D 30341 (3 pages) Name.....

Reg. No.....

THIRD SEMESTER B.TECH. (ENGINEERING) DEGREE EXAMINATION, DECEMBER 2003

EE 2K 303 / PT / PE 2K. 303 MECHANICAL ENGINEERING—I

(New Scheme)

Time : Three Hours Maximum : 100 Marks

Answer **all** *questions.*
Assume suitable data that are not given.
Use of Thermodynamic data books and Charts permitted.

1. (a) What are point functions and path functions ? Explain giving examples for each.

   (b) Apply the steady flow energy equation for calculation of work done in a turbine and exit velocity of flow through a nozzle.

   (c) State any *five* assumptions made in the devising of air standard cycles.

   (d) Sketch the open cycle gas turbine with a regenerator as flow diagram and on the T-s plane

   (e) Explain how high pressure boilers differ from conventional water tube boilers.

   (f) Sketch the layout of a hydel power plant employing impulse turbine and explain the functions of the components in it.

   (g) Give any *three* differences between Impulse steam turbines and Reaction steam turbines.

   (h) Deduce the expression for work done by a single stage single acting reciprocating air compressor.

   (8 × 5 = 40 marks)

2. (a) A cylinder contains 0.5 $m.^3$ of a gas at 0.1 MPa and 90° C., The gas is compressed to a volume of 0.125 $m.^3$ The final pressure is 600 kPa. Determine the work done and the heat transfer from or to gas during the process. Assume R = 0.287 kJ./kg K and C_v = 0.713 kJ./kgK.

   (9 marks)

   (b) Write the first law as a rate equation and hence deduce the steady flow energy equation and explain all the terms in it.

   (6 marks)

Or

Turn over

(c) Draw the Carnot cycle on P-V and T-s planes and obtain an expression for the thermal efficiency of the cycle.

(6 marks)

(d) 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° C, and engine B is in thermal communication with a sink at 4.4° C. If the work output of A is twice that of B find (a) the intermediate temperature between A and B, (b) the efficiency of each engine and (c) the heat rejected to the cold sink.

(9 marks)

3. (a) Discuss in detail the four stages of combustion observed in diesel engine using pressure-crank angle diagram.

(9 marks)

(b) With a neat sketch explain the air cycle refrigeration and deduce an expression for the C.O.P.

(6 marks)

Or

(c) In a gas turbine the pressure ratio used in 8. Determine the ideal efficiency. If the actual efficiency is 50 % of the above, determine the total fuel consumption in kg./hour for a 400 kW unit. The calorific value of the fuel is 42500 kJ./kg.

(6 marks)

(d) Draw the Mollier chart and represent the following processes on it : (i) constant pressure heating ; (ii) Throttling of wet steam to superheated steam ; (iii) isentropic expansion of superheated steam to wet steam.

(9 marks)

4. (a) Compare conventional and non-conventional energy sources. Also explain any *two* non-conventional energy sources in detail.

(8 marks)

(b) Give modern steam power plant layout and explain the various circuits in it. (7 marks)

Or

(c) Draw the layout of a Diesel power plant and explain the functions of components in it.

(8 marks)

(d) How are hydraulic turbines classified ? Explain. (4 marks)

(e) Explain the function of (i) draft tube and (ii) surge tank in hydel power plant. (3 marks)

5. (a) What is blade efficiency ? Derive an expression for the same. (6 marks)

(b) In a stage of impulse-reaction turbine operating with 50 % degree of reaction the blades are identical. The outlet angle of the fixed blades is 17° and the absolute discharge velocity of the steam is 50 m./s. in the direction at 110° to the motion of blades. Draw the velocity diagram and calculate the work done per kg. of steam flow per second.

(9 marks)

Or

(c) Give any *two* aviation application of gas turbine by showing neat sketches. (5 marks)

(d) A single stage single acting reciprocating compressor takes 5 $m.^3$ of air per minute at 1 bar and 15° C and delivers at 7 bar. The law of compression is $PV^{1.3} = C$ Neglecting the clearance volume calculate the indicated power.

(5 marks)

(e) With neat sketch explain the construction and operation of Roots (twin lobe) blower.

(5 marks)

[4 × 15 = 60 marks]