

**2021**

**PHYSICS — HONOURS**

**Paper : SEC-A-2**

*The figures in the margin indicate full marks.*

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

**Syllabus 2019-2020**

**(Renewable Energy and Energy Harvesting)**

**Full Marks : 80**

1. Answer **any ten** questions : 2×10
- (a) Define non-conventional energy source. Give one example.
  - (b) Name two greenhouse gases and explain how they are responsible for global warming.
  - (c) What is Geothermal power?
  - (d) Explain why the solar energy is called renewable.
  - (e) Name some organic materials used in biomass plants.
  - (f) Mention any two applications of wind energy.
  - (g) Define hybrid energy system.
  - (h) What are the main components of a fuel cell?
  - (i) Mention one merit and one demerit of nuclear energy harvesting.
  - (j) Differentiate tide and wave.
  - (k) Write down the working principle of a piezoelectric generator.
  - (l) What is electromagnetic energy harvesting?
2. Answer **any four** questions :
- (a) Explain structure and working principle of a solar cell. 2+3
  - (b) (i) Explain the working principle of a hydroelectric power plant.  
(ii) What are the drawbacks of hydroelectric power generation? 3+2
  - (c) (i) Describe briefly the working principle of a solar cooker.  
(ii) What are the disadvantages of using a solar cooker? 3+2
  - (d) Describe how electricity can be generated using bio-gas plant with a neat diagram. 4+1

**Please Turn Over**

(e) What is photo voltaic effect? Explain the working of a PV array. 2+3

(f) What is wind power? Show that the available wind power from a windmill is given by  $P = \frac{\pi D^2 \rho V^3}{8}$

where D = diameter of the blade,  $\rho$  = density of air and V = velocity of the wind towards the blade. 1+4

3. Answer **any four** questions :

(a) (i) Explain how energy is released in nuclear fission process of  ${}_{92}\text{U}^{235}$ . Is nuclear energy renewable?

(ii) What is full form of OTEC? What is its basic principle? (4+1)+(1+4)

(b) Explain in detail the solar thermal conversion devices and storage devices. What are the limitation of these devices? 8+2

(c) (i) Compare ocean energy usage with other renewable energy usages.

(ii) Discuss briefly the methods of ocean energy harvesting. 3+7

(d) (i) Explain why geothermal energy sources are important in near future. Explain briefly the technologies used in Geothermal energy harvesting.

(ii) What is meant by pitch angle and pitch control of a wind turbine? (2+6)+2

(e) Explain the design principle and operation of a fuel cell. Define its conversion efficiency. Classify fuel and name two applications of it. 6+1+2+1

(f) Write short notes on **any two** from the following : 5×2

(i) Carbon Capture Technology

(ii) Global warming

(iii) Osmotic power.

### Syllabus 2018-2019

#### (Electrical Circuits and Network Skills)

Full Marks : 80

1. Answer **any five** questions :

2×5

(a) When a DC motor runs at high speed

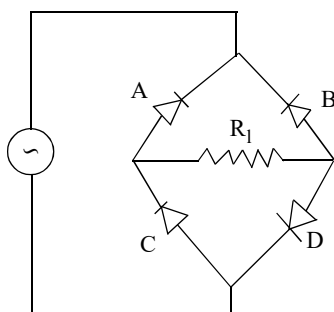
(i) its back emf is large

(ii) it develops less torque

(iii) its armature current is small

(iv) all of these.

- (b) The polar representation of the impedance  $(1 + j\sqrt{3})\Omega$  is
- (i)  $4\angle 60^\circ\Omega$       (ii)  $2\angle 60^\circ\Omega$       (iii)  $4\angle 30^\circ\Omega$       (iv)  $2\angle 30^\circ\Omega$ .
- (c) When reverse bias is applied to a P-N junction diode, the width of the depletion region will
- (i) decrease      (ii) increase  
(iii) vanish      (iv) unchanged.
- (d) The core of a transformer is assembled with laminated sheets to reduce
- (i) hysteresis loss      (ii) eddy-current loss  
(iii) magnetising current      (iv) magnetic noise.
- (e) A galvanometer may be converted to a voltmeter when a
- (i) high resistance is connected in series  
(ii) low resistance is connected in series  
(iii) high resistance is connected in parallel  
(iv) low resistance is connected in parallel.
- (f) A low load power factor for a generating station increases
- (i) line loss  
(ii) size of generators and transformers  
(iii) voltage drop in generators, transformers, cables etc.  
(iv) all of these.
- (g) The figure shows of a faulty circuit of a fullwave bridge rectifier.  
The fault is at
- (i) A  
(ii) B  
(iii) C  
(iv) D



