



राष्ट्रीय प्रौद्योगिकी संस्थान, मिजोरम  
**NATIONAL INSTITUTE OF TECHNOLOGY, MIZORAM**  
(An Institute of National Importance under Ministry of HRD, Govt. of India)  
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**DEPARTMENT OF MECHANICAL ENGINEERING**

**7<sup>th</sup> Semester:**

SL.No	Course code	Course Title	L-T-P	Credits
1.	MEL1736	Refrigeration & Air conditioning	3-0-0	6
2.	MEL1737	Environment Pollution & Renewal Energy	3-0-0	6
3.	MEL1739	Power Plant Technology	3-0-0	6
4.	MEP17XX	Elective - I	3-0-0	6
5.	MEP1740	Project-I	0-0-6	6
6.	MEP1741	Refrigeration & Air conditioning Laboratory	0-0-3	3
7.	MEP1742	Environment & Renewal Energy Laboratory	0-0-3	3

Elective-I

SL.No	Course code	Course Title	L-T-P	Credits
1.	MEL1748	Computational Fluid Dynamic	3-0-0	6
2.	MEL1749	Tribology	3-0-0	6

Course code	Course Title	Semester	L-T-P	Credits
MEL1736	Refrigeration & Air cooling	7 <sup>th</sup>	3-0-0	6

**Introduction to Refrigeration:** Introduction to refrigeration system, Methods of refrigeration, Carnot refrigeration cycle, Unit of refrigeration, Refrigeration effect & C.O.P. Air Refrigeration cycle: Open and closed air refrigeration cycles, Reversed Carnot cycle, Bell Coleman or Reversed Joule air refrigeration cycle, Aircraft refrigeration system, Classification of aircraft refrigeration system. Boot strap refrigeration, Regenerative, Reduced ambient, Dry air rated temperature.

**Vapour Compression System:** Single stage system, Analysis of vapour compression cycle, use of T-S and P-H charts, Effect of change in suction and discharge pressures on C.O.P, Effect of sub cooling of condensate & superheating of refrigerant vapour on C.O.P of the cycle, Actual vapour compression refrigeration cycle, Different configuration of multistage system, Cascade system.

**Vapour Absorption system:** Working Principal of vapour absorption refrigeration system, Comparison between absorption & compression systems, Ammonia – Water vapour absorption system, Lithium-Bromide water vapour absorption system.

**Refrigerants:** Classification, Nomenclature, Desirable properties of refrigerants, Common refrigerants, Secondary refrigerants and CFC free refrigerants.

**Air Conditioning:** Introduction to air conditioning, Psychometric properties and their definitions, Psychometric chart, Different Psychometric processes, Thermal analysis of human body Effective temperature and comfort chart, Cooling and heating load calculations, Infiltration & ventilation, Internal hear gain, Sensible heat factor ( SHF ), By pass factor, Grand Sensible heat factor ( GSHF), Apparatus dew point (ADP).

**Refrigeration Equipment & Application:** Elementary knowledge of refrigeration & air conditioning equipments e.g. compressors, condensers, evaporators & expansion devices, Air washers, Cooling, towers & humidifying efficiency, Food preservation, cold storage, Refrigerates Freezers, Ice plant, Water coolers, Elementary knowledge of transmission and distribution of air through ducts and fans, Basic difference between comfort and industrial air conditioning.

**Books:-**

SL.No	Name of the book	Author	Publication
1	Refrigeration and Air conditioning	C.P Arora.	Tata McGraw Hill.
2	Refrigeration and Air conditioning	Manohar Prasad	New Age International Publishers.
3	Refrigeration and Air conditioning	stoecker & Jones.	McGraw hill international.

Course code	Course Title	Semester	L-T-P	Credits
MEL1737	Environmental Pollution & Renewal Energy	7 <sup>th</sup>	3-0-0	6

**Air Pollution:** Air pollution and pollutants, criteria pollutants, Acid deposition, Global climate change due to green house gases, non-criteria pollutants, emission standard form industrial sources, air pollution meteorology, Atmospheric dispersion.

**Water Pollution:** Water quality standards and parameters, Assessment of water quality, Aquatic pollution, Freshwater pollution, Estuarine water quality, Marine pollution, Organic content parameters, DO and BOD demand in streams, Transformation process in water bodies, Oxygen transfer by water bodies, Turbulent mixing, Water quality in lakes and preservers , Ground water quality.

