Code No: RR221403 **Set No. 1**

II B.Tech II Semester Regular Examinations, November/December 2005
THERMAL ENGINEERING AND HEAT TRANSFER
(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) How the I.C. Engines are classified?
   (b) With neat sketches, explain the working of four strokes C.I. Engine. [6+10]

2. What are the different kinds of fuels used in an IC engine? Discuss them in detail. [16]

3. (a) What are the factors which affect the process of carburetion?
   (b) Describe with sketches the working of a solex carburettor. [6+10]

4. (a) List the parameters by which performance of an engine is evaluated.
   (b) What are the various methods for measurement of brake house power?[6+10]

5. A jet propulsion unit consists of compressor combustion chamber, turbine and nozzle. The air at 0.65 bar and 272K is compressed in compressor to 3.0 bar, ζ_e=85%. The temperature of the gases at the inlet of turbine is 700^0C, ζ_t= 80%. The gases coming out from the turbine are expanded in a nozzle to a pressure of 0.564 bar. The nozzle efficiency is 90%. Neglecting the pressure losses, mechanical losses and fuel mass, find the following:
   (a) Air fuel ratio used assuming calorific value of fuel as 44,000 kJ/kg and ζ_{com} = 90%.
   (b) H.P. required to run compressor.
   (c) Pressure of the gases entering the nozzle and
   (d) thrust developed for kg of air per second.

   C_{pa} = 1.005 kJ/kg K; ν = 1.4 for air and C_{pg} = 1.1514 and ν = 1.33 for gases. Speed of the jet propulsion unit = 720 km/hr. [16]

6. (a) Explain Fourier heat conduction equation.
   (b) Derive the general conduction equation in cylindrical coordinates by considering the infinitesimal volume. [6+10]

7. (a) Calculate the appropriate Grashot numbers. State whether the flow is laminar of turbulent for the following case.
   A central heating radiator, 0.6m high with a surface temperture of 75^0C in a room at 18^0C (ρ = 1.2 kg/m^3, Pr = 0.72 and $\mu = 1.8 \times 10^{-5}$ kg/ms).

(b) An airplane wing in 1.2m wide and its surface is at 24^0C. The aeroplane is flying at 240 km/hr is air at 0^0C and 67 cm Hg pressure. Calculate the heat loss per metre length of the wing. [8+8]

8. (a) When a body is said to be black? What is the range of wave lengths it absorbs?

(b) Compute the radiant energy loss from 1 cm diameter opening in a thin walled furnace located in a large enclosure, if the temperature with in the furnace is 900^0C and the surroundings are at 20^0C. [6+10]

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Code No: RR221403 **Set No. 2**

II B.Tech II Semester Regular Examinations, November/December 2005
THERMAL ENGINEERING AND HEAT TRANSFER
(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) Define specific fuel consumption of an engine and explain its importance.
   (b) With neat sketches, explain the working of two stroke S.I Engine. [6+10]
2. (a) Describe the important qualities of a CI engine fuel.
   (b) Briefly describe the rating of CI engine fuel. [8+8]
3. (a) What are the basic types of carburettors?
   (b) Describe with a sketch the working of S U Carburettor. [6+10]
4. (a) What are the basic requirements of a good injection system.
   (b) Explain the importance of a fuel filter and draw a neat diagram of a filter used with oil injection system. [6+10]
5. An open cycle gas turbine plant consists of compressor, combustion chamber and turbine. The pressure and temperature at the inlet of compressor are 1 bar and 15^0C and at the inlet of the turbine are 5 bar and 650^0C. Assume $\zeta_e = 80\%$, $\zeta_t = 85\%$, $\zeta_m = 90\%$ and $\zeta_{com} = 98\%$. Assuming $C_{pa} = 1$ KJ/kg K, $C_{pg} = 1.2$ kJ/kg K and ν (for air) = 1.4 and r(for gases) = 1.334. Find
   (a) the thermal efficiency
   (b) work ratio of the cycle.

   If a regenerator of 65% effectiveness in introduced in the cycle, with a pressure loss of 0.2 bar to air side as well as gas side, find the percentage increase in the thermal efficiency of the cycle. [16]
6. (a) What is the basic difference between conduction and radiation heat transfer processes?
   (b) Identify the modes of heat transfer in the following examples.
      i. A car disc brake during braking
      ii. A domestic boiler
      iii. Heating a room using an electric fan heater
      iv. Soldering an electric circuit board
      v. Gas welding two sheets of steel plate. [6+10]
7. (a) A gas flow (Pr = 0.71, $\mu = 4.63 \times 10^{-5}$ kg/ms and $C_p = 1175$ J/kg k) over a turbine blade of chord length 20 mm where the average heat transfer coefficient is 1000 W/m^{2}k. Calculate the Nusselt number.

(b) Calculate the heat transfer coefficient for water flowing through a 2 cm diameter tube with a velocity of 2.5 m/s. The average temperture of the water is 50^0C and surface temperature of the tube is slightly below this temperature. Assume the flow to be turbulent. The properties at 50^0C are given below:
$C_p = 4182$ J/kg k, $K = 0.643$ W/mK
$\rho = 988$ kg/m^3, $\mu = 544 \times 10^{-6}$ kg/ms. [6+10]

8. (a) When a body is said to be black? What is the range of wave lengths it absorbs?

