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Total No. of Questions: 09] **[Total No. of Pages: 02**

B. Tech. (Sem. – 1st & 2nd)
ELEMENTS OF MECHANICAL ENGINEERING
SUBJECT CODE: ME - 101 (2004 - 2010 Batch)
Paper ID: [A0123]

Time: 03 Hours **Maximum Marks: 60**

Instruction to Candidates:

1) Section - A is **Compulsory**.
2) Attempt any **Five** questions from Section - B & C.
3) Select atleast **Two** questions from Section - B & C.

Section - A ***(2 Marks each)***

Q1) a) On a hot summer day, a student turns his fan on when he leaves his room in the morning. When he returns in the evening, will the room be warmer or cooler than the neighboring rooms? Why? Assume all the door and windows are kept closed?

b) Can a steady state device have boundary work? Discuss?

c) If the efficiency of a power plant goes up as the low temperature drops why not let the heat rejection go to a refrigerator at say –10ºC instead of ambient 20ºC?

d) How internal combustion engines can be classified on the basis of cylinder arrangement?

e) For the same maximum pressure and work output, compare Otto cycle and Diesel cycle on P-v and T-s diagrams.

f) What is the difference between a nozzle flow and a throttle process?

g) How does a lifting machine can lift more load than the applied load?

h) State the purpose of cam shaft and piston rings in an I.C. engine?

i) Draw neat sketches of any two inversions of four bar kinematic chain?

j) Differentiate between creep and fatigue?

Section - B ***(8 Marks each)***

Q2) a) An insulated vessel containing 5 kg of liquid water at 38ºC, 1 kg of ice at OºC is placed. Calculate the temperature of the water when the ice is completely melted. Take the latent heat of fusion of ice as 335 kJ/kg and specific heat of water as 4.19 kJ/kg – ºC.

b) A gas having mass 4.5 kg undergoes a process from 50ºC to 100ºC. If the specific heat of the gas is a function of temperature alone, calculate the heat transfer during the process for the relation

$$C_p = 1.256 + \frac{80}{T + 50}\ \text{Kj/Kg} - \text{K}$$

Q3) a) A reversible heat engine operates between two reservoirs at temperatures of 600ºC and 40ºC. The engine drives a reversible refrigerator, which operates between 40ºC and - 20ºC. The heat transfer to the engine is 2000 kJ and the network output from the combined engine and the refrigerator system is 360 kJ. Calculate heat transfer to the refrigerator and net heat transfer to the reservoir at 40ºC.

b) List down the factors that render a process to be irreversible.

Q4) a) The mass rate of flow into a steam turbine is 1.5 kg/s, and the heat transfer from the turbine is 8.5 kW. The following data are known for the steam entering and leaving the turbine.

	Inlet	Outlet
Enthalpy	3137.0 kJ/kg	2675.5 kJ/kg
Velocity	50 m/s	200 m/s
Elevation above reference plane	6 m	3 m

Find the power output of the turbine.

b) Why specific heat of air at constant pressure is greater than specific heat at constant volume?

Q5) a) 2 kg of water at 367 K is mixed with 3 kg of water at 283 K in an isolated system. Calculate the change in entropy due to mixing process.

b) Show that the change of entropy during a polytropic process for a perfect gas per unit mass is given as $s_2 - s_1 = C_v \left(\frac{\gamma - n}{n - 1}\right) \ln \frac{T_1}{T_2}$.

Section - C ***(8 Marks each)***

Q6) a) Prove that the optimum pressure ratio r_p for maximum net work done between the temperatures T_1 and T_3 for a Brayton cycle is given by? $r_p = \left(\frac{T_3}{T_1}\right)^{\frac{\gamma}{2(\gamma-1)}}$

b) A diesel engine operating on diesel cycle has 20 cm bore and 30 cm stroke. The clearance volume is 420cm^3. The fuel is injected at constant pressure for 5% of the stroke. Calculate the air standard efficiency. If the cutoff is delayed from 5% to 8%, what will be the percentage loss in efficiency. Assume same compression ration in both cases?

Q7) a) Establish a relation between Young's modulus, modulus of rigidity and bulk modulus?

b) A specimen of steel 20 mm diameter with a gauge length of 200 mm is tested to destruction. It has an extension of 0.25 mm under a load of 80 kN and the load at elastic limit is l02 kN. The maximum load is 130 kN. The total extension at fracture is 56 mm and diameter at neck is 15 mm. Find

i) The stress at elastic limit
ii) Young's modulus
iii) Percentage elongation
iv) Percentage reduction in area
v) Ultimate tensile stress

Q8) a) In a lifting machine whose velocity ratio is 50, it was found that an effort of 100 N was necessary to lift a load of 4000 N. Is the machine reversible? If so, what effort could be removed so that the machine is at the point of reversing?

b) Explain the working of a pantograph with neat sketches.

Q9) a) Explain the working of two stroke C.I. engine with the help of neat sketches.

b) A steel rod 1 cm in diameter is subjected to an axial load of 200 N. If the diameter of the bar is increased by 10%, find the change in strain energy per unit length of the rod.

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