Name: Enrolment No:	UPES

UNIVERSITY OF PETROLEUM AND ENERGIE STUDIES
Mid Semester Examination, December 2018

Programme Name: B. Tech. APE Gas | **Semester : VII**
Course Name : Energy Conservation & Recovery | **Time : 03 hrs**
Course Code : CHGS 3010 | **Max. Marks : 100**
Nos. of page(s) : 2

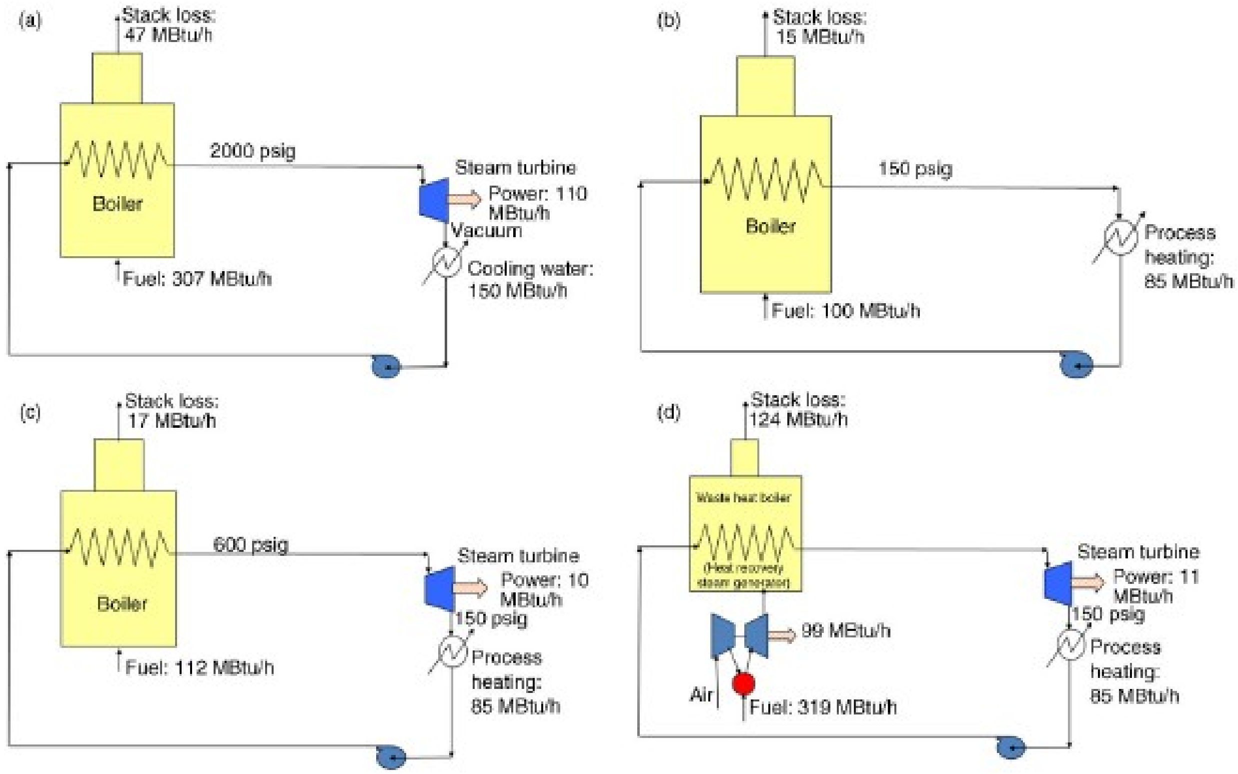
Instructions:

1. Put your Roll No. immediately on the question paper.
2. Mark question number clearly in the left margin.
3. Assume data if necessary, and justify your assumptions.
4. No student is allowed to leave exam hall in the first hour of exam.
5. Use of unfair means will lead to immediate disqualification

S. No.	Section A: Attempt All 5 (5 Q x 4 marks =20)	Marks	CO
Q1	List the Greenhouse Gas Impacts for Various Common Fuels in kg CO2/MBtu and explain how setting up an energy management program can lead to GHG reduction.	4	CO1
Q2	List some energy tools available which can be used freely for implementing energy efficiency in the petroleum and process plants.	4	CO2
Q3	Innovation energy technology adoption and diffusion is quite often gradual by firms and individuals. Illustrate with some examples and pictorially represent the adoption process.	4	CO4
Q4	Explain the Energy efficiency of Furnaces and boilers. List Components affecting thermal efficiency.	4	CO3
Q5	How Energy Star has succeeded in enhancing efficiency of process plants in USA.	4	CO2

