

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 any 5 (five) from Group B to E, taking at least one 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) The zones in a low temperature carbonisation unit of coal are
(a) Drying zone and carbonisation zone
(b) Carbonisation and coke cooling zone
(c) Drying zone, carbonisation zone and coke cooling zone
(d) Carbonisation zone
- (ii) If the fixed carbon percentage of a coal sample is FC, moisture and ash percentages are M and A, on a daf basis, fixed carbon percentage is
(a) FC
(b) $FC/(100-M)$
(c) $FC/(100-A)$
(d) $FC/(100-M-A)$
- (iii) Temperature range at which conversion of semi-coke to coke occurs in a by-product coke oven is
(a) 400-500 °C
(b) 600-1200 °C
(c) 500-600 °C
(d) 100-300 °C
- (iv) Which of the following convert's energy from the combustion of fuel directly to the electrical energy?
(a) Ni-Cd cell
(b) Dynamo
(c) Fuel cell
(d) Electrolytic cell
- (v) The process requiring dual function catalyst is
(a) Catalytic cracking
(b) visbreaking
(c) Hydrocracking
(d) thermal cracking
- (vi) The efficiency of a solar cell may be in the range
(a) 2 to 5%
(b) 10 to 15%
(c) 30 to 40%
(d) 70 to 80%

- (vii) 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
- (viii) Paraffins in comparison to aromatics have
(a) higher viscosity index, higher pour point
(b) lower viscosity index, higher pour point
(c) higher viscosity index, lower pour point
(d) lower viscosity index, lower pour point
- (ix) Volatile matter expressed in dry and ash free basis includes
(a) water formed from hydrogen and oxygen during coal decomposition
(b) part of mineral matter which escapes to the gaseous state
(c) moisture in coal
(d) Both (a) and (b)
- (x) 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

Group- B

2. (a) A coal sample gave the following proximate analysis: Ash 15%, VM 30, FC 53.6%, moisture: 1.4%. The calorific value of the sample is given by the equation: $C=82*FC+a*VM'$ where VM' is the volatile matter content on daf basis. Given: $a=94$ for $VM'=35$ and $a=85$ for $VM'=38$. Calculate the ash content of the sample on a dry basis and volatile matter on dmmf basis. Calculate the calorific value of the sample. [(CO2) (Evaluate/HOCQ)]
- (b) Distinguish between fixed carbon and total carbon in coal, and ash and mineral matter content in coal. [(CO2) (Analyze/LOCQ)]
- (c) "Rheoboxes play a major role in settling of different particles present in a coal sample in a rheolauveur launder": Justify the claim with a proper illustration of the process. [(CO1,CO2)(Analyze/IOCQ)]

4 + 4 + 4 = 12

3. (a) A by-product coke oven plant having annual production capacity 3 million ton coke uses good quality coking coal to give 71% yield. The plant used stamp charging technology to make green coal cake with bulk density 1 ton/m³ before feeding to coke oven. The coke oven chamber is 16.19 m long, 6.3 m high and 540 mm wide. Coking time provided is 24 hr/batch in an oven. Number of coke ovens on a battery is 60. Assuming 340 working days/year leaving 25 days for repair and considering 95% volatiles including moisture being removed during coking, calculate
- (i) the percent VM and moisture in coal charge,
(ii) the amount of coal used annually by the plant and
(iii) the number of coke oven batteries in the plant. [(CO2) (Evaluate/HOCQ)]

- (b) Discuss the stages of coke formation in a by-product coke oven plant with diagram. [(CO3) (Understand/LOCQ)]
- (c) Distinguish between Koppers and Koppers Becker oven system.
[(CO3) (Analyze/LOCQ)]
6 + 4 + 2 = 12

Group - C

4. (a) Describe the crude oil distillation process in VDU. [(CO4) (Understand/HOCQ)]
(b) Define aniline point and diesel index. [(CO2) (Remember/LOCQ)]
(c) State Fischer Tropsch process. [(CO1) (Analyze/IOCQ)]
5 + 4 + 3 = 12
5. (a) Describe the crude oil distillation process in ADU.
[(CO2, CO3) (Understand/LOCQ)]
(b) Write a short note on coking and hydrocracking.
[(CO2, CO3) (Understand/LOCQ)]
6 + 6 = 12

Group - D

6. (a) List the principal reactions taking place in a producer gas formation and identify the one which controls the process. [(CO4) (Remember/LOCQ)]
(b) Discuss the functions of different zones in a producer gas unit with a diagram.
[(CO2) (Analyze/IOCQ)]
(c) Comment on the significance of Weaver flame speed factor and classify gaseous fuels based on their flame speed. [(CO1) (Analyze/IOCQ)]
4 + 5 + 3 = 12
7. (a) Define the role of anaerobic digester. [(CO1) (Remember/LOCQ)]
(b) Describe the different steps of anaerobic digester. [(CO1) (Understand/LOCQ)]
(c) State the factors affecting the sludge digestion process.
[(CO1) (Evaluate/HOCQ)]
2 + 5 + 5 = 12

Group - E

8. (a) Define the working principle of Pyrheliometer. What is Fuel Cell?
[(CO4) (Analyze/LOCQ)]
(b) Define solar pond and its working principle. [(CO4) (Analyze/LOCQ)]
(c) Write a short note on the Linear Fresnel Reflector (LFR).
[(CO4) (Analyze/IOCQ)]
(3 + 1) + 4 + 4 = 12

9. (a) Write the different components of solar flat plate collector. Define collector efficiency. [(CO1) (Remember/LOCQ)]
- (b) Describe the working principle of heliostat concentrator collectors. [(CO2) (Analyse/IOCQ)]
- (c) State the role of breeder reactor. [(CO2) (Analyse/HOCQ)]
- (3 + 2) + 4 + 3 = 12**
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Cognition Level	LOCQ	IOCQ	HOCQ
Percentage distribution	47.8	37.0	15.2

Course Outcome (CO):

After the completion of the course students will be able to

CO1: Apply knowledge of various energy sources and their operating characteristics

CO2: Acquire knowledge of different crude oil extraction process and various characterization techniques of fossil fuels

CO3: Acquire knowledge of processing of crude oil with the estimation of various value-added products

CO4: Acquire knowledge on the non-conventional energy sources and their utilization

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

Department & Section	Submission Link
CHE	https://classroom.google.com/c/NDAwOTA2MDQ3MTc5/a/NDYzODM5NzIwMTM1/details