**Solar energy:** Solar radiation, measurement of solar radiation, solar collector-flat plate and concentrating, collector efficiency, storage of solar energy, application of solar energy. Solar PVS

**Wind energy:** Principles of wind energy conversion, various types of wind machines.

**Energy from bio-mass:** Bio-mass conversion technologies, different types of bio gas plants, thermal gasification of bio-mass.

**Geothermal energy:** Geothermal resources, advantages and disadvantages over other non-conventional energy resources.

**Energy from ocean:** Ocean thermal energy conversion, open and closed cycle, hybrid cycle, introduction to tidal energy.

**Hydrogen energy:** Production, storage of hydrogen energy, application.

**M H D power generation:** Principle of MHD power generation, open and closed cycle systems.

**Books:-**

SL.No	Name of the book	Author	Publication
1	Non-Conventional Energy Sources	G.D. Rai	Khanna Publishers.
2	Solar Energy	Sukhatme	Tata McGraw Hill.
3	Renewable energy resources	Tiwari and Ghosal	Narosa Publication.

Course code	Course Title	Semester	L-T-P	Credits
MEL1739	Power Plant Technology	7 <sup>th</sup>	3-0-0	6

**Economics of Power Generation:** Introduction to Economics of Power Generation, Load-duration Curves, Location of Power Plants, Power Plant Economics, Indian Energy Scenario, Cold-fuelled Electricity Generating Unit.

**Analysis of Steam Cycles:** Steam Power Plant, Rankine Cycle, Carnot Cycle, Mean Temperature of Heat Addition, Effect of Variation of System Condition on Thermal Efficiency of Steam Power Plant, Reheating of Steam, Regeneration, Regenerative Feed water Heating, Feed water Heaters, Carnotization of Rankine Cycle, Optimum Degree of Regeneration, Supercritical Pressure Cycle, Steam Power Plant Appraisal, Deaerator, Typical Layout of Steam Power Plant, Efficiencies in a Steam Power Plant, Cogeneration of Power and Process Heat.

**Combine Cycle Power Generation:** Flaws of Steam as Working Fluid in Power Cycle, Characteristics of Ideal Working Fluid for vapour Power Cycle, Binary Vapour Cycle, Coupled Cycles, Combined Cycle Plants, Gas Turbine-Steam Turbine Power Plant.

**Fuel and combustion:** Coal, Coal Analysis, Fuel Oil, Natural and Petroleum Gas, Emulsion Firing, Coal-Oil-Coal Water Mixtures, Industrial Wastes and Byproducts, Synthetic Fuels, Biomass, Thermodynamic View, Combustion Reactions, Mass Balance of a Steam Generator, Energy Balance of a Steam Generators, Heat of Combustion, Heating Values: Enthalpy of Combustion, Theoretical Flame Temperature, Free Energy of Formation, Equilibrium Constant, Effect of Dissociation, Kinetic of combustion Reactions, Mechanism of Fuel Combustion, Kinetic and Diffusion Control Combustion of Fuel Oil, Combustion of Gas.

**Ash handling plant:** Ash Handling and Dust collection System, Feed water Treatment, Deaeration, Insulation.

**Nuclear plant:** Structure of the Atom, Chemical and Nuclear Reactions, Nuclear Stability and Binding Energy, Radioactive Decay and Half Life, Nuclear Fission, Chain Reaction, Neutron Energies, Nuclear Cross-Sections, Neutron Flux and Reaction Rates, Moderating Power and Moderating Ratio, Variation of Neutron Cross- Section with Neutron Energy, Neutron Life Cycle, Reflectors, Heat Transfer and Fluid flow in Nuclear Reactors, Types of Reactors, Pressurized Water Reactor, Boiling Water Reactor, Gas-Cooled Reactors, Liquid Metal Fast Breeder Reactor, Heavy Water Reactors, Fusion Power Reactors.

**Diesel Engine Power Plant :** Application of diesel Engines in Power Field, Advantages and Disadvantage of Diesel Engine Power Plant, Types of Diesel Plants, General Layout, Combustion in a CI Engine, Performance Characteristics, Supercharging, Layout of a Diesel Engine Power Plant, Gas Turbine Power Plant, Components of Gas Turbine Plant, Gas Turbine Fuels, Gas Turbine Materials, Free Piston Engine Plant.

