NON CONVENTIONAL ENERGY SOURCES
(AEIE 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) What is the efficiency of coal-fired power station?
(a) 10-15% (b) 35-40%
(c) 60-70% (d) 80-90%.

(ii) One barrel of crude oil is
(a) 59 Ltr (b) 159 Ltr
(c) 259 Ltr (d) None of these.

(iii) API of heavy crude oil is
(a) 40-50 (b) 30-40
(c) 20-30 (d) 10-20.

(iv) The concentration ratio (CR) for solar flat plate collectors is
(a) CR>1 (b) CR=1
(c) CR<1 (d) None of these.

(v) A cylindrical parabolic concentrator requires
(a) Double-axis tracking (b) Single-axis tracking
(c) No tracking (d) Seasonal adjustment only.

(vi) What is the value of annual wind energy generation, based on the given parameters? Rated Power of the wind turbine: 5 MW Annual Capacity Factor of the plant: 0.35 Efficiency: 45%
(a) 787.5 MWh (b) 287.43 MWh
(c) 19710 MWh (d) 6898.5 MWh.

(vii) Which of the following turbines can work with any direction of wind?
(a) Horizontal axis turbine (b) Vertical axis turbine
(c) Oblique axis turbine (d) None of the above.

(viii) Ocean wave energy can be effectively stored as
(a) Hydrogen energy (b) Electrical energy
(c) Thermal energy (d) Mechanical energy.

(ix) Which one to be acted as best working fluid in OTEC?
(a) Ammonia (b) Alcohol
(c) Water plus ammonia (d) None of these.

(x) Double basin arrangement is a class of
(a) Biogas power plant (b) Solar pond power plant
(c) Large wind power generator (d) Tidal power plant.

Fill in the blanks with the correct word

(xi) Which type of solar cell is commonly used in scientific calculators _____.

(xii) The value of axial thrust coefficient (C_F) is_____.

(xiii) Give an example of VAWES_____.

(xiv) A solar cell has an open circuit voltage of 0.5 V and a short circuit current of 20m A. If 5 such solar cells are connected in series, the resultant current will be-_____.

(xv) Temperature of the lower mantle of Earth is _____.

Group - B

2. (a) Comparison between conventional and non conventional sources. *[(CO2)(Understand/LOCQ)]*

(b) Draw the basic block diagram of a hybrid system consists of biomass and PV cell as a resource. *[(CO3)(Apply/IOCQ)]*

(c) Why energy audit is important? What are the different types of energy audit phase? *[(CO2)(Understand/LOCQ)]*

4 + 4 + (2 + 2) =12

3. (a) Explain where and when curtailment is applicable and how? *[(CO1)(Analyze/IOCQ)]*

(b) What is the primary element used to make wall board? What is the basic health hazard component involved in the production of wall board? How it can be minimized? *[(CO1)(Understand/LOCQ)]*

(c) Design a hybrid system consist of biomass based electricity generation with wind energy based electricity production. *[(CO2)(Design/HOCQ)]*

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

Group - C

4. (a) Derive an expression of maximum efficiency of a solar cell in terms of fill factor. *[(CO3)(Understand/LOCQ)]*

(b) What is a solar PV module? *[(CO3)(Understand/LOCQ)]*

(c) What are the different materials used for fabrication of solar cells? *[(CO3)(Understand/LOCQ)]*

4 + 4 + 4 = 12

5. (a) Considering solar radiation of 500J/m^2 per unit time during daylight, find the area if PV cellsneeded to generate enough electric power to run for the following
   (i) A tea maker using 200W
   (ii) A cooker using 400W
   Assume the efficiency of PV to be 20%. *[(CO5)(Evaluate/IOCQ)]*
   (b) Explain the MPPT using I-V characteristics of a solar cell. *[(CO5)(Remember/LOCQ)]*
   (c) What are the major advantages and disadvantages of solar PV system? *[(CO5)(Remember/LOCQ)]*

4 + 4 + 4 = 12

Group - D

6. (a) Wind at one standard atmospheric pressure and 15° C has a speed of 10m/s. A 10m diameter wind turbine is operating at 5rpm with maximum efficiency of 40%. Using the given data, from the design point of view what will be the extracted energy.
   (i) Total power density in wind stream,
   (ii) Maximum power density,
   (iii) The actual power density,
   (iv) Power output of the turbine
   (v) The axial thrust on the turbine structure. *[(CO5)(Design/HOCQ)]*
   (b) Graphically express the variation of power coefficient with the tip speed ratio depending on the number of blades of the rotor. *[(CO5)(Analyze/IOCQ)]*
   (c) Define drag force and lift force. *[(CO5)(Remember /LOCQ)]*

5 + 3 + 4 = 12

7. (a) Prove that the maximum turbine output of Horizontal Axis Wind Turbine (HAWT) can be obtained when $V_2=(1/3)V_0$. (All are standard symbols) *[(CO5)(Remember/LOCQ)]*
   (b) If wind energy based system generates 1500watts at a rated speed of 24kmph at an atmospheric pressure and temperature of 20°C. Calculate the change in output if the wind generator is operated at a altitude of 1800m, temperature 10°C, wind speed 30kmph and air pressure 0.88 at atmosphere. (Given R=287J/Kg.K). *[(CO5)(Evaluate/IOCQ)]*
   (c) Draw the block diagram of a wind farm designed with microprocessor based control system. *[(CO5)(Design/HOCQ)]*

3 + 5 + 4 = 12

Group - E

8. (a) Derive the expression for potential energy, kinetic energy and total energy per unit width of wave front of wave. A 5m wave has period of 15 s. calculate the total energy and potential density of the wave. Take water density as 1025 kg/m^3. *[(CO3)(Analyze/IOCQ)]*
   (b) What do you understand by spring and neap tides? *[(CO3)(Understand/LOCQ)]*
   (c) Draw the scheme of geothermal based electricity extraction process. *[(CO3)(Understand/LOCQ)]*

4 + (2 + 2) + 4 = 12

9. (a) What are the site requirements to construct a tidal power plant? What are the disadvantages of wave motion based power plant? *[(CO3)(Understand/LOCQ)]*

(b) Describe the characteristics of the material used for different component of a power plant using geothermal energy. *[(CO2)(Understand/LOCQ)]*

(c) Graphically analyze thermocline. *[(CO2)(Analyze/IOCQ)]*

(3 + 3) + 4 + 2 = 12

Cognition Level	LOCQ	IOCQ	HOCQ
Percentage distribution	61.45	26.04	12.5