Name: **Enrolment No:**	UPES UNIVERSITY WITH A PURPOSE

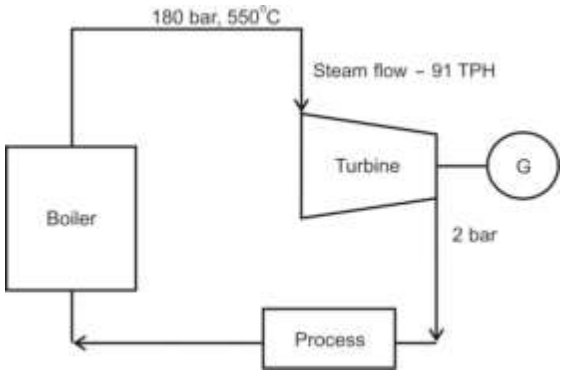
UNIVERSITY OF PETROLEUM AND ENERGY STUDIES
End Semester Examination, July 2020

Course: Waste Heat Recovery & Cogen **Semester: II**
Program: M.Tech. – Energy System + Renewable Energy Engg. **Time 03 hrs.**
Course Code: EPEC7004 **Max. Marks: 100**

Instructions:

1. **Attempt all the questions (Theory, Numerical, Case study etc.) on A4 size blank sheets.**
2. **Attempt all questions serially as per question paper.**
3. **Answer should be neat and clean. Draw a free hand sketch for circuits/tables/schematics wherever required.**
4. **Scan the whole answer script and check the resolution carefully before upload on the blackboard. Note that answer scripts will be considered for evaluation only through Blackboard. No other mode of submission is acceptable.**
5. **You are expected to be honest about each attempt which you make to progress in life**

SECTION A 60 Marks

		Marks	CO
Q 1	The schematic and operating data of a steam turbine cogeneration plant with a backpressure turbine is given below.  Enthalpy of steam at 180 bar, 550 0C – 3420 kJ/kg Exhaust steam enthalpy at isentropic expansion from 180 bar to 2 bar – 2430 kJ/kg Enthalpy of boiler feed water – 504.7 kJ/kg , Efficiency of boiler - 80 %, Calorific value of coal – 4500 kcal/kg, Steam flow rate into the Turbine - 91 TPH Turbine isentropic efficiency - 90 % , Generator efficiency - 97 % Gear box efficiency - 98 % **Calculate: (each carries 5 Marks)** a) Electrical output from the generator in MW b) Fuel consumption in Boiler in TPH	**20**	CO4

NOTE : The submission time of the Question Paper Answer Sheet is 24 Hhrs from the scheduled time (*exceptional provision due to extraordinary circumstance due to COVID-19 and due to internet connectivity issues in the far-flung areas*).
No Submission will be entertained after 24 Hrs

	c) Energy Utilization factor of the cogeneration plant d) Heat to power ratio of the cogeneration plant, kCal/Kw		
Q 2	Compare performance of various co-gen prime movers.	**20**	CO4
Q 3	i) Explain the following a) Over all heat transfer coefficient b) Log mean temp difference c) Co-current and counter current flow d) Heat duty of heat exchanger ii) In a double pipe heat exchanger hot fluid is entering at 220°C and leaving at 115°C. Cold fluid enters at 10 deg c and leaves at 75°C. Mass flow rate of hot fluid is 100 kg/hr, cp of hot fluid 1.1 kcal/kg°C. Cp of cold fluid 0.95 kcal/kg°C. Calculate LMTD i) If the flow is parallel ii) If the flow is counter current.	**20**	CO3
SECTION B (40 Marks)			
Q 4	A counter flow double pipe heat exchanger using hot process liquid is used to heat water, which flows at 20 m3/hr. The process liquid enters the heat exchanger at 180 0C and leaves at 130 0C. The inlet and exit temperatures of water are 30 0C and 90 0C. Specific heat of water is 4.187 kJ/kg K. a) Calculate the heat transfer area if overall heat transfer coefficient is 820 W/m2 K. b) What would be the percentage increase in the area if fluid flow were parallel (Assuming same overall heat transfer coefficient)?	**10**	CO3
Q5	Describe waste heat recovery system suitable for typical thermal Power Plant.	**5**	CO2
Q 6	List down 8 high-grade thermal processes / utilities and their heating ranges	**5**	CO1
Q 7	Describe concept of Regenerator	**5**	CO2
Q 8	Illustrate major considerations for an appropriate waste heat recovery system	**5**	CO3
Q 9	Describe any four types of topping cycle cogeneration systems.	**5**	CO5
Q 10	Describe significance of Heat to power ratio.	**5**	CO4

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