTTE102

Teaching Scheme

Lectures: 3 hrs/week

Syllabus Contents:

- Governing equations in Fluid Dynamics: Derivation of Continuity and Momentum equations using integral and differential approach, dimensionless form of governing equations, special forms of governing equations, integral quantities
- Exact Solutions of Navier-Stokes Equations: Fully developed flows, parallel flow in straight channel, Couette flow, Creeping flows
- Potential Flow: Kelvin's theorem, Irrotational flow, Stream function-vorticity approach,
- Laminar Boundary layers: Boundary layer equations, flow over flat plate, Momentum integral equation for boundary layer, approximate solution methodology for boundary layer equations
- Turbulent Flow: Characteristics of turbulent flow, laminar turbulent transition, time mean motion and fluctuations, derivation of governing equations for turbulent flow, shear stress models, universal velocity distribution
- Experimental Techniques: Role of experiments in fluid, layout of fluid flow experiments, sources of error in experiments, data analysis, design of experiments, review of probes and transducers, Introduction to Hot wire Anemometry, Laser Doppler Velocimetry and Particle Image Velocimetry

References:

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

Energy Conservation and Management

Subject Code: MEMTTE103

Teaching Scheme

Lectures: 3 hrs/week

Syllabus Contents:

- The energy market, energy scenario, planning, utilization pattern and future strategy, Importance of energy management.
- Energy auditing- methodology and analysis,
- Energy economics,
- Energy conservation in industries, Cogeneration, Combined heating and power systems,
- Relevant international standards and laws.

References:

1. L.C. Witte, P.S. Schmidt, D.R.Brown, “Industrial Energy Management and Utilization”, Hemispherical Publication, 1988.
2. Callaghan “Energy Conservation”.
3. D.A. Reeg, “Industrial Energy Conservation”, Pergamon Press, 1980.
4. T.L. Boyen, “Thermal Energy Recovery” Wiley, 1980.
5. L.J. Nagrath, “Systems Modeling and Analysis”, Tata McGraw Hill, 1982.
6. W.C. Turner, “Energy Management Handbook “, Wiley, New York, 1982.
7. I.G.C. Dryden, “The Efficient Use of Energy “, Butterworth, London, 1982.
8. R. Loftnen, Van Nostrarid Reinhold C. “Energy Handbook”, 1978.
9. TERI Publications.

Gas Turbines

Subject Code: MEMTTE104

Teaching Scheme

Lectures: 3 hrs/week

Syllabus Contents:

- Introduction, Cycles, Performance characteristics and improvement,
- Gas dynamics, Centrifugal, axial and mixed flow compressor, principles and characteristics, Turbine construction, Blade materials, manufacturing techniques, blade fixing,
- Problems of high temperature operation, blade cooling, practical air cooled blades Combustion Systems, various fuels and fuel systems,
- Jet propulsion cycles and their analysis, parameters affecting performance, thrust augmentation, environmental considerations and applications

References:

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

Thermal Engineering Lab Practice – I

Subject Code: MEMTTE105

Teaching Scheme
Practical: 4 hrs/week

Syllabus Contents:
- The lab practice consists of the tutorials and experiments as decided by the course supervisors of the Program Core Courses (PCC) namely Fluid Dynamics, Advanced Heat Transfer, Thermodynamics and Combustion, Refrigeration and Cryogenics.

Thermal Engineering Lab Practice – II

Subject Code: MEMTTE106

Teaching Scheme
Practical: 4 hrs/week

Syllabus Contents:
- The lab practice consists of the tutorials and experiments as decided by the course supervisors of the Program Core Courses (PCC) namely Fluid Dynamics, Advanced Heat Transfer, Thermodynamics and Combustion, Refrigeration and Cryogenics.

Research Methodology and IPR

Subject Code: MEMTTE107

Teaching Scheme

Lectures: 1hrs/week

Syllabus Contents:

Unit 1: Meaning of research problem, Sources of research problem, Criteria Characteristics of a good research problem, Errors in selecting a research problem, Scope and objectives of research problem.

Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, Necessary instrumentations

Unit 2: Effective literature studies approaches, analysis

Plagiarism, Research ethics,

Unit 3: Effective technical writing, how to write report, Paper

Developing a Research Proposal, Format of research proposal, a presentation and assessment by a review committee

Unit 4: Nature of Intellectual Property: Patents, Designs, Trade and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development. International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, Patenting under PCT.

Unit 5: Patent Rights: Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications.

Unit 6: New Developments in IPR: Administration of Patent System. New developments in IPR; IPR of Biological Systems, Computer Software etc. Traditional knowledge Case Studies, IPR and IITs.

References:

- Stuart Melville and Wayne Goddard, “Research methodology: an introduction for science & engineering students’”
- Wayne Goddard and Stuart Melville, “Research Methodology: An Introduction”
- Ranjit Kumar, 2 nd Edition, “Research Methodology: A Step by Step Guide for beginners”
- Halbert, “Resisting Intellectual Property”, Taylor & Francis Ltd ,2007.
- Mayall , “Industrial Design”, McGraw Hill, 1992.
- Niebel , “Product Design”, McGraw Hill, 1974

AUDIT 1: ENGLISH FOR RESEARCH PAPER WRITING

Subject Code: MEMTTE-A01

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

Suggested Studies:

1. Goldbort R (2006) Writing for Science, Yale University Press (available on Google Books)
2. Day R (2006) How to Write and Publish a Scientific Paper, Cambridge University Press
3. Highman N (1998), Handbook of Writing for the Mathematical Sciences, SIAM. Highman's book .
4. Adrian Wallwork , English for Writing Research Papers, Springer New York Dordrecht Heidelberg London, 2011

Advanced Heat Transfer

Subject Code: MEMTTE201

Teaching Scheme

Lectures: 3 hrs/week

Syllabus Contents:

- Conduction- one and two dimensional,
- Fins, conduction with heat source, unsteady state heat transfer,
- Natural and forced convection, integral equation, analysis and analogies,
- Transpiration cooling, ablation heat transfer, boiling, condensation and two phase flow mass transfer, cooling, fluidized bed combustion,
- Heat pipes, Radiation, shape factor, analogy, shields,
- Radiation of gases &vapours

References:

1. J.P. Holman, “Heat Transfer”, McGraw Hill Book Company, New York, 1990.
2. Incropera and Dewitt, “Fundamentals of Heat and Mass Transfer”, John Wiley and Sons, NewYork, 2000.
3. Frank Kreith, “Principles of Heat Transfer”, Harper and Row Publishers, New York, 1973.
4. Donald Q. Kern “Process Heat Transfer”, Tata McGraw Hill Publishing Company Ltd., New Delhi, 1975.
5. Gupta and Prakash, “Engineering Heat Transfer”, New Chand and Bros, Roorkee (U.P.) India, 1996.
6. R.C. Sachdeva “Fundamentals of Engineering Heat and Mass Transfer”, Wiley Eastern Ltd., India,

Steam Engineering

Subject Code: MEMTTE202

Teaching Scheme

Lectures: 3 hrs/week

Syllabus Contents:

- Introduction : Fundamentals of steam generation, Quality of steam, Use of steam table, Mollier Chart Boilers ,Types, Mountings and Accessories, Combustion in boilers, Determination of adiabatic flame temperature, quantity of flue gases, Feed Water and its quality, Blow down; IBR, Boiler standards
- Piping & Insulation :Water Line, Steam line design and insulation; Insulation-types and application, Economic thickness of insulation, Heat savings and application criteria, Refractory-types, selection and application of refractory, Heat loss.
- Steam Systems :Assessment of steam distribution losses, Steam leakages, Steam trapping, Condensate and flash steam recovery system, Steam Engineering Practices; Steam Based Equipments / Systems.
- Boiler Performance Assessment :Performance Test codes and procedure, Boiler Efficiency, Analysis of losses; performance evaluation of accessories; factors affecting boiler performance.
- Energy Conservation and Waste Minimization :Energy conservation options in Boiler; waste minimization, methodology; economicalviability of waste minimization
- Instrumentation & Control : Process instrumentation; control and monitoring. Flow, pressure and temperature measuring and controlling instruments, its selection

