Paper Code: MME-306	**Roll No.**									

M.Tech.
THIRD SEMESTER EXAMINATION, 2016-17
ADVANCED THERMAL ENGINEERING

[Time: 3 Hours] [Max. Marks: 100]

Note: Attempt all questions. Marks are indicated against each question. Assume any missing data suitably.

1. Attempt any *two* parts of the following: - **(10x2=20)**

(a) Two reversible heat engines A and B are arranged in series. Engine A rejects heat directly to engine B.A receives 200 KJ at a temperature of 421^0C from the hot source while engine B is in communication with a cold sink at a temperature of 5^0C. If the work output of A is twice that of B, find (i) Intermediate temperature between A and B (ii) Efficiency of each engine (iii) Heat rejected to the sink

(b) Explain the Generalized compressibility chart with neat sketch. What is the application of reduced pressure and reduced temperature of a gas in a generalized compressibility chart?

(c) 1 m^3 of air is heated reversibly at constant pressure from 290k to 580k, and is then cooled reversibly at constant volume back to initial temperature. If the initial pressure is 1bar, work out the net heat flow and overall change in entropy. Represent the processes on T-S plot. Take Cp=1.005KJ/KgK and R=287J/KgK .

2. Attempt any *two* parts of the following: - **(10x2=20)**

(a) Drive the Maxwell Equations and discuss about Joule –Thomason coefficient.

(b) The velocity & enthalpy of a fluid at the inlet of a certain nozzle are 50 m/s and 2800KJ/Kg respectively. The enthalpy at the exit of nozzle is 2600KJ/Kg. The nozzle is insulated. Find: (a) velocity of fluid at exit (b) mass flow rate if the area at inlet of nozzle is 0.09 m^3 and specific volume is 0.185m^3/Kg. (c) exit area of nozzle if specific volume at the exit of nozzle is 0.495 m^3/Kg.

(c) A reversible engine is supplied with heat from two constant temperature sources at 900 k and 600 k and rejects heat to a constant temperature sink at 300 k. The engine develop work equivalent to 90kJ/sec and reject heat at a rate of 56 kJ/sec. Estimate the Heat supplied by each source and Thermal efficiency of engine?

3. Attempt any *two* parts of the following: - **(10x2=20)**

(a) What do you mean by Available & Unavailable energy? Also drive the expression for Available & Unavailable energy. A lump of 800 kg steel at 1250 K is to be cooled to 500 K. If the change in entropy is occur at constant pressure process then Calculate: (i) Availability (ii) Unavailability of energy

(b) What do you understand by space resistance and surface resistance? Derive an expression for surface resistance of a gray body.

(c) Drive the Navier-stokes Equation for the flow of incompressible fluids.

4. Attempt any *two* parts of the following: - **(10x2=20)**

(a) Find the vorticity of the following two-dimentional flows

(i) u=ky , v=-kx (ii) u=kx , v=-ky

(b) Calculate the drag force on each side of a thin smooth plate 2m long and 1m wide with the length parallel to a flow of fluid moving at 30m/s. The density of the fluid is 800kg/m3 and the dynamic viscosity is 8 cP.

(c) Drive the boundary layer thickness equations for fluid flowing over a flat plate.

5. Attempt any *two* parts of the following: - **(10x2=20)**

(a) A flat bottomed hole 6 mm in diameter is drilled to a depth of 24 mm in a material (black body) at uniform temperature of 1000 K. Determine the radiant power leaving the opening of the cavity. (The opening of the cavity may be approximated as a black body at 0 K).

(b) Consider two large, diffuse gray, parallel surfaces separated by a small distance. If the surface emissivities are 0.8, what emissivity should a thin radiation shield (placed between the surfaces) have to reduce the radiation heat transfer rate between the surfaces to 10 % of the original?

(c) What do you understand by the following?

(i) Emissive power of a surface.
(ii) Colored Surface
(iii) Kirchoff's Law