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Total No. of Questions : 09] [Total No. of Pages : 03

B.Tech. (Sem. - 1st/2nd)

ELEMENTS OF MECHANICAL ENGINEERING

SUBJECT CODE : ME - 101(2K4 & Onwards)

Paper ID : [A0114]

[Note : Please fill subject code and paper ID on OMR]

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 at least **Two** questions from section - B & C.

Section - A

Q1) **[Marks : 2 Each]**

a) What do you understand by Quasi-static process? How it is achieved?

b) Discuss concept of thermal equilibrium.

c) Write and explain analytical expression applicable for a process and cycle.

d) What are non flow processes? Give suitable examples.

e) Discuss equivalence of various statements of second law of thermodynamics.

f) What is air standard efficiency?

g) Differentiate between mechanism and machine.

h) What is Poisson's ratio?

i) Describe creep and fatigue.

j) What do you understand by throttling process?

Section - B

[Marks : 8 Each]

Q2) (a) Define wok. Show that work done $\delta W = pdV$.

(b) The pressure volume correlation for a non flow reversible process is given by $p = (8-4V)$ bar, where V is in m^3. If 150 kJ of work is supplied to the system, determine the final pressure and volume. Take initial volume = 0.6 m^3.

Q3) Air initially at 60 kPa pressure, 800 K temperature and occupying a volume of 0.1m^3 is compressed isothermally till the volume is halved and further it goes compression at constant pressure till the volume is halved again. Sketch the process on p-V diagram and make calculations for total work done and total heat interaction for the two processes. Assume ideal gas behaviour for air and take c_p = 1.005kJ/kg K.

Q4) A centrifugal pump delivers 2750 kg of water per minute from initial pressure of 0.8 bar absolute to a final pressure of 3.8 bar absolute. The suction is 2 m below and delivery is 5 m above the centre of pump. If the suction and delivery pipes are of 15 cm and 10 cm diameter respectively, make calculations for power required to run the pump. Density of water = 1000kg/m^3.

Q5) Two reversible heat engines E_1 and E_2 are arranged in series between a hot reservoir at temperature T_1 of 600 K and a cold reservoir at temperature T_2 of 300 K. Engine E_1 receives 500 kJ of heat from reservoir at T_1. Presuming that both engines have equal thermal efficiency determine:

(a) The temperature at which heat is rejected by E_1 and is received by engine E_2.

(b) The thermal efficiency of each engine.

(c) Work done by engine E_1 and E_2.

(d) The heat rejected by engine E_2 to cold reservoir.

Section - C

[Marks : 8 Each]

Q6) A reversible heat engine operates between 875 K and 310 K and drives a reversible refrigerator operating between 310 K and 255 K. The engine receives 2000 kJ of heat and the net work output from the arrangement equals 350 kJ. Make calculations for cooling effect.

Q7) (a) What is cut off ratio? How it affects the air standard efficiency of diesel cycle?

(b) With the help of p-V and T-s diagram show that for same maximum pressure and heat input

$$\eta_{diesel} > \eta_{dual} > \eta_{otto}$$

Q8) (a) Define velocity ratio, mechanical advantage and efficiency of a machine.

(b) The upper block of the differential pulley block has two pulleys of diameter 250 mm and 200 mm. What load will be lifted by this machine by the application of an effort equal to 20 N? Take efficiency of the system as 60 percent.

Q9) Two vertical rods of steel and copper are firmly secured at their upper ends and lie at a distance of 100 cm apart. Each rod is of 3 m length and 30 mm in diameter. A horizontal rigid cross bar connects the lower ends of the rod and on it is placed a load of 40kN. Determine:

(a) Location of the load on the cross bar if it remains horizontal even after being loaded.

(b) What will be the inclination of the cross bar if the load is hung at its mid span?

Take E for steel = 2×10^5 N/mm^2, E for copper = 1×10^5 N/mm^2.

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