S. No.	Section B: Attempt All 4 (4 Q x 10 marks =40)	Marks	CO
Q6	Describe the role of Coil-wound Heat Exchanger (CWHE) in LNG process. Analyze the industry desire for higher diameter and explain how the diameter correlates with capacity.	10	CO2
Q7	Though LNG processes offer high efficiency, but suboptimal process control during operations can reduce the benefits. Explain how Enhanced LNG Liquefier controls Main Cryogenic Heat Exchanger (MCHE) to increase the efficiency.	10	CO2
Q8	Three main challenges for floating LNG vessel design are: (i) size and weight (ii) vessel motion (iii) inventory of flammable material. Explain how these challenges can be addressed and also illustrate the role of multiple expander.	10	CO4
Q9	More than 60% of the energy consumption in a typical olefins plant is in the furnaces. Explain how by better tubing arrangement, and refractory design, energy efficiency is obtained.	10	CO3

S. No.	Section C: Attempt All 2 (2 Q x 20 marks =40)	Marks	CO
Q10	Explain how one can introduce energy Efficiency in process design stage for flowing processes: (5 each) i. Feed gas chilling for moisture removal ii. Fractionation pre-cooling for NGL (natural gas liquids) removal, scrub column, LPG (liquefied petroleum gas), NGL, and expanders iii. Liquefaction, including the MCHE (main cryogenic heat exchanger) iv. Refrigeration, including sub-coolers	20	CO3
Q11	The *first law of thermodynamics* states that energy can be neither created nor destroyed. It can, however, change in form. Within the environment of process facilities, the main forms of energy that we see include the following: 1. *Chemical energy*, within both fuels and process streams. Combustion of fuel and exothermic reactions of chemicals both release heat (thermal energy). This heat can be recovered for use in other parts of the process or facility. Some chemical reactions are endothermic, meaning they consume heat. Naphtha reforming is a common endothermic process in typical refineries. 2. *Thermal energy:* Virtually all processes require heating and cooling in some areas, such as distillation and other separation operations. 3. *Mechanical energy* is needed primarily for transporting materials, for example, in pumps and compressors. 4. *Electrical energy:* Some processes are electrochemical, so electricity is explicitly required for the process. Electricity is also used for lighting, monitoring, metering, and control, and, of course, to provide the mechanical energy required by many of the pumps and compressors mentioned above. The *second law of thermodynamics* focuses on the quality, or value, of energy. There are several different statements or definitions of the second law. Almost all mechanical energy is derived from some type of heat engine, whether this is an on-site steam turbine or heat engine. Also, all heat engine cycles operating between a heat supply temperature of Th and a heat rejection temperature of Tc, the most efficient is a reversible engine taking in all of its supply heat Qh at fixed temperature Th and discharging all of its reject heat Qc at fixed temperature Tc. This is known as the Carnot cycle. We can define the "first-law efficiency" or "thermal efficiency" η of a heat engine as $\eta = W/Q$h, where W is the work output. By the first law, W=Qh-Qc (assuming no frictional losses). So, η = (Qh-Qc)/Qh =1-Qc/Qh. With this backdrop, please do the following: i. Show a Generalized heat engine, showing heat flows Qh and Qc and work output W. What are the I and II law implications for η. (4) ii. Relative energy flows showing power generation and heat rejection for condensing steam are shown in figure below for (a) power only (b) boiler only (c) boiler + steam turbine (d) combined cycle employing gas turbine. Calculate 1. Power/incremental fuel, 2. Power/heat to process, and 3. efficiency for each of a, b, c, d and give detailed reasoning. Which scheme will be most suitable for practical application. Comment also on achieving achievability of efficiency. What are the I and II law implications of the results. (16)	20	CO4



	(a) Condensing Turbine	(b) Boiler Only	(c) Boiler and Steam Turbine	(d) Combined Cycle
Fuel	307	100	112	319
Incremental fuel	307	0	12	219
Power	110	0	10	110