17410

21718

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.

Marks

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

(i) Define 'Extensive' property. Give two examples.

(ii) State Zeroth law of thermodynamics.

(iii) State Charle's law.

(iv) What is universal gas constant? State its unit.

(v) Define 'dryness fraction' of steam.

(vi) List four applications of nozzle.

(vii) State the functions of steam condenser.

(viii) State the Dalton's law of partial pressure.

Marks

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

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

(ii) Define, wet steam, dry saturated steam and superheated steam. Mention dryness fraction for each.

(iii) State Fourier's law and Stefan-Boltzman law.

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

a) Distinguish between open system and closed system giving their examples.

b) Compare fire tube boiler and water tube boiler.

c) One kg of air is heated in a closed vessel from a pressure of 2 bar to 5 bar. If the initial temperature of the air is 302°K. Determine the final temperature and change in internal energy of air. Take Cv = 0.712 KJ/kg°K.

d) Explain working of impluse steam turbine with pressure-velocity variation diagram.

e) Explain the process of regenerative feed heating with neat sketch.

f) A carnot refrigerator requires 1.5 KW/ton of refrigeration, to maintain temperature of –20°C. Find,

(i) C.O.P. of refrigerator

(ii) Temperature at which heat is rejected.

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

a) Write general steady flow energy equation and apply it to boiler and condenser.

b) Represent following ideal gas process on P-V and T-S diagram:

(i) Isobaric process

(ii) Isothermal process

(iii) Adiabatic process

(iv) Polytropic process

Marks

c) Calculate the enthalpy of 1 kg of steam at a pressure of 7 bar and dryness fraction 0.8. How much heat would be required to generate 2 kg of this steam from water at 30°C.

Take Cpw = 4.187 kJ/kg°K.

d) Explain nozzle control governing of steam turbine.

e) What is function of cooling tower in steam power plant? List various types of cooling towers and sketch any one.

f) Write various modes of heat transfer. Give one example of each mode.

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

a) Give various statements of 1st law of thermodynamics.

b) List four boiler mountings and accessories giving function of each.

c) Give classification of steam turbine.

d) Define 'A perfect black body' By considering a body. Explain the terms - absorpitivity, transmissivity and reflectivity.

e) Define vacuum efficiency and condenser efficiency?

f) Wet steam at 10 bar pressure having total volume of 0.125 m^3 and enthalpy content is 1800 KJ. Calculate mass and dryness fraction of steam.

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

a) (i) State Kelvin-Plank statement and Clausius statement of second law.

(ii) Prove that the Kelvin-Plank and Clausius statements are equivalent.

b) Why compounding of steam turbine is necessary. State methods of compounding and describe any one in brief.

Marks

c) At the begining of compression a cylinder contains 750m^3 of gas at a pressure of 100 KN/m^2 absolute. Compression takes place according to law $PV^n = C$. Untill pressure is 780 KN/m^3 absolute. If the final volume is 1/5 of original volume find,

(i) Index of compression

(ii) Work done during compression

(iii) Heat rejected during compression
Take $\gamma = 1.4$

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

a) (i) Compare jet and surface condenser on the basis of construction, performance and application.

(ii) Describe with sketch working of surface condenser.

b) (i) Draw Temperature - Entropy diagram for formation of steam and show the following on it.

1) Saturated liquid line

2) Wet region

3) Critical point

4) Dryness fraction lines.

(ii) Draw neat sketch of Lamont boiler.

c) (i) A metal pipe having diameter of 150 mm carries steam at 250°C. The pipe is covered externally by a 25 mm thick of insulating material whose thermal conductivity is 0.112 W/m°K. If outside temperature is 38°C. Find out amount of heat lost per meter length per minute.

(ii) Give any four applications of heat exchangers and also state commonly used materials for it.
Extract from steam table

P bar	ts °C	Vg m^3/kg	hf kJ/kg	hfg kJ/kg	hg kJ/kg
7	164.96	0.2729	697.20	2066.3	2763.5
10	179.91	0.19429	762.79	2015.3	2778.1

Note: Please ensure above values from standard steam table. It may vary slightly.