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)   Which of the following constituents of a fuel does not contribute to its calorific value on combustion?
        (a) Hydrogen   (b) Sulphur   (c) Carbon   (d) None of these.

   (ii)   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.

   (iii) High temperature carbonization of coal takes place at _____ ^{0}C.
        (a) 2000   (b) 1000   (c) 600   (d) 1600

   (iv) Calorific value of coke oven gas is around _____ Kcal/Nm^3.
        (a) 900   (b) 4200   (c) 7500   (d) 2000

   (v)   The maximum temperature upto which a crude petroleum oil can be heated without cracking is about
        (a) 200^{0}C   (b) 400^{0}C   (c) 600^{0}C   (d) 400^{0}C.

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

   (vii) Smoke point is an important parameter with respect to
        (a) Gasoline   (b) Diesel   (c) Kerosene   (d) Gas oil.

   (viii)For the generation of electricity, which source is used largely in India?
        (a) Coal   (b) Hydro-power   (c) Wood   (d) Solar energy.

   (ix) 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%.

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

Group- B

2. (a) Mention the differences between the following:
    (i) Gross calorific value and net calorific value.
    (ii) Carbonisation and gasification.   [(CO1)(Remember/LOCQ)]
  (b) The following ultimate analysis data are available for a Chanch coal of the Raniganj coalfield: Carbon 86.5, Hydrogen 5.3, Sulphur 0.64, Nitrogen 2.36, Oxygen 5.20. Calculate its calorific value.   [(CO1)(Evaluate/HOCQ)]
  (c) Discuss any one of the coal cleaning processes.   [(CO1)(Understand/LOCQ)]
(3 × 2) + 3 + 3 = 12

3. (a) (i) What do you understand by rank of coal?
    (ii) Define proximate analysis of coal.   [(CO1) (Remember/LOCQ)]
  (b) (i) Mention various types of coal carbonisation processes.
    (ii) Discuss the products of by-product slot type coke ovens. Also discuss the construction of by-product slot type coke ovens.   [(CO1) (Understand/LOCQ)]
(2 + 2) + (2 + 3 + 3) = 12

Group - C

4. (a) (i) Mention the operating conditions during various stages of petroleum distillation.
    (ii) Mention the common fractions of crude petroleum and their approximate boiling ranges.   [(CO3)(Remember/LOCQ)]
  (b) Define octane number. State its significance. Also name certain additives used to increase octane rating.   [(CO3)(Analyze/LOCQ)]
(3 + 5) + 4 = 12

5. (a) Mention the differences of the following:
    (i) Flash point and fire point
    (ii) Smoke point and aniline point.   [(CO2)(Analyze/IOCQ)]
  (b) Why is catalytic reforming carried out in refinery? Mention the operating conditions and catalysts used during this process.   [(CO3)(Understand/LOCQ)]
(4 + 4) + 4 = 12

Group – D

6. (a) (i) Discuss in brief the Lurgi gasification process.
    (ii) How is Producer gas obtained ?
    (iii) What is coal bed methane? State its use.   [(CO1)(Remember/LOCQ)]
  (b) State the advantage and disadvantages of anaerobic and aerobic digestor.
      [(CO4)(Analyze/HOCQ)]
(3 + 4 + 2) + 3 = 12

7. (a) (i) Give example of a rich gas and a lean gas. Mention their calorific values.
    (ii) What do you understand by Wobbe number and flame speed?
      [(CO1)(Remember/LOCQ)]

(b)   What are the constituents of refinery gases. Write down their uses.

[(CO3)(Understand/LOCQ)]

(c)   State the factors affecting the sludge digestion process.   [(CO4)(Evaluate/HOCQ)]

(2 + 4) + 3 + 3 = 12

Group – E

8. (a)   Write a short note on beam radiation and diffuse radiation. Describe the difference between active and passive solar radiation.   [(CO4) (Remember/LOCQ)]

(b)   Write the difference between solar thermal and solar photo voltaic energy.

[(CO4) (Understand/LOCQ)]

(c)   Describe the polarization curve of PEM fuel cell.   [(CO4) (Analyse/HOCQ)]

(3 + 3) + 2 + 4 = 12

9. (a)   Write the different components of solar flat plate collector. Define collector efficiency.   [(CO4) (Remember/LOCQ)]

(b)   Write a short note on Breeder reactor and its operation.   [(CO4)(Analyse/IOCQ)]

(c)   Describe the different routes for the Hydrogen production via green synthesis process.   [(CO4)(Analyse/HOCQ)]

(3 + 2) + 4 + 3 = 12

Cognition Level	LOCQ	IOCQ	HOCQ
Percentage distribution	70.8	12.5	16.7

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