

# Area of Research

## Department of Mechanical Engineering

Computational Fluid Mechanics and Heat Transfer, Renewable Energy, Design of Thermal System, Computer Aided Analysis and Design, Solar Energy, Waste Heat Recovery, I.C.Engines and Gas Turbines, Bio-fuels and Combustion, Refrigeration and Air Conditioning Systems, Fluidics, Mechanics of Materials, Plastic Deformation and Fracture

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## Syllabus for Subject Specific Test

**Plastic Deformation and Fracture:** Mechanism of plastic deformation, Yield criteria, Mechanisms of strengthening, Effect of temperature, strain and strain rate in plastic behaviors Griffith's theory, stress intensity factor and fracture toughness, ductile- brittle transition; creep, fatigue.

**Design of Thermal System:** Principle of thermal design, system simulation and optimization, modeling of typical thermal equipment, dynamic response of thermal system, methods of optimization, search methods, dynamic and geometric programming.

**Waste Heat Recovery:** properties of exhaust gas, gas-air heat recovery, gas water heat recovery, Garrett pyrolysis process, Kinney thermal recovery process, heat recovery by steam generation, waste heat recovery in steel making, organic rankine cycle combined power plant.

**I.C.Engines and Gas Turbine :** Variable specific heats and cycle analysis, fuel-air cycles and their analysis, fuel supply to S.I. engines, fuel injection systems for C.I. engines, two stroke engines and scavenging methods, I C Engine cooling systems, engine friction and lubrication, supercharging, performance characteristic of I.C. Engines, Performance of actual gas turbine cycles

**Computational Fluid Mechanics and Heat Transfer:** Differential equations of motion in fluid flow - Navier stokes equation, different technique for solving boundary layer problems, elementary idea of CFD. Two –dimensional steady and unsteady state heat conduction processes, extended surfaces: fins, finite difference method for conduction and convection . Blasius solution for laminar boundary layer flows, Von-Karman integral momentum equation ,Pohlhausen solution for energy equation, turbulent boundary layer flows, electrical network approach for radiation heat exchange

### **Solar Energy:**

Solar radiation, availability different , measurement and estimation, different types of solar collectors, solar thermal conversion devices and storage, application. Solar photovoltaic conversion. Power from renewable sources ( wind, tidal, ocean thermal, geothermal, biomass and small hydro etc )

**Refrigeration and A/C systems:** Air cycle of refrigeration, principle of psychrometry, different psychrometric processes mathematical analysis of a simple and actual vapour compression refrigeration cycle, practical absorption refrigeration cycle, estimation of cooling load calculation.

**Computer Aided Analysis and Design:** DDA and Breeseham's line algorithm, circle generation, windowing and clipping, 2D and 3D transformation, wire-frame, surface, solid and geometric modeling, introduction to different CAD softwares, finite element modeling, constant strain triangles (CST), principle of optimization, optimum design of simple linkage mechanism.

**Fluidics:** Introduction to control system, types and utility, hydraulic power generation and transmission, flow relationship for hydraulic valves, introduction to fluidic devices and sensor, pure fluidic analog amplifiers, physical concepts of pneumatics and electricals, electro-pneumatic components operation and application.

**Bio-fuels and Combustion :** Different sources of bio-fuels, production of bio-diesel and ethanol, general introduction to LNG & CNG- as an alternative fuel, bio-gas, producer gas and their characteristics. Combustion kinetics, first and second law analysis of reacting system, adiabatic flame temperature calculation, flame structure, flame stability, velocity of flame propagation.

**Mechanics of Materials:** Mohr's circle for stress in 3D, Euler's column formula, columns with initial eccentricity and eccentric loads, calculation of critical load by energy method, buckling of tubes, bending of plates, deformation of shells with and without bending, stresses due to rotary sections, radial and tangential stress in solid disc and ring of uniform thickness, free and forced vibrations, effect of damping.