UNIVERSITY OF PETROLEUM AND ENERGY STUDIES
Online End Semester Examination, June 2021

Program Name : M.Tech. – REE and Energy System **Semester** : II
Course Name : Waste Heat Recovery and Co-generation **Time** : 03 hrs.
Course Code : EPEC 7004 **Max. Marks: 100**

SECTION A

1. Each question carry 5 marks
2. Instructions : Select all the correct answer (s)

	Question	CO
Q 1	WHR is dependent on (Select all the correct statements) a) Quantity of heat b) Quality of heat c) Point of Availability d) Cost of WHR equipment	CO1
Q 2	Heat transfer is fastest by (Select all the correct statements) a) Conduction b) Convection c) Radiation d) Insulator	CO1
Q 3	High temperature waste heat is available in (Select all the correct statements) a) Metal furnaces b) Glass furnaces c) Ceramic furnaces d) Annealing furnace	CO2
Q 4	Maximum heat transfer occur in (Select all the correct statements): a) Co-current flow b) Counter current flow c) Cross flow d) Liquid to liquid	CO2
Q 5	The fluid in Heat pipe should have (Select all the correct statements) a) High latent heat b) high thermal conductivity c) High Viscosity d) High surface tension	CO3
Q 6	Thermic Fluid system is used in (Select all the correct statements) a) Steel Plant b) Polyester Plant c) Oil Refinery d) Glass Industry	CO3

1. **Each question carry 10 marks**
2. **Instructions : Write short / brief notes**

| Q 7 | Describe the standard WHR devices used in a typical big boiler system. | CO1 |

| Q 8 | Compare the VCR with VAM. | CO2 |

| Q 9 | A shell and tube exchanger of following configuration is considered being used for oil cooler with oil at the shell side and cooling water at the tube side.
Tube Side : 460 Nos x 25.4mmOD x 2.11mm thick x 7211mm long,
Pitch – 31.75mm 30° triangular, 2 Pass
Shell Side : 787 mm ID, Baffle space – 787 mm, 1 Pass
The monitored parameters are as below: | CO3 |

Parameters	Units	Inlet	Outlet
Hot fluid flow, W	kg/h	719800	719800
Cold fluid flow, w	kg/h	881150	881150
Hot fluid Temp, T	^OC	145	102
Cold fluid Temp, t	^OC	25.5	49
Hot fluid Pressure, P	bar g	4.1	2.8
Cold fluid Pressure, p	bar g	6.2	5.1

Calculate the

    i)   Capacity Ratio &

    ii)   Effectiveness of heat exchanger

| Q 10 | Illustrate the main criteria for deciding about type of Cogen plant. | CO4 |

| Q 11 | Describe Combined cycle and its T-S diagram. | CO4 |

SECTION-C

1. **Question carries 20 Marks.**

2. **Instruction: Write long answer.**

Q 12	A Gas Turbine Based Co-generation system is having following parameters
	
	Capacity of gas turbine generator : 4000 kW Plant
	Operating hours per annum: 8000hrs. , Plant load factor : 90 %
	Heat rate as per standard given by gas.trubine supplier: 3049.77 kCal / kWh
	Waste heat boiler parameters – unfired steam output : 10 TPH
	Steam temperature: 200 ^{0}C, Steam pressure: 8.5 kg /cm^2.
	Steam enthalpy: 676.44 kCal / Kg. , Fuel used : Natural gas
	Calorific value – LCV : 9500 Kcal/ sm^3, Price of gas : Rs 3000 /1000 sm^3
	Capital investment for total co-generation plant : Rs. 1300 Lakhs
	
	Calculate the Following:
	
	      a). Power Generation,
	      b). Heat input to generate above units
	      c). Natural gas quantity required per annum
	      d). Cost of fuel per annum
	
	OR
	
	Make a comparison of typical performance parameters of various Co-generation prime movers.
		CO5