Name:

Enrolment No:

UNIVERSITY OF PETROLEUM AND ENERGY STUDIES
End Semester Examination, May 2019w2

Course: Waste Heat Recovery & Cogen **Semester: I**
Program: M.Tech. – Energy System + Renewable Energy Engg.
Time: 03 hrs. **Max. Marks: 100**
Instructions: All Questions are to be attempted. Maximum marks are mentioned below.

SECTION A

		Marks	CO
Q 1	Write a note for low-grade waste heat recovery.	4	CO1
Q 2	Dew Point Temp is a major hindrance in maximizing waste heat recovery. Justify.	4	CO2
Q 3	Write the criteria for designing a waste heat recovery device.	4	CO3
Q 4	What is the difference between Thermal power plant turbine & Cogen turbine?	4	CO4
Q 5	What should be main criteria for deciding about type of Cogen plant?	4	CO5

SECTION B

Q 6	Describe the "Radiation / Convective Hybrid recuperator" and "Plate heat exchanger".	10	CO2
Q 7	Explain the steps to be taken sequentially to successfully implement a waste heat recovery mechanism in any industry.	10	CO3
Q 8	Explain Combined cycle and its T-S diagram	10	CO4
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, 2 Pass, Pitch – 31.75mm, 30^{o} triangular, **Shell Side :** 787 mm ID, Baffle space – 787 mm, 1 Pass The monitored parameters are as below:	10	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	^{O}C	145	102
Cold fluid Temp, t	^{O}C	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 Capacity Ratio & Effectiveness of heat exchanger		
	SECTION-C		
Q 10	Elaborate the classifications of various Cogen Systems	20	CO5
Q 11	A Gas Turbine Based Co-generation system is having following parameter Capacity of gas turbine generator : 4000 kW Plant Operating hours per annum: 8000 hrs. , 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** Compare typical performance parameters of various cogen prime movers.	20	CO4

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Time: 03 hrs. **Max. Marks: 100**
Instructions: All Questions are to be attempted. Maximum marks are mentioned below.

SECTION A

		Marks	CO
Q 1	Describe the options for waste heat recovery from metal furnaces?	4	CO1
Q 2	Justify that "all waste heat recovery devices are basically heat exchangers".	4	CO1
Q 3	Write a note about "Thermo compressor".	4	CO2
Q 4	"Sugar industry is a classic case of cogeneration". Justify it.	4	CO4
Q 5	Describe the significance of "Heat to Power Ratio" in Cogen.	4	CO5
	SECTION B		
Q 6	Elaborate the LMTD in a heat exchanger and its significance.	10	CO1
Q 7	Describe the various recuperators and their application.	10	CO2
Q 8	Describe factors affect the "Effectiveness of Heat exchanger"	10	CO3
Q 9	Explain schematic diagram and T-S diagram of a Cogen Cycle	10	CO4
	SECTION-C		
Q 10	Evaluate the Advantages & Disadvantages (Relative Merits) of various Cogen Systems?	20	CO5
Q 11	A Gas Turbine Based Co-generation system is having following parameters Capacity of gas turbine generator : 4000 kW Plant operating hours per annum : 8000 hrs. , 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. , Price of gas : Rs 3000 /1000 sm^3 Fuel used : Natural gas , Calorific value – LCV : 9500 Kcal/ sm^3 , Capital investment for total co-generation plant : Rs. 1300 Lakhs **Calculate the Following:** a). Natural gas quantity required per annum b). Cost of fuel per annum c). Overall cost of power from cogeneration Plant d). Cost of power **OR** Elaborate the Best practices recommended for a Cogen system.	20	CO4