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Name.....

Reg. No.....

THIRD SEMESTER B.TECH. (ENGINEERING) DEGREE EXAMINATION DECEMBER 2004

EE 2K 303/PT/PE 2K 303–MECHANICAL ENGINEERING–I

(New Scheme)

Time : Three Hours Maximum : 100 Marks

Assume suitable data that are not given.
Use of thermodynamic data book and charts permitted.

Part A

1. Explain the thermodynamic concept of cyclic process and quasistatic process.
2. State the classical statements of II law of thermodynamics.
3. Give an expression for air standard efficiency of a dual cycle and explain the effect of compression ratio, cut–off ratio and explosion ratio on the efficiency of dual cycle.
4. Explain with a T–S diagram the various methods by which the efficiency of the simple Rankine cycle can be improved.
5. List out the advantages of IC engine power plants over the other type of power plants.
6. Differentiate between a boiler mounting and a boiler accessory with suitable examples.
7. Explain the fundamental difference between the operation of impulse and reaction steam turbines.
8. List and explain the advantages of multistage compression over the single stage compression in case of reciprocating compressors. (8 × 5 = 40 marks)

Part B

1. (a) State and explain the first law of thermodynamics and its corollaries.

   (b) Compare the following table for water

Sl. No.	T(°C)	P(kPa)	h(kJ/kg)	Dryness fraction	Phase description
1.		325		0.4	
2.	160		1682		
3.		950		0.0	
4.	80	500			

(6 + 9 = 15 marks)

Or

2. The velocity and enthalpy of a fluid at the inlet of a certain nozzle are 110 m/sec and 3000 kJ/kg. respectively. The enthalpy at the exit of the nozzle is 2500 kJ/kg. The nozzle is horizontal and adiabatic. Find

   (i) The velocity of the fluid at the exit of the nozzle,

   (ii) Mass flow rate if the inlet area is $0.1m^2$ and the specific volume is 0.19 m^3/kg.

   (iii) Exit area of the nozzle if the specific volume at the exit of the nozzle is $0.5m^3/kg$.

Turn over

3. (a) Explain the working of the diesel cycle with P–V and T–S diagrams and derive an expression for the air standard efficiency of the cycle.

   (b) Find out the percentage change in the air standard efficiency of the diesel cycle if the compression ratio changes from 5 to 10 with a constant cut off ratio of 2.5.

(8 + 7 = 15 marks)

Or

4. In a steam power plant operating, on the ideal Rankine cycle the steam enters the turbine at 5 MPa and 450°C and is condensed in the condenser at 15 kPa. Determine (a) Thermal efficiency of the plant (b) Thermal efficiency of the plant if boiler pressure is raised to 10 MPa while turbine inlet temperature is kept constant at 450°C.

5. Sketch and describe the working of a modern high–pressure boiler. Show the positions of different mountings and accessosaries and explain the functions of each.

Or

6. With a schematic layout explain the working of a diesel power plant. Discuss briefly the features of various subsystems and accessosaries of the power plant.

7. (a) Define the following terms for reaction turbines.

   (i) Diagram efficiency and (ii) Stage efficiency.

   (b) Determine the condition for maximum efficiency of a 50 % reaction turbine and show that the maximum efficiency for such a turbine is $[2 \cos^2 \alpha 1/ (1 + \cos^2 \alpha 1]$, where $\alpha 1$ is the angle at which the steam enters the blades.

(6 + 9 = 15 marks)

Or

8. (a) Explain the working of a centrifugal compressor with a neat sketch and derive an expression for the power input for unit mass flow rate of air delivered.

   (b) Derive expressions for the indicated power of a reciprocating compressor from the fundamentals considering and neglecting the clearance volume.

(8 + 7 = 15 marks)

[4 × 15 = 60 marks]