Scheme – I

Sample Question Paper

Program Name : **Mechanical Engineering Program Group**
Program Code : **ME / PG / PT**
Semester : **Third**
Course Title : **Thermal Engineering**
Marks : **70** **Time: 3 Hrs.**

22337

Instructions:

(1) All questions are compulsory.
(2) Illustrate your answers with neat sketches wherever necessary.
(3) Figures to the right indicate full marks.
(4) Assume suitable data if necessary.
(5) Preferably, write the answers in sequential order.
(6) Use of steam table and Mollier chart is permitted.

Q.1) Attempt any FIVE of the following. **10 Marks**

(a) Explain similarities between Heat & Work.
(b) State Avogadro's law.
(c) Define sensible heat and latent heat
(d) Define bleeding and regenerative feed heating.
(e) Explain the purpose of governing of steam turbines.
(f) Define Mach number and critical pressure.
(g) Define thermal Conductivity. State it's Unit.

Q.2) Attempt any THREE of the following. **12 Marks**

(a) Apply steady state energy equation with a block diagram to Boiler & IC Engine
(b) Define isothermal process and plot it on Pv & Ts diagrams.
(c) Describe generation of steam at constant pressure with temperature enthalpy diagram
(d) Define enthalpy of evaporation, dryness fraction, degree of superheat

Q.3) Attempt any THREE of the following. **12 Marks**

(a) Explain different losses in steam turbines
(b) Explain principle of working of reaction steam turbine with a sketch.
(c) Air is expanded from 7 bar and 80 ^{o}C to 1 bar according to law $PV^{1.2} = C$. Plot the process on Pv & Ts diagram and state the formula to be used to find out the work done during the above process.
(d) Steam expands from 20 bar and 300 ^{o}C to 1 bar at constant entropy. Using mollier chart, find change in enthalpy during the process.

Q.4) Attempt any THREE of the following. **12 Marks**

(a) Differentiate surface and jet condensers (any four points).

(b) A steel flask of 0.04 m^3 capacity is to be used to store nitrogen at 120 bar and 20 ^oC. The flask is protected against excessive pressure by a fusible plug which will melt and allow gas to escape if temperature rise is too high.

i. Estimate mass of nitrogen in kg, the flask will hold at designed condition?

ii. At what temperature fusible plug will melt in order to limit pressure of flask to a maximum of 150 bar. Take R = 287 J/Kg K (2)

(c) 1 kg of air at a pressure of 8 bar and a temperature of 100 ^oC undergoes a reversible polytropic process following the law $Pv^{1.2} = C$. If final pressure is 1.8 bar, find final specific volume and temperature. Use R = 287 J/Kg K and $\gamma = 1.4$ for air (2)

(d) Draw a labeled sketch of plate heat exchanger. (6)

(e) In the given formula for a steam condenser, state meanings of different terms involved with their units.

$$\eta_{vaccum} = \frac{P_{baro} - P_{abs}}{P_{baro} - P_{sat}}$$

Q.5) Attempt any TWO of the following. 12 Marks

(a) Attempt the following

i. Suggest measure to improve thermal efficiency of steam turbine power plant and also discuss limitations for the same.

ii. Suggest method for governing of reaction turbines and also discuss limitations for the same.

(b) A thermo pane window consists of two 5 mm thick glass (k = 0.78 W / m K) sheets separated by 10 mm stagnant air gap (k = 0.025 W / m K). The convection heat transfer coefficient for inner and outer air are 10 W / m^2 K and 50 W / m^2 K. Determine rate of heat loss per m^2 of the glass surface for a temperature difference of 60 ^oC between inside and outside air. Compare results of heat loss if window has only single sheet of glass of thickness 5 mm instead of thermo pane.

(c) Attempt the following

i. A steam sample was taken at certain point. The mass of water was found 90% more than mass of dry steam. Find dryness fraction.

ii. If above steam is at 5 bar find enthalpy required to make it dry saturated.

