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| **Name:**<br>**Enrolment No:** | |

**UNIVERSITY OF PETROLEUM AND ENERGY STUDIES**
**End Term Examination, December 2022**

**Programme Name: B.Tech APE Gas** **Semester : V**
**Course Name : Gasification and Gas to Liquid Technology** **Time : 3 hr**
**Course Code : CHGS3008P** **Max. Marks: 100**
**Nos. of page(s) : 2**
**Instructions: Answer the questions in sequence.**

**SECTION A (Attempt all questions)**

| S. No. | | Marks | CO |
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| Q1. | a) Define biomass, sources of biomass and its utilization.<br>b) Illustrate the challenges in the use of biomass. | **(6+6) 12M** | **CO1** |
| Q2. | Wood pellets are gasified in an open core throatless gasifier. The initial design conditions are given in the below table.<br>Calculate a) Fuel Consumption rate b) Cross Sectional area of the reactor c) Diameter of the reactor d) Height of reactor e) Air flow rate f) Superficial air velocity | **12M** | **CO2** |
| Q3. | Explain the phenomenon of Fluidization and explain the working of a circulating fluidized bed gasifier with a neat diagram. | **12M** | **CO2** |
| Q4. | Syngas produced from coal gasification needs to be cleaned and conditioned for downstream processing. Illustrate. | **12M** | **CO3** |

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| Type of gasifier | Downdraft Throatless |
| Type of fuel | Wood pellets |
| Calorific value of fuel | 14 MJ/kg |
| Density of fuel | 375 kg/m3 |
| Gasification efficiency | 60% |
| Specific Gasification Rate | 120 kg/$m^2$ h |
| Equivalence Ratio | 0.25 |
| Stochiometric Air to Fuel Ratio | 6.5 kg of air/Kg of wood |
| Net Energy | 6 kW |

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| Q5. | Compare the different reactor configurations for Fischer-Tropsch Synthesis to produce liquid products from syngas. | **12M** | **CO4** |
| **SECTION B**<br>**(Q6 is Compulsory & Answer any one from Q7)** | | | |
| Q6. | Coal has the following composition on mass basis %.C-73.2, H-5.2, O-13.6, N-1.3, S-1.7, Moisture-5. If the above material is gasified in a downdraft gasifer what will be the composition of the gas produced when coal to oxygen ratio is 0.5 mass of coal/mass of oxygen and steam to coal ratio is 0.5 mass/mass. Assume CO to $H_2$ is 2:1 vol/vol. Ignore the presence of impurities. Find the molecualr weight of coal and composition of the product gas and CO and Hydrogen yield. | **20M** | **CO3** |
| Q7. | a) Calculate the mass of methanol (in lb) that can be produced from 4 Bcf of natural gas. Assume that it is all methane. How many pounds of oxygen would be required?<br>b) With a basic flow chart outline the process of indirect conversion of natural gas to liquids through syngas and Fischer-Tropsch synthesis. | **(5+15) 20M** | **CO4** |
| | **(Or)** | | |
| | a) Discuss the Biomass to Liquids -Fischer -Tropsch final fuel products in detail.<br>b) Summarize the role of catalysts in the hydrogenation of carbon monoxide to higher hydrocarbons. | **(10+10) 20M** | **CO4** |