Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–IV(New) EXAMINATION – SUMMER 2016

Subject Code:2140907 Date:26/05/2016

Subject Name:Applied Thermal and Hydraulic Engineering

Time:10:30 AM to 01:00 PM Total Marks: 70

Instructions:

1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**
4. **Use of steam tables and Mollier chart are permissible.**

Q.1 Short Questions **14**

1 What do you mean by steam rate and heat rate? What are their units?
2 Sate the variables affecting efficiency of simple Rankine cycle.
3 What is the effect of intercooling on thermal efficiency of gas turbine plant?
4 Why aircraft cooling is required?
5 Why is compression process required in vapour compression refrigeration system?
6 What is dry and wet compression in vapour compression refrigeration system?
7 What is a 'black body'? How does it differ from a gray body?
8 What is 'fouling' in heat exchangers?
9 Define the term capillarity.
10 What is Net Positive Suction Head (NPSH)? State its importance.
11 Why splitter is provided to the bucket of Pelton wheel turbine?
12 Classify completely: Kaplan turbine.
13 State Newton's law of cooling.
14 State Kirchhof's law of radiation.

Q.2 **(a)** Give comparison between open cycle and closed cycle gas turbines. **03**

(b) When does the reheating of steam become necessary? Explain the effect of reheat on cycle output and efficiency. **04**

(c) A steam turbine plant equipped with a regenerative feed heater operates under the following conditions: **07**

Initial steam pressure = 20 bar, Extraction pressure = 4 bar
Initial super heat = 100^{o}C, Exhaust pressure = 0.05 bar

Neglecting pump work, compare the regenerative and non-regenerative cycle with respect to the following: (i) thermal efficiency, and (ii) steam consumption in kg/kWh.

OR

(c) An R-134a vapour compression system has saturated suction temperature of 0^{o}C, and saturated discharge temperature is 40^{o} C. The refrigerant vapour is dry saturated at the suction of compressor and becomes superheated after the compression. For one ton of refrigeration capacity, calculate (i) refrigerating effect, (ii) mass flow rate, (iii) power required, (iv) COP of the system. **07**

Use following properties of R-134a:

Saturation temperature °C	Specific enthalpy kJ/kg		Specific entropy kJ/kg K		Specific heat kJ/kg K	
	Liquid	Vapour	Liquid	Vapour	Liquid	Vapour
40	256.41	419.43	1.1905	1.7111	1.498	1.145
0	200.00	398.6	1.000	1.7271	1.341	0.897

Q.3 **(a)** What is the function of fins in heat transfer? State applications of fins. **03**

(b) Explain with schematic diagram open cycle gas turbine with regeneration. **04**

(c) The air enters the compressor of an open cycle constant pressure gas turbine at a pressure of 1 bar and temperature 25°C. The pressure of air after compression is 5 bar. The isentropic efficiencies of compressor and turbine are 85%. The air fuel ratio used as 90:1, the flow rate of air is 3 kg/s. Find: (i) power developed, and (ii) thermal efficiency of cycle. Assume: C_p = 1.005 kJ/kg and γ = 1.4 for air and gas, and Calorific value of fuel = 41,800 kJ/kg. **07**

OR

Q.3 **(a)** Define the terms: (i) Viscosity, (ii) Cohesion and adhesion, and (iii) Surface tension. **03**

(b) Plot the temperature distribution along the length of following heat exchangers: **04**

(i) parallel flow, (ii) counter flow, (iii) evaporator, and (iv) condenser.

(c) Flow rates of hot and cold water streams running through a parallel flow heat exchanger are 0.25 kg/s and 0.6 kg/s respectively. The inlet temperatures on the hot and cold sides are 80°C and 25°C respectively. The exit temperature of hot water is 45°C. If the individual heat transfer coefficients on both sides are 600 W/m^2 °C, calculate the area of the heat exchanger. **07**

Q.4 **(a)** Sate and prove Hydrostatic law. **03**

(b) What is notch? Derive an expression for discharge over a rectangular notch. **04**

(c) Derive an expression for steady state heat conduction through hollow cylinder. **07**

OR

Q.4 **(a)** Plot the main characteristics curves for centrifugal pump. **03**

(b) Explain fully the micro-manometers. **04**

(c) A pipe is having diameters 40 cm and 20 cm at the cross sections 1 and 2 respectively through which water is flowing. The velocity of water at section 1 is 5 m/s. Determine the velocity head at section 1 and 2, and also flow rate. **07**

Q.5 **(a)** Differentiate between impulse and reaction hydraulic turbines. **03**

(b) What is specific speed of centrifugal pump? Derive an expression of specific speed of centrifugal pump. **04**

(c) Francis turbine is designed to develop 150 kW, working under a head of 10 m and running at 200 rpm. The hydraulic losses in turbine are 15% of available energy. The overall efficiency of turbine is 80%. Assume: flow ratio = 0.94 and speed ratio = 0.25. Calculate: (i) the guide blade angle and runner vane angle at inlet, (ii) runner diameter and width at inlet. **07**

OR

Q.5 **(a)** Differentiate between Francis and Kaplan turbines. **03**

(b) Explain draft tube and its importance. **04**

(c) Explain performance characteristics curves of hydraulic turbines. **07**

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