ALIGARH MUSLIM UNIVERSITY, ALIGARH

FACULTY OF ENGINEERING & TECHNOLOGY

SYLLABUS FOR

MASTER OF TECHNOLOGY (M.TECH.) – MECHANICAL ENGINEERING

Applied thermodynamics: Laws of thermodynamics, availability and irreversibility, thermodynamic relations, ideal and real gas equations of state, mixture of ideal gases, psychrometry, heat load calculations, air-standard cycles, basic refrigeration cycles and refrigerants, reciprocating and rotary compressors.

Energy Conversion Systems: Modern **S**team boilers; Rankine cycle and its modifications, nuclear and combined cycles; gas and steam flow through nozzles, equilibrium and supersaturated steam flows, steam turbines; their compounding and governing, condensers and cooling tower analysis.

IC Engines: Fuel-air and actual cycles, engine performance parameters, scavenging methods, combustion phenomena, carburetion and fuel injection, supercharging and turbo-charging, conventional and alternative fuels, engine emissions and emission standards, Gas turbine cycle and its modifications, Jet engines.

Heat-Transfer: Modes of heat transfer, heat conduction with and without heat generation, heat transfer through fins; unsteady heat conduction, lumped capacity system, Heisler's charts; thermal boundary layer, dimensionless parameters in free and forced convection, heat transfer correlations for flow over flat plates and through pipes; heat exchangers, LMTD and NTU methods; radiative heat transfer, black and grey surfaces, view factors, radiation network analysis; solar-thermal energy utilization; diffusive and convective mass transfer.

Fluid Mechanics: Fluid statics, forces on submerged bodies, stability of floating bodies; control-volume analysis; Material derivative and fluid acceleration; differential equations of continuity and Euler; Bernoulli's equation; dimensional analysis; viscous flow through pipes, friction factor and energy losses in pipes, bends and fittings.
Viscous, incompressible flow of fluids, Stress-Strain rate relations for Newtonian fluids and Stokes hypothesis, Navier-Stokes Equations, Dimensionless formulations and Dynamic similarity, Exact solutions of N-S Equations for steady Uni-directional (parallel) flows, Stokes problems.

Boundary Layer Flow: Prandtl boundary layer equations, Boundary layer along a flat surface, Blasius Solution, Integral analysis: Displacement and Momentum, thickness, Von-Karman Momentum integral equation. Drag and local shear in zero pressure gradient boundary layers.

Statistical description of Turbulent flow; Ensemble, time and volume averages, length and time scales in turbulent flow. Kolmogorov Hypothesis, Reynolds

decomposition and RANS equations, eddy viscosity model and Prandtl mixing length model, log-law of the wall.

Basics of compressible fluid flow: Isentropic flow, Static and Stagnation properties, Quasi-1D isentropic flow in variable area passages, Area-velocity and Area-Mach number relations, Normal shocks and Rankine-Hugoniot relations.

Turbomachinery: Energy Transfer between rotor and fluid in Turbomachines; Impulse and Reaction Turbines, Pelton, Francis, Kaplan Turbines, Reciprocating and Centrifugal pumps–Theory, Losses, Efficiencies, Performance Curves; Draft Tube, Cavitation, Dynamic Similarity and Model Testing, Instrumentation for Testing of Hydraulic Machines. Compressors: Reciprocating, Centrifugal and Axial-theory and applications.

Engineering Materials: Structure and properties of engineering materials, phase diagrams, heat treatment, stress-strain diagrams for engineering materials.

Casting, Forming and Joining Processes: Different types of castings, design of patterns, moulds and cores; solidification and cooling; riser and gating design. Plastic deformation and yield criteria; fundamentals of hot and cold working processes; load estimation for bulk (forging, rolling, extrusion, drawing) and sheet (shearing, deep drawing, bending) metal forming processes; principles of powder metallurgy. Principles of welding, brazing, soldering and adhesive bonding.

Machining and Machine Tool Operations: Mechanics of machining; basic machine tools; single and multi-point cutting tools, tool geometry and materials, tool life and wear; economics of machining; principles of non-traditional machining processes; principles of work holding, design of jigs and fixtures.

Metrology and Inspection: Limits, fits and tolerances; linear and angular measurements; comparators; gauge design; interferometry; form and finish measurement; alignment and testing methods; tolerance analysis in manufacturing and assembly.

Computer Integrated Manufacturing: Basic concepts of CAD/CAM and their integration tools, CAPP and Production systems.

Production Planning and Control: Productivity and its models; forecasting models, aggregate production planning, scheduling, materials requirement planning, job design.

Inventory Control: Deterministic models; stochastic models; safety stock inventory control systems.

Operations Research: Linear programming, simplex method, transportation, assignment, Non-linear programming, network flow models, simple queuing models, PERT and CPM.

Economy & Management: Economics laws, breakeven analysis, P.W., F.W. and A.W., methods, depreciation, replacement studies, Management process, decision making, strategic management, organizing, leadership and motivation.

Engineering Mechanics : Free-body diagrams and equilibrium, friction and its applications including rolling friction, belt-pulley, brakes, screw jack, wedge, etc.;virtual work kinematics and dynamics of rigid bodies in plane motion; impulse and momentum (linear and angular) and energy formulations.

Mechanics of Materials : Stress and strain, elastic constraints, Poisson's ratio; Mohr's circle of plane stress and plane strain; thin and thick cylinders; shear force and bending moment diagrams; bending and shear stresses; deflection of beams; torsion of circular shafts; Euler's theory of columns; energy methods; strain gauges and rosettes; testing of materials with universal testing machine; testing of hardness and impact strength

Theory of Machines: Displacement, velocity and acceleration analysis of plane mechanism; dynamic analysis of linkages; cams; gears and gear trains; flywheels and governors; balancing of reciprocating and rotating masses; gyroscope.

Vibrations : Free and forced vibration of single degree of freedom systems, effect of damping; vibration isolation; resonance; critical speeds of shafts.

Machine Design : Design for static and dynamic loading; failure theories; fatigue strength and the S-N diagram; principles of the design of machine elements such as bolted, riveted and welded joints; shafts, gears, rolling and sliding contact bearings, brakes and clutches, springs.