ENERGY ENGINEERING
(CHEN 3132)

Time Allotted : 3 hrs **Full Marks : 70**

Figures out of the right margin indicate full marks.

Candidates are required to answer Group A and
<u>any 5 (five)</u> from Group B to E, taking <u>at least one</u> from each group.

Candidates are required to give answer in their own words as far as practicable.

Group – A
(Multiple Choice Type Questions)

1. Choose the correct alternative for the following: **10 × 1 = 10**

    (i)   In semi-direct process of by-product recovery in a coke oven plant
    (a) ammonia is recovered fully as aqueous ammonia solution
    (b) ammonia is recovered fully as ammonium sulphate
    (c) ammonia is recovered partly as aqueous solution and partly as sulphate
    (d) ammonia is recovered in gaseous form.

    (ii)   The composition of 90% or more of coal ash is as follows
    (a) Silica, alumina, lime and iron oxide
    (b) Silica and oxides of magnesium, sodium
    (c) Silica, titania and nickel
    (d) Silica, sodium and potassium sulphate.

    (iii)   Which of the following converts energy from the combustion of fuel directly to
    the electrical energy?
    (a) Ni-Cd cell   (b) Dynamo
    (c) Fuel cell   (d) Electrolytic cell.
    (iv)   The reaction occurring at the cathode of hydrogen-oxygen fuel cell is
    (a) $2H_2 + 4OH^- \rightarrow 4H_2O + 4e^-$ (b) $2H_2 + O_2 \rightarrow 2H_2O$ (l)
    (c) $H^+ + OH^- \rightarrow H_2O$ (d) $O_2 + 2H_2O + 4e^- \rightarrow 4OH^-$

    (v)   A typical output of a solar cell is
    (a) 0.1 V   (b) 0.26 V
    (c) 1.1 V   (d) 2 V.

    (vi)   Main parameter used to characterize knocking resistance of gaseous fuels is
    (a) octane number   (b) cetane number
    (c) methane number   (d) Wobbe number.

(vii)   The high flame speed gases are characterised with a Weaver flame speed factor
(a) 32-45   (b) 13-25
(c) 25-32   (d) 50-70

(viii)   If fixed carbon percentage of a coal is FC, moisture and ash percentages are M and A respectively, the fixed carbon percentage on dmmf basis is
(a) FC   (b) $[FC/(100-M-A)] \times 100$
(c) $[FC/(100-M-1.1A)] \times 100$ (d) $[FC/(100-M)] \times 100$.

(ix)   Test used for determining amount of aromatics in diesel fuel is
(a) Aniline point   (b) Smoke point
(c) Pour point   (d) Conradson carbon residue.

(x)   The single most important reaction in producer gas formation is
(a) Neumann reversal reaction   (b) Boudouard reaction
(c) methanation reaction   (d) water gas shift reaction.

Group – B

2.   (a)   What are the products of a low temperature carbonization process? Distinguish between indirectly heated and directly heated fixed bed retorts. Discuss the working principle of a Lurgi-Spulgas retort with a diagram.

     (b)   Comment on the statement: All coking coal are caking but all caking coal are not necessarily coking. Enumerate the important properties of metallurgical grade coke. Distinguish between gross and net calorific values of solid fuel.

                                                        (1 + 2 + 3) + (2 + 2 + 2) = 12

3.   (a)   The float and sink test data for an Indian coal and European coal are given below. Without drawing the washability curves, what information can be obtained from these data on the ease and difficulty of washing the two coals?

Specific gravity		Below 1.30	1.30-1.40	1.40-1.50	1.50-1.60	1.60-1.70	1.70-1.80	Above 1.80	Total
European coal	Yield percent	37.7	31.3	2.9	2.8	1.2	0.7	23.4	100.0
	Ash percent	3.2	5.8	24.9	32.3	42.1	57.5	78.6	23.6
Indian coal	Yield percent	1.2	6.0	38.4	43.0	6.6	2.5	2.3	100.0
	Ash percent	2.1	9.6	19.6	25.2	34.2	41.6	57.4	23.6

     (b)   Discuss the different ways in which energy can be classified. Show the global energy consumption and production patterns with the aid of diagrams. What is the significance of energy intensity?

                                                        6 + (3 + 2 + 1) = 12

Group – C

4. (a)   Describe the topping operation in a distillation unit with the help of a flow diagram. What are the different types of reflux arrangements in a distillation column?

    (b)   Discuss the fluid coking process with the aid of a flow diagram. State the main purpose of carrying out catalytic reforming.

                                                                (4 + 2) + (5 + 1) = 12

5. (a)   With the aid of a schematic diagram, show the different ways in which an existing refinery can be integrated with downstream petrochemical unit. Explain with the aid of a flow diagram, the role played by a naphtha cracking unit of a refinery in providing integration options

    (b)   Discuss the different testing criteria of marketable kerosene.

                                                                (3 + 5) + 4 = 12

Group – D

6. (a)   What is carburetted water gas? Describe the method of production of carburetted water gas with the aid of schematic diagrams of the different units.

    (b)   Explain what is meant by anaerobic digestion. With the aid of a diagram, illustrate the different steps of anaerobic digestion process. State the significance of hydraulic retention time

                                                                (1 + 5) + (2 + 3 + 1) = 12

7. (a)   Explain the significance of IGCC. With the help of a process flow diagram, show the different sections in an IGCC unit. Explain the function of HTGC section in an IGCC unit.

    (b)   Calculate the gross calorific value and Wobbe index of a fuel gas having the composition, percent by volume: methane 90%, ethane: 7%, propane: 2% and butane: 1%. The heat of combustion of methane, ethane, propane and butane are 9500 kcal/Nm^3, 16644 kcal/Nm^3, 23688 kcal/Nm^3 and 30744 kcal/Nm^3 respectively

                                                                (1 + 5 + 3) + 3 = 12

Group – E

8. (a)   Define the working principle of Pyrheliometer. What is Fuel Cell?

    (b)   Define solar pond and its working principle and advantages. Define Linear Fresnel Reflector (LFR).

                                                                (3 + 1 + 2) + (4 + 2) = 12

9. (a) What is geothermal Energy? Define the basic parts of wind turbine.

   (b) What is OTEC? Describe the working principle of OTEC.

   (2 + 4) + (2 + 4) = 12

Department & Section	Submission Link
CHE	https://classroom.google.com/c/MTIzNjM5MTYzMjI1/a/MjcxMjE1MzY0Mjk0/details