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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 atleast **Two** questions from Section - B & C.

Section - A

Q1) ***(Marks : 2 Each)***

a) What are similarities and dissimilarities between heat and work?

b) What is reversible process? Also write conditions for reversibility.

c) Why gases have two specific heats?

d) What is PMM1 (perpetual motion machine of first kind)?

e) How COP of heat pump and refrigerator are related?

f) What is mean effective pressure and what is its role in gas power cycles?

g) List different systems of pulleys.

h) What are temperature stresses?

i) What is significance of elastic constant?

j) What are the limitations of first law of thermodynamics?

Section - B

(Marks : 8 Each)

Q2) (a) Define and explain Zeroth law of thermodynamics? Why it is so called?

(b) A new temperature scale in degrees N is desired with freezing point at 100° N and the boiling point at 400° N. Establish a correlation between degrees Celsius and degrees N. What would be the absolute temperature at 0° N?

Q3) Air initially at 90 kPa pressure, 700 K temperature and occupying a volume of 0.5 m^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 = 1.004 kJ/kg K.

Q4) (a) Explain and derive steady flow energy equation.

(b) A perfect gas flows through a nozzle where it expands in a reversible adiabatic manner. The inlet conditions are 22 bar, 500° C, 38 m/s. At the exit the pressure is 2 bar. Determine the velocity and exit area if the flow rate is 4 kg/s. Take R = 190 J/kg K and γ = 1.35.

Q5) (a) State and explain Carnot theorem.

(b) Write various statements of second law of thermodynamics and also show their equivalence.

Section - C

(Marks : 8 Each)

Q6) A reversible heat engine operates within the higher and lower temperature limits of 1400 K and 400 K respectively. The entire output from this engine is utilized to operate a heat pump. The pump works on reversed Carnot cycle, extracts heat from a reservoir at 300 K and delivers it to the reservoir at 400 K. If 100 kJ/s of net heat is supplied to the reservoir at 400 K, calculate the heat supplied to the engine by the reservoir at 1400 K.

Q7) In an air standard diesel cycle, the compression ratio is 15 and the pressure and temperature of the air at the beginning of the compression are 1 bar and 288 K. The peak temperature in the cycle is 2700 K. Calculate

(a) Heat supplied;

(b) Work done;

(c) Cycle efficiency;

(d) Peak pressure of the cycle;

(e) Cut-off ratio, and

(f) Mean effective pressure.

Q8) (a) Draw stress-strain diagram and explain various salient features.

(b) A conical bar tapers uniformly from a diameter of 4 cm to 15 cm in a length of 40 cm. If an axial force of 80 kN is applied at each end, determine the elongation of the bar. Take E = 200 GPa.

Q9) (a) Define kinematic link, kinematic pair and kinematic chain.

(b) In a differential wheel and axel, the diameter of the larger axel is 250 mm and that of the smaller is 225 mm. the diameter of the effort wheel is 500 mm. find the velocity ratio. If an effort of 150 N lifts a load of 3.5 kN, what is the efficiency and effort lost in friction?

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