Q.6) Attempt any TWO of the following. 12 Marks

(a) Attempt the following

i. The enthalpy across a device decreases by 2000 kJ/Kg and the heat transfer from the device is 50 kJ/Kg. Find the power developed assuming device a steam turbine. Take mass flow rate of steam as 1.3 kg/s and neglect kinetic energy changes.

ii. The room temperature was found to be maintained at 18 ^oC when atmosphere was at 36 ^oC. Find the Coefficient of Performance of air-conditioner used assuming it is working on carnot cycle.

(b) Following data is available for a power plant

i. Steam Power Plant of 250 MW capacity.

ii. Water handled by condenser is large.

iii. Water available for cooling is saline water.

Select a condenser to be required in above situations with justification

(c) A typical application is to be designed to maintain -15 ^{o}C in a chamber. The atmosphere is at 29 ^{o}C. Thermal conductivity values for different materials used are: *Steel – 50 W/mK, Brass – 125 W/mK.* Select material from above which will give least thickness required for unit heat flow per unit area. Use electrical analogy to solve the problem.

Scheme – I

Sample Test Paper - I

Program Name : **Mechanical Engineering Program Group**
Program Code : **ME/PT/Fabrication Technology**
Semester : **Third**
Course Title : **Thermal Engineering**
Marks : **20**

22337

Time: 1 Hour

Instructions:

(1) All questions are compulsory.
(2) Illustrate your answers with neat sketches wherever necessary.
(3) Figures to the right indicate full marks.
(4) Assume suitable data if necessary.
(5) Preferably, write the answers in sequential order.

Q.1) Attempt any FOUR of the following. **08 Marks**

a) State Zeroth Law of Thermodynamics. Give application of the same
b) State assumptions for Steady State Energy Equation.
c) What is Universal gas constant? State it's Value with unit.
d) Define adiabatic process and polytropic process.
e) Differentiate refrigerator with heat pump.
f) Write characteristic gas equation & state meaning of each term involved write unit for each term.

Q.2) Attempt any THREE of the following. **12 Marks**

a) Describe with examples flow work and non flow work.
b) Find enthalpy change when 3 kg of air expands at constant pressure. Initial conditions of air are 1 m^3 & 30 ^oC. Final conditions of air are 1.5 m^3 and 80 ^oC.
c) Sketch Pv & Ts diagrams for constant volume process.
d) Find characteristic gas constants for CO_2, N_2, O_2. Value of Universal gas constant is 8.314 kJ/Kg mole K. Values of atomic weights are C – 12, O – 16, N – 14.

Scheme – I

Sample Test Paper - II

Program Name : **Mechanical Engineering Program Group**
Program Code : **ME/PT/Fabrication Technology**
Semester : **Third**
Course Title : **Thermal Engineering**
Marks : **20**

22337

Time: 1 Hour

Instructions:

(1) All questions are compulsory.
(2) Illustrate your answers with neat sketches wherever necessary.
(3) Figures to the right indicate full marks.
(4) Assume suitable data if necessary.
(5) Preferably, write the answers in sequential order.
(6) Use of steam table and Mollier chart is allowed.

Q.1) Attempt any FOUR of the following. **08 Marks**

a) Define Dryness fraction, wet steam.
b) Select nozzles for different types of turbines.
c) State need of condenser in a power plant.
d) State Fourier's law of conduction.
e) Differentiate mountings and accessories.
f) Define boiler draught.

Q.2) Attempt any THREE of the following. **12 Marks**

a) Sketch any one high pressure, water tube boiler and label it.
b) Differentiate between impulse and reaction turbine.
c) Explain 1. Governing 2. Compounding in steam turbines.
d) Temperature rise in cooling water of a steam condenser was found 50 ^{o}C. Inlet temperature of water is 30 ^{o}C. Find condenser efficiency if absolute pressure in condenser is 60 mm of Hg.