(b) Compute the radiant energy loss from 1 cm diameter opening in a thin walled furnace located in a large enclosure, if the temperature with in the furnace is 900^0C and the surroundings are at 20^0C. [6+10]

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Code No: RR221403 **Set No. 3**

II B.Tech II Semester Regular Examinations, November/December 2005
THERMAL ENGINEERING AND HEAT TRANSFER
(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) Define mean effective pressure. What is its importance in reciprocating engines?
   (b) An air standard Otto cycle operates with a compression ratio of 8.5. At the beginning of compression the air is at 1 bar and 32^0C and during the heat addition process the pressure is tripled. Calculate
      i. the thermal efficiency of the cycle and
      ii. the efficiency of the Carnot engine operating between the same overall temperature limits. [6+10]

2. What are the different kinds of fuels used in an IC engine? Discuss them in detail. [16]

3. (a) Which engine is more suitable for supercharging SI engine or CI engine? Why?
   (b) Describe with suitable sketches the following system of a carburettor.
      i. Power enrichment or economizer system.
      ii. Acceleration pump system. [4+12]

4. (a) What are the basic requirements of a good injection system.
   (b) Explain the importance of a fuel filter and draw a neat diagram of a filter used with oil injection system. [6+10]

5. An open cycle gas turbine plant consists of compressor, combustion chamber and turbine. The pressure and temperature at the inlet of compressor are 1 bar and 15^0C and at the inlet of the turbine are 5 bar and 650^0C. Assume ζ_e = 80%, ζ_t= 85%, ζ_m = 90% and ζ_{com} =98%. Assuming C_{pa} = 1 KJ/kg K, C_{pg} = 1.2 kJ/kg K and ν (for air) = 1.4 and r(for gases) = 1.334. Find
   (a) the thermal efficiency
   (b) work ratio of the cycle.

   If a regenerator of 65% effectiveness in introduced in the cycle, with a pressure loss of 0.2 bar to air side as well as gas side, find the percentage increase in the thermal efficiency of the cycle. [16]

6. A 15 cm outer diameter pipe is covered with 5 cm of insulation of thermal conductivity 0.093 W/mK and 4 cm insulation of thermal conductivity 0.07 W/mK. Calculate the heat loss from 100m of pipe if the inner and outer surface temperatures of the insulation are 400^0C and 30^0C respectively. What is the heat loss per $100m^2\Omega$ outer pipe surface? [16]

7. (a) Explain the difference between natural and forced convection.
   (b) State the Buckingham's Π-theorem. Using dimensional analysis obtain an expression for Nusselt number in terms of Reynolds and Prandtl numbers. [4+12]

8. (a) When a body is said to be black? What is the range of wave lengths it absorbs?
   (b) Compute the radiant energy loss from 1 cm diameter opening in a thin walled furnace located in a large enclosure, if the temperature with in the furnace is 900^0C and the surroundings are at 20^0C. [6+10]

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Code No: RR221403 **Set No. 4**

II B.Tech II Semester Regular Examinations, November/December 2005
THERMAL ENGINEERING AND HEAT TRANSFER
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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) A Carnot engine rejects heat 200 kJ/s to a cooling found at 27^0C. If the efficiency of the cycle is 30%, find the power of the engine and source temperature.
   (b) Compare Otto, Diesel and Dual cycles for the
      i. Same maximum pressure and heat input
      ii. Same maximum pressure and temperature
      iii. Same maximum pressure and output. [8+8]

2. (a) Describe the important qualities of a CI engine fuel.
   (b) Briefly describe the rating of CI engine fuel. [8+8]

3. (a) Why cooling of an I.C engine is necessary?
   (b) What are the various types of radiators? Is the name 'radiator' correct? Sketch the tube and fin arrangements in these radiators. [4+12]

4. (a) What do you understand by solid injection? What are its advantages over air-injection system?
   (b) Draw a schematic diagram of Bosch type fuel pump and explain its working. [8+8]

5. An open cycle gas turbine plant consists of compressor, combustion chamber and turbine. The pressure and temperature at the inlet of compressor are 1 bar and 15^0C and at the inlet of the turbine are 5 bar and 650^0C. Assume ζ_e = 80%, ζ_t= 85%, ζ_m = 90% and ζ_{com} =98%. Assuming C_{pa} = 1 KJ/kg K, C_{pg} = 1.2 kJ/kg K and ν (for air) = 1.4 and r(for gases) = 1.334. Find
   (a) the thermal efficiency
   (b) work ratio of the cycle.

   If a regenerator of 65% effectiveness in introduced in the cycle, with a pressure loss of 0.2 bar to air side as well as gas side, find the percentage increase in the thermal efficiency of the cycle. [16]

6. (a) What are different modes of heat transfer? Discuss the mechanism of conduction heat transfer in solids.
   (b) Identify the various modes of heat transfer in the following cases.
      i. Heat transfer from an auto radiator
      ii. Condensation of steam in condenser

iii. Heat loss from a thermos flask

iv. Protection of human body with warm clothing in winter. [8+8]

7. The parallel outer and inner walls of a building are 4m high and 5m long. The walls are 10 cm apart. The inner surface of the inner wall is at 25^0C and the inner surface of the outer wall is at 5^0C.

   (a) Calculate the total heat loss per hour.

   (b) If the air space is divided in half by a sheet of aluminium foil 0.025 mm thick parallel to the walls, what would be the heat loss per hour. [16]

8. (a) When a body is said to be black? What is the range of wave lengths it absorbs?

   (b) Compute the radiant energy loss from 1 cm diameter opening in a thin walled furnace located in a large enclosure, if the temperature with in the furnace is 900^0C and the surroundings are at 20^0C. [6+10]

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