References:

1. T. D. Estop, A. McConkey, Applied Thermodynamics, Parson Publication
2. Domkundwar; A Course in Power Plant Engineering; Dhanapat Rai and Sons
3. Yunus A. Cengel and Boles, “Engineering Thermodynamics “,Tata McGraw-Hill Publishing Co. Ltd
4. Book II - Energy Efficiency in Thermal Utilities; Bureau of Energy Efficiency
5. Book IV - Energy Performance Assessment for Equipment & Utility Systems; Bureau of Energy Efficiency
6. Edited by J. B. Kitto& S C Stultz; Steam: Its Generation and Use; The Babcock and Wilcox Company

Refrigeration and Cryogenics

Subject Code: MEMTTE203

Teaching Scheme

Lectures: 3 hrs/week, Tutorial:1hr/week

Syllabus Contents:

- Vapour compression refrigeration, actual cycle, second law efficiency,
- Multistage compression with inter-cooling, Multi-evaporator systems, Cascade systems,
- Performance characteristics and capacity control of reciprocating and centrifugal compressors, screw compressor and scroll compressor,
- Design, selection of evaporators, condensers, control systems, motor selection,
- Refrigerants, alternative refrigerants, CFC/HCFC phase-out regulations,
- Refrigeration applications, food preservation, transport,
- Introduction to Vapor absorption refrigeration, single effect and double effect systems,
- Gas liquefaction systems - Linde-Hampson, Linde dual pressure, Claude cycle

References:

1. R.J.Dossat, "Principles of Refrigeration", Pearson Education Asia, 2001.
2. C.P.Arora, "Refrigeration and Air-conditioning", Tata McGraw-Hill, 2000.
3. Stoecker& Jones, "Refrigeration and Air-conditioning", McGraw Hill Book Company, New York, 1982.
4. Jordan &Priester, "Refrigeration and Air-conditioning".
5. A.R.Trott, "Refrigeration and Air-conditioning", Butterworths, 2000.
6. J.L.Threlkeld, "Thermal Environmental Engineering", Prentice Hall, 1970.
7. R.Barron, "Cryogenic systems", McGraw–Hill Company, New Yourk, 1985.
8. G.G.Hasseldon. "Cryogenic Fundamentals", Academic Press.
9. Bailey, "Advanced Cryogenics", Plenum Press, London, 1971.
10. W.F.Stoecker, "Industrial Refrigeration Handbook", McGraw-Hill, 1998.
11. John A.Corinchock, "Technician's Guide to Refrigeration systems", McGrawHill.
12. P.C.Koelet, "Industrial Refrigeration: Principles, Design and Applications", Macmillan, 1992.
13. ASHRAE HANDBOOKS (i) Fundamentals (ii) Refrigeration.
14. Graham Walker, "Miniature Refrigerators for Cryogenic Sensors and Cold Electronics", Clarendon Press, 1989

Computational Fluid Dynamics

Subject Code: MEMTTE204

Teaching Scheme

Lectures: 3 hrs/week, Tutorial :1hr/week

Syllabus Contents:

- **Introduction to CFD:** Computational approach to Fluid Dynamics and its comparison with experimental and analytical methods, Basics of PDE: Elliptic, Parabolic and Hyperbolic Equations.
- **Governing Equations:** Review of Navier-Stokes Equation and simplified forms, Solution Methodology: FDM and FVM with special emphasis on FVM, Stability, Convergence and Accuracy.
- **Finite Volume Method:** Domain discretization, types of mesh and quality of mesh, SIMPLE, pressure velocity coupling, Checkerboard pressure field and staggered grid approach
- **Geometry Modeling and Grid Generation:** Practical aspects of computational modeling of flow domains, Grid Generation, Types of mesh and selection criteria, Mesh quality, Key parameters and their importance
- **Methodology of CFDHT:** Objectives and importance of CFDHT, CFDHT for Diffusion Equation, Convection Equation and Convection-Diffusion Equation
- **Solution of N-S Equations for Incompressible Flows:** Semi-Explicit and Semi-Implicit Algorithms for Staggered Grid System and Non Staggered Grid System of N-S Equations for Incompressible Flows

