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3 Hours / 100 Marks Seat No. | | | | | | | | |

Instructions – (1) All Questions are *Compulsory.*

(2) Answer each next main Question on a new page.

(3) Illustrate your answers with neat sketches wherever necessary.

(4) Figures to the right indicate full marks.

(5) Assume suitable data, if necessary.

(6) Use of Non-programmable Electronic Pocket Calculator is permissible.

(7) Mobile Phone pager and any other Electronic Communication devices are not permissible in Examination Hall.

(8) Use of Steam tables, logarithmic, Mollier's chart is permitted.

(9) Preferably, write the answers in sequential order.

Marks

1. a) **Attempt any SIX of the following:** **12**

(i) Define thermodynamic system.

(ii) State clausius statement.

(iii) Write equation of state and name various terms used in it.

(iv) Draw isochoric process on P-V and T-S diagram.

(v) Define boiler mountings with two examples.

(vi) Write continuity equation of steam nozzle.

(vii) What is Mach number? State its significance.

(viii) Define condenser efficiency.

P.T.O.

Marks

b) **Attempt any TWO of the following:** **8**

(i) Differentiate between boiler mountings and accessories.

(ii) State the sources of air leakage and its effects in steam condenser.

(iii) Classify heat exchangers and state their applications.

2. Attempt any FOUR of the following: **16**

a) Differentiate between heat and work.

b) A gas occupying 0.26 m^3 at 300°C and 0.4 MPa pressure expands till volume becomes 0.441 m^3 and pressure 0.26 MPa. Calculate the change in internal energy per kg of gas
C_p = 1 KJ/kg K, C_v = 0.71 KJ/kg k

c) Explain the steam generation process for 1 kg water at 0°C under constant pressure with T-h diagram.

d) Differentiate between impulse and reaction turbine.

e) Why compounding of steam turbine is done? State different types of compounding.

f) Write steady flow energy equation and apply it to nozzle and turbine.

3. Attempt any FOUR of the following: **16**

a) Differentiate between open system and closed system.

b) Represent the following gas processes on P-V and T-S diagram:

(i) Isobaric

(ii) Isothermal

c) Explain with neat sketch working of cochran boiler.

d) Explain with neat sketch working of regenerative feed heating system.

e) Compare jet condenser with surface condenser (any four points)

f) Define free convection and forced convection. Give one example of each.

Marks

4. Attempt any FOUR of the following: **16**

a) Define point function and path function with two examples of each.

b) What is boiler draught? State its necessity.

c) Explain working of impulse steam turbine by using pressure velocity variation diagram.

d) Determine the rate of heat flow through the boiler wall made of 3 cm thick steel and covered with an insulating material of 0.5 cm thick. The temperature of wall inside boiler is 300°C and temperature of outer surface is 50°C.

Assume K for steel = 60 W/mK

K for insulation = 0.12 W/mK

e) The vacuum in a surface condenser is 705 mm of Hg and the barometer reading is 760 mm of Hg. The outlet and inlet temperature of cooling water to condenser is 37.5°C and 30°C respectively. Determine condenser efficiency.

f) Determine the state of steam if:

(i) Pressure is 10 bar and specific volume is 0.185 m^3/kg

(ii) Pressure is 12 bar and temperature is 200°C

5. Attempt any TWO of the following: **16**

a) Explain the application of second law of thermodynamics to heat engine.

b) What is governing of steam turbine.? Explain with neat sketch nozzle control governing.

c) 1 kg of air at a pressure of 14 bar occupies 0.6 m^3 and from this condition it expands to 1.4 bar according to law $PV^{1.25} = C$. Find:

(i) Change in internal energy

(ii) Work done by air

Assume C_p = 1.005 KJ/kg K and

C_v = 0.718 KJ/kg K

Marks

6. Attempt any TWO of the following: **16**

a) Explain construction and working of surface condenser with neat sketch.

b) Explain the construction and working of Babcock and Wilcox boiler with neat labelled sketch.

c) A steam pipe of 16 cm inside diameter and 17 cm outside diameter (K = 58 W/mk) is covered with first layer of insulating material of 3 cm thick (K = 0.17 W/mk) and second layer of insulating material 5 cm thick (K=0.093 W/mk). The temperature of steam passing through the pipe is 300°C and atmosphere is 30°C.

Take h_i = 30 W/m^2K

h_o = 5.8 W/m^2K

Find the heat lost per metre length of pipe.

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