HAS (mains) -2021

This question paper contains **5** printed pages]

Roll Number

ASME-21-MEEG–(II)

MECHANICAL ENGINEERING (PAPER-II)

Time Allowed : 3 Hours] [Maximum Marks : 100

QUESTION PAPER SPECIFIC INSTRUCTIONS

Please read each of the following instructions carefully before attempting questions.

1. There are **EIGHT** questions printed in English.
2. Candidate has to attempt **FIVE** questions in all.
3. Question No. **1** is compulsory. Out of the remaining SEVEN questions, **FOUR** are to be attempted.
4. *All* questions carry equal marks. The number of marks carried by a question/part are indicated against it.
5. Write answers in legible handwriting.
6. Wherever any assumptions are made for answering a question, they must be clearly indicated.
7. Diagrams / Figures, wherever required, shall be drawn neatly. Unless otherwise mentioned, symbols and notations carry their usual standard meanings.
8. Attempts of questions shall be counted in sequential order. Unless struck off, attempt of a question shall be counted even if attempted partly. Any page or portion of the page left blank in answer book must be clearly struck off.
9. Re-evaluation/Re-checking of answer book of the candidate is not allowed.
10. Use of calculators is allowed.

1. (*a*) 4 kg of air at 80°C and 500 kPa, expands in a adiabatic process in a closed system until its volume becomes two times and its temperature becomes same as that of the surroundings which is at 5°C and 100 kPa. For this process, calculate the maximum work and change in availability.

For air, assume: C_v = 0.718 kJ/kg K; U : C_vT where C_v is constant; pV = mRT where p is pressure in kPa, V is volume in m^3, m is mass in kg, R is a constant with value of 0.287 kJ/kgK and T is temperature in K. 10

(*b*) (*i*) A CI engine is more economical than an SI engine with reference to fuel consumption. Do you agree and justify your answer ?

(*ii*) What is the difference between concentrator collector and non-concentrator collector for solar energy ? Explain with neat sketches. 2×5

2. (*a*) Explain Carnot cycle with a P-V diagram. Describe the working of Carnot heat engine. 10

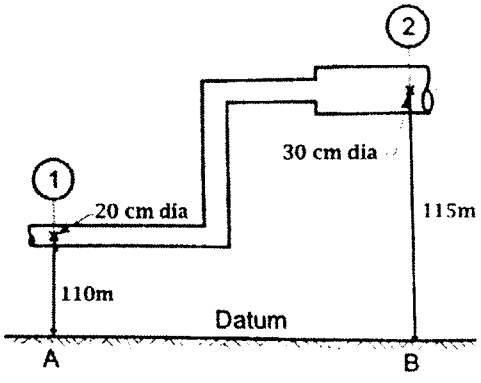
(*b*) A rectangle represents an ideal gas cycle on a P-V diagram. P_A & P_B are the lower and the higher pressures and V_A & V_B are the smaller and the larger volumes respectively. Calculate the work done per cycle and with the help of the diagram, also show which parts of the cycle involve heat flow into the gas. If heat capacities are constant, then show that : 10

$$\eta = \frac{\gamma - 1}{\frac{\gamma P_B}{P_B - P_A} - \frac{V_A}{V_A - V_B}}$$

3. State and explain Bernoulli equation. Water flows through a pipeline lying at different elevations as shown in the diagram. At point 'A', elevation is 110 m and diameter of pipe is 20 cm whereas at point B elevation is 115 m and diameter of pipe is 30 cm. When a discharge of 50 L/s of water is passed through the pipe, section 'A' shows a pressure of 30 kPa. Assuming energy loss in the pipe is 2 m, calculate the pressure at section 'B' under following two conditions :

(*i*) Water is flowing from 'A' to 'B'

(*ii*) Water is flowing from 'B' to 'A'. 20



4. (*a*) Explain the concept of boundary layer. What is separation phenomenon and explain how it can be controlled ? 10

(*b*) Explain the working of a single acting reciprocating pump, using a neat sketch. 10

5. (*a*) A 20 kW heater is to be made using a NiCr alloy wire which has a resistivity of 100 μΩ-cm. The maximum surface temperature of the wire can be 1220°C, atmospheric air temperature is 20°C, outside surface coefficient is 1.15 kW/m^{2}K and thermal conductivity of the wire material is 17 W/mK. If heater is 1 m long, calculate the diameter of NiCr alloy wire required. What will be the rate of current flow ? 10

(*b*) With a schematic diagram explain the working of a domestic refrigerator. 10

6. (*a*) Explain the working of evaporative condenser and a water cooled condenser using neat sketches. 10

(*b*) A pipe, with an outside diameter of 30 cm, is passing through a room. It is carrying steam and is exposed to outside air having temperature of 30°C. If surface temperature of pipe is 400°C and emissivity of pipe surface is 0.8; calculate the heat loss per meter of pipe due to thermal radiation to the surroundings. If same pipe is enclosed in a 50 cm diameter conduit having emissivity 0.91, then calculate the loss of heat due to radiation. 10

7. (*a*) What is multi-point fuel ignition system and how it is advantageous ? Explain the working of throttle body injection system. 10

(*b*) A four cylinder and four stroke diesel engine develops a break power of 60 kW, when running at 2200 rpm. Calculate fuel consumption (kg/s), air consumption (m^3/s), indicated thermal efficiency, volumetric efficiency and break mean effective pressure. Use the following data :

CV of fuel = 40 MJ/kg, break thermal efficiency = 30%, engine bore = 120 mm, Stroke length = 100 mm, air fuel ratio = 15:1, η_m = 80%, ρ_a = 1.15 kg/m^3. 10

8. (*a*) Briefly describe :

(*i*) What are advantages and disadvantages of alcohol as a fuel for an IC engines ?

(*ii*) What is cavitation in turbines ? Discuss remedies to minimise it. 2×5

(*b*) (*i*) How does an economiser increase the efficiency of a boiler ?

(*ii*) What is dry ice and why is it called so ? Discuss any *four* applications. 2×5