References:

1. Computational Fluid Dynamics, The Basic with applications by John A. Anderson, Jr., McGraw Hill International editions, Mechanical Engineering series.
2. Numerical Methods in Fluid Flow & Heat Transfer by Dr. SuhasPatankar.
3. An Introduction to Computational Fluid Flow (Finite Volume Method), by H.K. Versteeg, W.Malalasekera, Printice Hall
4. Computational Methods for Fluid Dynamics by Ferziger and Peric, Springer Publication.
5. An Introduction to Computational Fluid Mechanics by Chuen-Yen Chow, Wiley Publication.
6. Computational Fluid Flow & Heat Transfer by Murlidhar and Sundarrajan, Narosa Publication

Thermal Engineering Lab Practice III

Subject Code: MEMTTE205

Teaching Scheme
Practical: 4 hrs/week

Syllabus Contents:
- The lab practice consists of the tutorials and experiments as decided by the course supervisors of the Program Core Courses (PCC) namely Design of Heat Exchangers and Computational Fluid Dynamics, Modelling of I C Engine.

Thermal Engineering Lab Practice IV

Subject Code: MEMTTE206

Teaching Scheme
Practical: 4 hrs/week

Syllabus Contents:
- The lab practice consists of the tutorials and experiments as decided by the course supervisors of the Program Core Courses (PCC) namely Design of Heat Exchangers and Computational Fluid Dynamics, Modelling of I C Engine.

AUDIT 2: VALUE EDUCATION

Subject Code: MEMTTE-A02

Syllabus

Unit	*Content*	*Hours*
1	• Values and self-development –Social values and individual attitudes. Work ethics, Indian vision of humanism. • Moral and non- moral valuation. Standards and principles. • Value judgements	4
2	• Importance of cultivation of values. • Sense of duty. Devotion, Self-reliance. Confidence, Concentration. Truthfulness, Cleanliness. • Honesty, Humanity. Power of faith, National Unity. •Patriotism.Love for nature ,Discipline	6
3	• Personality and Behavior Development - Soul and Scientific attitude. Positive Thinking. Integrity and discipline. • Punctuality, Love and Kindness. • Avoid fault Thinking. • Free from anger, Dignity of labour. • Universal brotherhood and religious tolerance. • True friendship. • Happiness Vs suffering, love for truth. • Aware of self-destructive habits. • Association and Cooperation. • Doing best for saving nature	6
4	• Character and Competence –Holy books vs Blind faith. • Self-management and Good health. • Science of reincarnation. • Equality, Nonviolence ,Humility, Role of Women. • All religions and same message. • Mind your Mind, Self-control. • Honesty, Studying effectively	6

Suggested reading

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

Mini project

Subject Code: MEMTTE207

Teaching Scheme

Lectures: 2 hrs/week

Syllabus Contents:

- Students can take up small problems in the field of design engineering as mini project. It can be related to solution to an engineering problem, verification and analysis of experimental data available, conducting experiments on various engineering subjects, material characterization, studying a software tool for the solution of an engineering problem etc.

Design of Solar and Wind Systems

Subject Code: MEMTTE301

Teaching Scheme

Lectures: 3 hrs/week

Syllabus Contents:

- Conventional sources of energy, Nuclear, Alternative energy sources,
- Solar Radiation-estimation, prediction & measurement, Solar energy utilization,
- Performance of Solar flat plate collectors, concentrating collectors, thermal storage,
- Wind energy, Direct Energy conversion- PV, MHD,
- Fuel cells, thermionic, thermoelectric, Biomass, biogas, hydrogen, Geothermal

References:

1. D.Y. Goswami, F. Kreith and J.F. Kreider, “Principle of Solar Engineering”, Taylor and Francis, 2000.
2. Sukhatme S.P., “Solar Energy”, Tata McGraw Hill Publishing Co. Ltd., New Delhi, 1994.
3. Bansal and othes, “Non-Conventional Energy Sources”.
4. J.F. Kreider, F. Kreith, “Solar Energy Handbook”, McGraw Hill, 1981
5. J.A. Duffie and W.A. Beckman, “Solar Engineering of Thermal Processes”, John Wiley, 1991.

