Code No: RR211401 **Set No. 1**

II B.Tech I Semester Supplementary Examinations, November 2006
THERMODYNAMICS & FLUID MECHANICS
(Common to Mechatronics and Production Engineering)

Time: 3 hours **Max Marks: 80**

Answer any FIVE Questions
All Questions carry equal marks

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1. (a) Explain the terms state, path, process and cyclic process. [4x2=8]
   (b) Discuss the macroscopic and microscopic point of view of thermodynamics. [8]

2. (a) Derive the governing equation for the adiabatic process. [8]
   (b) Explain joules experiment in detail. [8]

3. (a) Prove that the change in entropy during a polytropic process is given by
   $s_2 - s_1 = C_v (n - \gamma / n - 1) \log_e (T_2 / T_1)$
   where γ is ratio of specific heats and n- index of compression or expansion. [8]
   (b) A closed system consists of 1kg of air which is initially at 1.5 bar and 67^0C. The volume doubles as the system undergoes a process according to the law $pV^{1.2}$ = Constant. Find the work done, Heat transfer and change in entropy. [8]

4. (a) Derive expression for the Gibbs Function of a mixture of inert ideal gases. [8]
   (b) Show that on a Mollier diagram (h-s diagram) the slope of a constant pressure line increases with temperature in the superheat region. [8]

5. (a) Derive an expression for the mean effective pressure for an engine working on an ideal Diesel cycle in terms of pressure at the beginning of compression, compression ratio, cut-off ratio and the adiabatic index. [8]
   (b) A four cylinder 4.5L engine which operates on an ideal Diesel cycle has a compression ratio of 17 and cut-off ratio of 2.2. Air is at 27^0C and 97kPa at the beginning of the compression process. Using the cold air-standard assumptions, determine how much power the engine will deliver at 1500rpm. [8]

6. (a) What are the different types of pressure gauges ? [6]
   (b) Two discs of 20 cm diameter are placed 1mm apart and the gap is filled with an oil of viscosity 2 Pa-sec. Determine the power required to rotate the upper disc at 600 rpm while holding the lower one stationary. [10]

7. (a) Show that the stream lines and equipotential lines form a net of mutually perpendicular lines . [8]
   (b) For the following velocity vector determine the magnitude of velocity at A (x=2 , y=-3 , z = 1 , t = 2) . Check whether continuity equation is satisfied.
   $V = (10t + xy)i + (- yz -10t)j + (-yz + z^2 /2)k$ [8]

8. (a) A liquid is flowing through a pipe line. Show that the accelerating force on the mass of liquid between two sections of the pipe is equal to the product of mass flowing per second and the change in velocity. [8]

   (b) A pipe 300 m long has a slope of 1 in 100 and tapers from 1.20m diameter at the high end to 0.6m diameter at the low end. The rate of flow of water through the pipe is 0.10 cumecs. If the pressure at the high end is 0.75 kg/cm^2, find the pressure at the low end. Neglect losses. [8]

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Code No: RR211401

Set No. 2

II B.Tech I Semester Supplementary Examinations, November 2006
THERMODYNAMICS & FLUID MECHANICS
(Common to Mechatronics and Production Engineering)

Time: 3 hours **Max Marks: 80**

Answer any FIVE Questions
All Questions carry equal marks

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1. (a) Explain thermodynamic system, surroundings and universe, illustrate the same with examples. [8]
   (b) Distinguish between closed system, open system and isolated system with suitable examples. [8]
2. (a) Derive the continuity equation. [6]
   (b) Show that heat transfer during the polytrophic process is { $(\gamma$ - n$)/(\gamma$ - 1)} X polytrophic work done. [10]
3. A heat pump working on the reversed Carnot cycle takes in heat from a reservoir at 5^0C and delivers heat to a reservoir at 60^0C. The heat pump is driven by a reversible heat engine which, receives heat from a reservoir at 840^0C and rejects heat to a reservoir at 60^0C. the reversible heat engine also drives a machine that absorbs 30 kW. If the heat pump extracts 17kJ/s from the 5^0C reservoir, determine [16]
   (a) the rate of heat supply from 840^0C source, and
   (b) the rate of heat rejection to the 60^0C sink.
4. (a) Define : Helmholtz function and Gibbs function and hence deduce the two Maxwell's relations. [8]
   (b) Prove that the partial molal Gibbs function is equal to the chemical potential [8]
5. (a) Show the ideal Rankine cycle with three stages of reheating on a T-s diagram. Assume the turbine inlet temperature is the same for all stages. How does the cycle efficiency vary with the number of reheat stages? [8]
   (b) Steam is produced at 19.5MPa, 560^0C. The condenser pressure is 2.5kPa. Assume ideal conditions in the turbine and neglect the pump work. Determine the thermal efficiency. [8]
6. (a) What are the different types of pressure gauges ? [6]
   (b) Two discs of 20 cm diameter are placed 1mm apart and the gap is filled with an oil of viscosity 2 Pa-sec. Determine the power required to rotate the upper disc at 600 rpm while holding the lower one stationary. [10]
7. (a) What is velocity potential function ? What is its use in the fluid flow analysis. [8]

(b) For the given three dimensional flow field described by
$V = (x + y)i + (y + z)j + (x^2 + y^2 + z^2)w$ find the components of rotation at (1,1,1). [8]

8. (a) Define laminar boundary layer, turbulent boundary layer, laminar sub-layer and boundary layer thickness. [8]

(b) A 1.8m wide, 5m long plate moves through stationary air of density 1.22×10^{-3} gm/cc and viscosity 1.8×10^{-4} poise at a velocity of 1.75 m/sec parallel to its length. Determine the drag force on one side of the plate assuming [8]

i. laminar flow condition
ii. turbulent flow condition.