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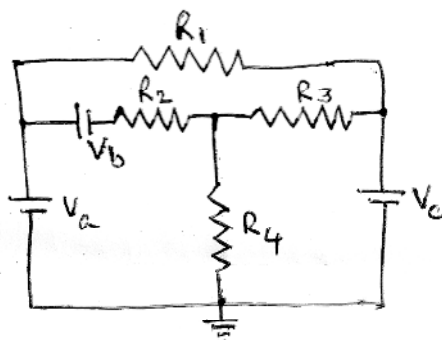
2. Answer **any five** questions :

- (a) Why a relay is generally used with a circuit breaker? 2
- (b) Explain the term 'slip' in induction motor. 2
- (c) What is the significance of 'Q' value in resonant circuit? 2
- (d) For a pure sinusoidal waveform calculate the 'form factor'. 2
- (e) Why does a full wave bridge rectifier is better than a full wave centre tapped rectifier? 2
- (f) Draw the symbols for fuse and zener diode in electrical circuits. 1+1
- (g) What do you mean by power factor of an AC circuit? Can the value of the power factor be more than 1? 1+1

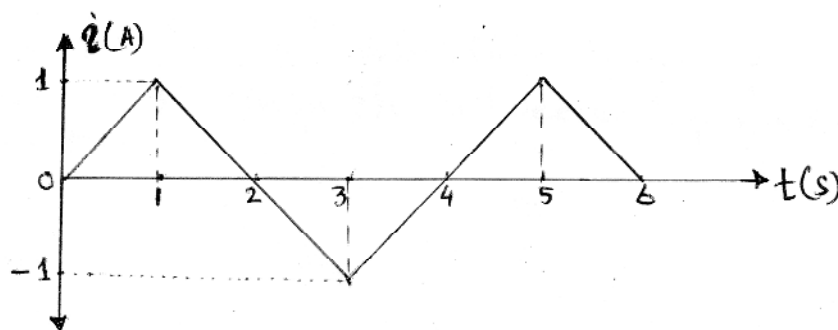
### Group – A

3. Answer **any four** questions :

- (a) (i) What are the advantages and disadvantages of AC over DC? 3+2
- (ii) How does an electrical fuse function? 3+2
- (b) (i) What do you mean by 'node', 'loop' and 'mesh' in an electric circuit? 3+2
- (ii) How many nodes and meshes are there in the circuit shown here? 3+2



- (c) Derive the emf equation of a DC generator. 5
- (d) What are the advantages and disadvantages of 3-phase induction motor? 5
- (e) Through a coil of inductance 1 henry, a current of the waveform as shown below is flowing. Sketch the waveform of the voltage across the coil and calculate the r.m.s. value of the voltage. 3+2



- (f) (i) What are the fundamental differences between a DC motor and DC generator?  
 (ii) A 3-phase, 4-pole induction motor is connected to a 50Hz supply. Calculate the speed of the rotor when the slip is 0.04. 3+2

### Group – B

4. Answer **any four** questions :

- (a) (i) Calculate the average and rms value of a sinusoidal alternating voltage.  
 (ii) Impedances  $Z_2 = (5 + j0)\Omega$  and  $Z_3 = (5 - jx_c)\Omega$  in parallel are connected in series with a impedance  $Z_1 = (6.25 + j1.25)\Omega$  and a 100V, 50Hz AC supply. Determine the value of the capacitance  $X_c$  such that the total current of the circuit will be in phase with the total voltage. Then calculate the circuit current and power. (2+2)+(4+2)
- (b) (i) Draw and explain the torque-speed characteristics of a series DC motor.  
 (ii) What is the function of armature winding in a DC generator? Distinguish between lap and wave armature winding. 5+(2+3)
- (c) (i) With neat sketches briefly describe the construction of an induction wattmeter.  
 (ii) Describe how a relay in electrical circuit works.  
 (iii) What are the advantages and disadvantages of oil circuit breaker? 4+4+2
- (d) (i) Distinguish between Star & Delta Connection.  
 (ii) Briefly describe the characteristics of a compound motor.  
 (iii) For a DC shunt motor draw the three important characteristic curves. 3+4+3
- (e) (i) With neat sketches describe the working principle of a transformer.  
 (ii) What are the properties of an ideal transformer?  
 (iii) The primary winding of a 50Hz single-phase transformer has 480 turns and is fed from a 6.4kV supply. If the secondary winding has 20 turns find the peak flux value in the core. 5+2+3
- (f) Write short notes on **any two** :
- (i) Surge protection in electrical wiring.  
 (ii) Megger for high resistance measurement.  
 (iii) Iron-loss and 'Cu-loss' in transformer. 5+5
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