Cost Management of Engineering Projects

Subject Code: MEMTTE302

Teaching scheme
Lecture: - 3 h/week

Syllabus Contents:

Introduction and Overview of the Strategic Cost Management Process
Cost concepts in decision-making; Relevant cost, Differential cost, Incremental cost and Opportunity
cost. Objectives of a Costing System; Inventory valuation; Creation of a Database for operational control; Provision of data for Decision-Making.
Project: meaning, Different types, why to manage, cost overruns centres, various stages of project
execution: conception to commissioning. Project execution as conglomeration of technical and nontechnical activities. Detailed Engineering activities. Pre project execution main clearances and
documents Project team: Role of each member. Importance Project site: Data required with significance. Project contracts. Types and contents. Project execution Project cost control. Bar charts
and Network diagram. Project commissioning: mechanical and process
Cost Behavior and Profit Planning Marginal Costing; Distinction between Marginal Costing and Absorption Costing; Break-even Analysis, Cost-Volume-Profit Analysis. Various decision-making
problems. Standard Costing and Variance Analysis. Pricing strategies: Pareto Analysis. Target costing, Life Cycle Costing. Costing of service sector. Just-in-time approach, Material Requirement
Planning, Enterprise Resource Planning, Total Quality Management and Theory of constraints. Activity-Based Cost Management, Bench Marking; Balanced Score Card and Value-Chain Analysis.
Budgetary Control; Flexible Budgets; Performance budgets; Zero-based budgets. Measurement ofDivisional profitability pricing decisions including transfer pricing.
Quantitative techniques for cost management, Linear Programming, PERT/CPM, Transportation problems, Assignment problems, Simulation, Learning Curve Theory.

References:

2. Cost Accounting A Managerial Emphasis, Prentice Hall of India, New Delhi
3. Charles T. Horngren and George Foster, Advanced Management Accounting
4. Robert S Kaplan Anthony A. Alkinson, Management & Cost Accounting
5. Ashish K. Bhattacharya, Principles & Practices of Cost Accounting A. H. Wheeler publisher
6. N.D. Vohra, Quantitative Techniques in Management, Tata McGraw Hill Book Co. Ltd.

Dissertation Phase-1

Subject Code: MEMTTE303

Teaching Scheme

Lectures: 20 hr/week

Guidelines:

- The Project Work will start in semester III and should preferably be a problem with research potential and should involve scientific research, design, generation/collection and analysis of data, determining solution and must preferably bring out the individual contribution. Seminar should be based on the area in which the candidate has undertaken the dissertation work as per the common instructions for all branches of M. Tech. The examination shall consist of the preparation of report consisting of a detailed problem statement and a literature review. The preliminary results (if available) of the problem may also be discussed in the report. The work has to be presented in front of the examiners panel set by Head and PG coordinator. The candidate has to be in regular contact with his guide and the topic of dissertation must be mutually decided by the guide and student

Dissertation Phase- II

Subject Code: MEMTTE401

Teaching Scheme

Lectures: 32 hr/week

Guidelines:

- It is a continuation of Project work started in semester III. He has to submit the report in prescribed format and also present a seminar. The dissertation should be presented in standard format as provided by the department. The candidate has to prepare a detailed project report consisting of introduction of the problem, problem statement, literature review, objectives of the work, methodology (experimental set up or numerical details as the case may be) of solution and results and discussion. The report must bring out the conclusions of the work and future scope for the study. . The work has to be presented in front of the examiners panel consisting of an approved external examiner, an internal examiner and a guide, co-guide etc. as decided by the Head and PG coordinator. The candidate has to be in regular contact with his guide.