**Energy storage:** Pumped Hydro, Compressed Air Energy Storage (CAES), Flywheel Energy Storage, Electrochemical Energy Storage, Magnetic Energy Storage, Thermal Energy Storage, Chemical Energy Storage, Hydrogen Energy.

**Books:-**

SL.No	Name of the book	Author	Publication
1	Power Plant Engineering	P.K. Nag	Tata McGraw Hill.
2	Power Plant Technology	M.M. El Wakil	Tata McGraw Hill.
3	Power Plant Engineering	Black and Veatch	CBS Publication.

Elective-I

Course code	Course Title	Semester	L-T-P	Credits
MEL1748	Computational Fluid Dynamics	7 <sup>th</sup>	3-0-0	6

**Basic equations of Fluid Dynamics:** General form of a conservation law, Equation of mass conservation; Conservation law of momentum; Conservation equation of energy, The dynamic levels of approximation, Mathematical nature of PDEs and flow equations.

**Basic Discretization techniques:** Finite Difference Method (FDM), The Finite Volume Method (FVM) and conservative discretization.

**Analysis and Application of Numerical Schemes:** Consistency, Stability, Convergence, Fourier or von Neumann stability analysis, Modified equation, Application of FDM to wave, Heat, Laplace and Burgers equations.

**Integration methods for systems of ODEs:** Linear multi-step methods, Predictor-corrector schemes; ADI methods, The Runge-Kutta schemes, Numerical solution of the compressible

**Euler equations:** Mathematical formulation of the system of Euler equations, Space-centered schemes and Upwind schemes for the Euler equations – flux vector and flux difference splitting, Shock-tube problem.

**Numerical solution of the incompressible Navier-Stokes equations:** Stream function-vorticity formulation, Primitive variable formulation, Pressure correction techniques like SIMPLE, SIMPLER and SIMPLEC, Lid-driven cavity flow.

**Numerical heat transfer:** Brief discussion of numerical methods for conduction and convection

**Books:-**

SL.No	Name of the book	Author	Publication
1	Computational fluid dynamics - Basics with applications	John. D. Anderson	Tata McGraw Hill.
2	Numerical Heat Transfer and Fluid Flow	S. Patankar	Taylor & Francis publication.
3	Fundamentals of Computational Fluid Dynamics	Tapan K. Sengupta	Universities Press.

Course code	Course Title	Semester	L-T-P	Credits
MEL1749	Tribology	7 <sup>th</sup>	3-0-0	6

**Introduction:** Historical background and introduction to Tribology of bearings.

**Properties and Testing of Lubricants:** Types of lubricants and their properties, Viscometry.

**Basic equations:** The generalized Reynolds Equation, Continuity Equation, Energy Equation

**Idealized Hydrodynamic Bearings:** Mechanism of Pressure Development, Plane slider Bearing, Idealized slider bearing with a pivoted shoe, Step bearing, Infinitely long journal bearing, Infinitely short journal bearing.

**Finite Bearings:** Analytical and Numerical Solution, Cavitation and cavitation boundary condition.

**Oil Flow and Thermal equilibrium:** Circumferential flow and axial flow, Heat generation and heat balance, effective temperature of lubricant.

**Bearing Design:** Practical considerations in bearing design, Design of journal bearings.

**Squeeze Film bearings:** Parallel surface bearing, step bearing, some situation under squeeze film lubrication.

**Hydrodynamic Instability:** Mechanism of hydrodynamic Instability, Stiffness and damping coefficients.

**Externally pressurized Oil Bearings:** Systems of hydrostatic lubrication, Circular step bearings.

**Gas-lubricated Bearings:** Governing equations, Limiting solutions, Finite journal bearings, perturbation method.

**Introduction of Elastohydrodynamic:** Lubrication, Surface Roughness, Effect on Hydrodynamic Bearings and Elastohydrodynamic Line contacts. Ball Bearings, Roller Bearings.

**Friction of Metals:** Laws of friction, Friction Theories, Frictional heating Effect of sliding speed on friction.

**Wear of Metals:** Classification of wear, Mechanism of wear, Quantitative laws of wear.

**Books:-**

SL.No	Name of the book	Author	Publication
1	Applied Tribology	Michael M. Khonsari	Wiley India Pvt Ltd.
2	Basic Lubrication theory	A. Cameron et.al.	Wiley India Pvt Ltd.
3	Introduction to Tribology of Bearing	B.C. Majumdar	S. Chand

