ENERGY ENGINEERING
(CHEN 3132)

Time Allotted : 2½ hrs **Full Marks : 60**

Figures out of the right margin indicate full marks.

Candidates are required to answer Group A and any 4 (four) from Group B to E, taking one from each group.

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

Group – A

1. Answer any twelve: **12 × 1 = 12**

Choose the correct alternative for the following

(i) Spontaneous combustion of coal on storage results due to
(a) inadequate ventilation
(b) low temperature oxidation
(c) storage in large heaps with small surface to volume ratio
(d) none of these.

(ii) Medium temperature carbonization of coal takes place at _____ ^{0}C.
(a) 400^{0}C (b) 600^{0}C (c) 800^{0}C (d) 1000^{0}C

(iii) Which is the most effective catalyst used in catalytic cracking of petroleum products?
(a) Iron oxide (b) Nickel
(c) Vanadium petoxide (d) Zeolite.

(iv) Blast Furnace coke size range is
(a) 10-25 mm (b) 25-40 mm
(c) 40-100 mm (d) >100 mm.

(v) The reactor conditions during catalytic reforming are
(a) temperature 200^{0}C-300^{0}C, pressure 5 – 10 kgf/cm^2
(b) temperature 450^{0}C- 520^{0}C , pressure 15 – 45 kgf/cm^2
(c) temperature 700^{0}C-770^{0}C, pressure 45– 50 kgf/cm^2
(d) temperature 800^{0}C-850, pressure 52 – 55 kgf/cm^2.

(vi) Blast furnace gas is a very poisonous gas because its predominantly high _____ content
(a) H_2O (b) CO_2 (c) CO (d) CH_4

(vii) Cetane number is a very important parameter for
(a) gasolin (b) diesel (c) lubricating oil (d) coal.

(viii) The production of methane and carbon dioxide is carried out through
(a) Hydrolysis (b) Fermentation
(c) Methanogenesis (d) Acetogenesis.

(ix) The percentage of methane in biogas is
(a) 24 - 54 (b) 50 - 75
(c) 5 - 20 (d) 80 - 90.

(x) Solid Oxide Fuel Cell (SOFC) operates in the temperature range of
(a) Above 2000^{o}C (b) 50^{o}C - 120^{o}C
(c) 450^{o}C – 500^{o}C (d) 800^{o}C – 1000^{o}C.

Fill in the blanks with the correct word

(xi) In coke ovens, the by-product recovery process is called direct if ammonia is fully recovered as _____.

(xii) Dean and Stark method is used for moisture determination of _____ .

(xiii) For a liquid fuel, flash point is _____ than fire point.

(xiv) Gobar gas burns with a blue flame at an efficiency _____ greater than that of burning cowdung cakes.

(xv) The visible range of photon energy is _____ (μm).

Group – B

2. (a) A particular Jharia coal gave the following proximate analysis: Moisture-1.7%, ash 16.0%, volatile matter – 27.6% and rest fixed carbon. Calculate its ash on a dry basis and volatile matter on d.a.f basis and d.m.m.f basis. *[(CO1)(Evaluate/HOCQ)]*

(b) Mention the products and by-products in case of by-product slot type coke ovens.
Discuss how the by-products are recovered in this type of coke ovens .
[(CO1)Apply(/LOCQ)]

6 + (2 + 4) = 12

3. (a) Discuss the process carried out in Lurgi-Spul low temperature carbonizer. Also mention the products obtained. *[(CO1)(Remember/LOCQ)]*

(b) Discuss briefly the characteristics of anthracite coal. *[(CO1)(Remember/LOCQ)]*

(c) Discuss, in brief, the construction of beehive coke ovens. Write down its demerits. *[(CO2)(Apply/IOCQ)]*

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

Group - C

4. (a) Mention the common fractions obtained from crude petroleum. Also mention their approximate boiling ranges. *[(CO2)(Analyse/HOCQ)]*

(b) Discuss any one of type of 'coking ' process carried out in refinery.
[(CO3)(Remember/LOCQ)]

(c) Define Cetane no. State its significance. *[(CO2)(Apply/IOCQ)]*

6 + 3 + 3 = 12

5. (a) What is the purpose of 'visbreaking'? Write down the salient features of the operation. *[(CO3)(Analyse/IOCQ)]*

(b) Define the following:
(i) fire point (ii) smoke point and char value (iii) pour point (iv) API gravity. *[(CO3)(Remember/LOCQ)]*

4 + 8 = 12

Group - D

6. (a) Explain how 'blast furnace gas' is generated. *[(CO1)(Analyse/IOCQ)]*

(b) What do you understand by 'semi-water gas', double-water gas' and carburetted water gas? *[(CO3)(Apply/IOCQ)]*

(c) Name two processes used for complete gasification of coal. *[(CO3)(Remember/LOCQ)]*

4 + 6 + 2 = 12

7. (a) Briefly explain the principle of Anaerobic digester. *[(CO2)(Understand/IOCQ)]*

(b) Calculate the volume of a biogas digester and the power available from it. Given data: Number of cow: 8, retention period: 20 days, temperature for fermentation: 30^0C, dry matter consumed per cow per day: 2 Kg, burner efficiency: 0.7, methane proportion: 0.7, heat of combustion: 28. *[(CO4,CO2)(Analyse/HOCQ)]*

(c) Describe briefly the utilisation of Gobar gas plant products. *[(CO2)(Apply/LOCQ)]*

5 + 5 + 2 = 12

Group - E

8. (a) Discuss the operating principle of solar PV cell with a help of a diagram. *[(CO4)(Understand/LOCQ)]*

(b) Briefly describe the working principle of a Phosphoric Acid Fuel Cell (PAFC) with help of a diagram. *[(CO4)(Analyse/IOCQ)]*

(c) Write a short note on Pyranometer. *[(CO4)(Remember/LOCQ)]*

4 + 4 + 4 = 12

9. (a) Discuss the utilisation of Geothermal energy. *[(CO4,CO1)(Analyse/IOCQ)]*

(b) Discuss the operating principle of a Liquid Metal Cooled FBR with a help of neat sketch. *[(CO4)(Understand/LOCQ)]*

(c) Write a short note on parabolic collector. *[(CO4)(Remember/LOCQ)]*

3 + 6 + 3 = 12

Cognition Level	LOCQ	IOCQ	HOCQ
Percentage distribution	40.63	48.96	10.41

Course Outcome (CO):

After the completion of the course students will be able to

1. Apply Knowledge of the various energy sources and their operating characteristics.
2. Acquire knowledge of different crude oil extraction process and various characterizationtechniques of fossil fuels.
3. Acquire knowledge on the processing of crude oil along with an estimation of various value-added products.
4. Acquire knowledge on the non-conventional energy resources and their utilization.

**LOCQ: Lower Order Cognitive Question; IOCQ: Intermediate Order Cognitive Question; HOCQ: Higher Order Cognitive Question.*