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Code No: RR211401 **Set No. 3**

II B.Tech I Semester Supplementary Examinations, November 2006
THERMODYNAMICS & FLUID MECHANICS
(Common to Mechatronics and Production Engineering)

Time: 3 hours **Max Marks: 80**

Answer any FIVE Questions
All Questions carry equal marks

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1. (a) Explain thermodynamic system, surroundings and universe, illustrate the same with examples. [8]
   (b) Distinguish between closed system, open system and isolated system with suitable examples. [8]

2. (a) Derive an expression for heat transfer in polytropic process. [8]
   (b) A household refrigerator contains fresh food and it is closed one kwh of electric energy is consumed in cooling the food and internal energy of the system decreases by 500kJ as the temperature drops. Find the magnitude and direction of heat transfer for the process. Assume the entire refrigerator and its contents as a system. [8]

3. (a) Prove that Kelvin-planck statement and Clausius statement of Second law of thermodynamics are equivalent. [8]
   (b) Two reversible heat engines A and B are arranged in series with A rejecting heat directly to B through an intermediate reservoir. Engine A receives 200 kJ of heat from a reservoir at 421^0 C, and engine B is in thermal communication with a sink at 4.4^0 C. If the work out put of A is twice that of B find [8]
      i. the intermediate temperature between A and B,
      ii. the efficiency of each engine and
      iii. the heat rejected to the cold sink.

4. Starting from first law and using second law derive the Gibb's equations and hence deduce the Maxwell's relations [16]

5. (a) Show that the efficiency of an Otto cycle depends only on compression ratio? And also derive the equation for mean effective pressure? [8]
   (b) Calculate the air standard efficiency of an Otto cycle with compression ratio 7, and compression begins at 35^0C and 0.1 Mpa. The max temperature of the cycle is 1100^0C. [8]

6. (a) The standard atmospheric pressure is 76cm of mercury. Express it in terms of column height of water and in N/m^2. [8]
   (b) A closed tank contains 0.5m of mercury, 2m of water, 3m of oil of specific gravity 0.6 successively and air is present on top. If the guage pressure at the bottom of the tank is 124Kpa, what is the pressure of air at top of the tank? [8]

7. (a) For steady incompressible flow verify whether the following values of velocity components are possible. [8]
   i. $u = 4xy + y^2$, $v = 6xy + 3x$
   ii. $u = 2x^2 + y^2$, $v = -4xy$
   iii. $u = -x (x + y)$, $v = -y (x + y)$

   (b) Derive the equation of continuity for one dimensional flow using stream tube. [8]

8. (a) How will you find the drag on a flat plate due to laminar and turbulent boundary layers. [8]

   (b) A smooth flat plate of length 5m and width 2m is moving with a velocity of 4 m/sec in stationary air of density as 1.25 kg/m^3 and kinematic viscosity 1.5×10^{-5} m^2/sec. Determine thickness of boundary layer at the trailing edge of the smooth plate. Find the total drag on one side of the plate assuming that the boundary layer is turbulent from the very beginning . [8]

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Code No: RR211401 **Set No. 4**

II B.Tech I Semester Supplementary Examinations, November 2006
THERMODYNAMICS & FLUID MECHANICS
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Time: 3 hours **Max Marks: 80**

Answer any FIVE Questions
All Questions carry equal marks

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1. (a) Explain with a neat sketch the working principle of a constant volume gas thermometer. [8]
   (b) Explain the concept of temperature and equality of temperature. [8]

2. Explain the physical significance of the various terms of the steady flow energy equation & also explain how all the terms in that expression has the same units. [16]

3. (a) Obtain expressions to find entropy change for a system of ideal gas in terms of pressure, temperature and volume during any process. [8]
   (b) One kg of air is compressed according to the law pv1.25 = C from a pressure of 105 kPa and temperature of 15^0C to a pressure of 1680 kPa. Calculate the temperature at the end of compression, the heat received or rejected by the air and change in entropy. Assume for air Cp= 1.005 kJ/kg.K and R = 0.287 kJ/kg.K [8]

4. Starting from first law and using second law derive the Gibb's equations and hence deduce the Maxwell's relations [16]

5. (a) Explain the variation of the thermal efficiency of the Diesel cycle with respect to compression ratio and cut-off ratio. [8]
   (b) An air standard Diesel cycle as a compression ratio of 16 and a cut-off ratio of 2. At the beginning of the compression process, air is at 95kPa and 27^0C. Accounting for the variation of specific heats with temperature, determine the temperature after the heat addition process, the thermal efficiency and the mean effective pressure. [8]

6. (a) What is differential manometer ? Explain how it works? [8]
   (b) Find the pressure in N /m^2 represented by a column of 10 cm of water, 4 cm of oil of relative density 0.89 and 2 cm of mercury of specific gravity 13.6. Specific weight of water is 9810 N / m^3. [8]

7. (a) What do you understand by uniform flow and non uniform flow ? What are the practical examples? [8]
   (b) The stream function of a flow is given by $\psi= x^3 - 3xy^2$. Find the velocity at a point (3,2) and the velocity potential function. [8]

8. (a) Define laminar boundary layer, turbulent boundary layer, laminar sub-layer and boundary layer thickness. [8]

(b) A 1.8m wide, 5m long plate moves through stationary air of density 1.22×10^{-3} gm/cc and viscosity 1.8×10^{-4} poise at a velocity of 1.75 m/sec parallel to its length. Determine the drag force on one side of the plate assuming [8]

i. laminar flow condition

ii. turbulent flow condition.

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