(Please write your Exam Roll No.) *Exam Roll No. .....*

END TERM EXAMINATION

FOURTH SEMESTER [B.TECH.]– MAY-JUNE 2009

Paper Code: ETIC-212 ***Subject: Fluid Mechanics & Thermodynamics***
Paper ID: 30212 ***(Batch: 2003-2007)***

Time : 3 Hours ***Maximum Marks :75***

Note: Attempt one question from each unit including Q.No.1 which is compulsory.

(2.5x10=25)

Q.1 (a) What is the difference between Dynamic Viscosity and Kinematic Viscosity? State their units of measurement.

(b) What do you understand by Hydrostatic law?

(c) What are the conditions of equilibrium of floating and submerged body?

(d) Define the equation of continuity. Obtain and expression for continuity equation for a three-dimensional flow.

(e) Name the different forces present in a fluid flow. For the Euler's equation of motion, which forces are taken into consideration?

(f) Explain, why does free expansion have zero work transfer?

(g) Can you use the same plant as a heat pump in winter and as a refrigerator in summer? Explain.

(h) When the system is at equilibrium, why would any conceivable change in entropy be zero?

(i) Explain the process and methods to achieve cooling and dehumidification.

(j) Write the Fourier rate equation for heat transfer by condition. Give the units and physical significance of each term appearing in this equation.

UNIT-I

Q.2 A U-Tube manometer is used to measure the pressure of water in a pipe line, which is in excess of atmospheric pressure. The right limb of the manometer contains mercury and is open to atmosphere. The contact between water and mercury is in the left limb. Determine the pressure of water in the main line, if the difference in level of mercury in the limbs of U-tube is 10 cm and the free surface of mercury is in level with the centre of the pipe. If the pressure of water in pipe line is reduced to 9810 N/m^2, calculate the new difference in the level of mercury. Sketch the arrangements in both cases. **(12.5)**

Q.3 Find the total pressure and position of centre of pressure on a triangular plate of base 2 m an height 3 m which is immersed in water in such a way that the plane of plate makes an angle of 60° with the free surface of the water. The base of the plate is parallel to water surface and at a depth of 2.5 m from water surface. Draw the labeled diagram also. **(12.5)**

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UNIT-II

Q.4 A solid cylinder of diameter 4.0 m has a height of 4.0 m. Find the meta-centric height of the cylinder if the specific gravity of the material of cylinder is 0.6 and it is floating in water with its axis vertical. State whether the equilibrium is stable or unstables. **(12.5)**

Q.5 The following cases represent the two velocity components, determine the third component of velocity such that they satisfy the continuity equation: - **(12.5)**

(i) $u = x^2 + y^2 + z^2$; $v = xy^2 - yz^2 + xy$

(ii) $v = 2y^2$; $w = 2xyz$

(iii) $u = 4x^2$; $v = 4xyz$

UNIT-III

Q.6 Two reversible heat engines 'A' and 'B' are arranged in series, 'A' rejecting heat directly to 'B'. Engine 'A' receives 200 KJ at a temperature of 421°C from a hot source, while engine 'B' is in communication with a cold sink at temperature of 4.4°C. If the work output of 'A' is twice that of 'B', Find (i) the intermediate temperature between 'A' & 'B', (ii) the efficiency of each engine and (iii) the heat rejected to the cold sink. **(12.5)**

Q.7 Ten grams of water at 20°C is converted into ice at -10°C at constant atmospheric pressure. Assuming the specific heat of liquid water to remain constant at 4.2 J/gK and that of ice to be half of this value and taking latent heat of fusion of ice at 0°C to be 335 J/g, calculate the total entropy change of the system. **(12.5)**

UNIT-IV

Q.8 Beginning with a general conduction equation, makes suitable assumptions to show that temperature distribution through a plane wall is linear. Also explain the phenomenon of heat transfer by free convection in brief. **(12.5)**

Q.9 A furnace wall comprises three layers: 13.5 cm thick inside layer of fire brick, 7.5 cm thick middle layer of insulating brick and 11.5 cm thick outside layer of red brick. The furnace operates at 870°C and it is anticipated that the outside of this composite wall can be maintained at 40°C by the circulation of air, Assuming close boding of layers at their interfaces. Find the rate of heat loss from the furnace and the wall interface temperatures. The wall measures 5m x 2m and the data on thermal conductivities is : Fire brick, K_1 = 1.2 w/m-deg. Insulation brick, K_2 = 0.14 w/m-deg. Red brick, K_3 = 0.85 w/m-deg. **(12.5)**

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