

GSEB QUESTION PAPER

PHYSICS

Time : 3 Hours

Maximum Marks : 100

Instructions:

1. There are **four** sections and total 60 questions in this question paper.
2. Symbols used in this question paper have their usual meanings.
3. Log table or simple calculator can be used.
4. Begin new section on a new page. Follow the sequence.

Section - A

Question Nos. 1 to 16 are multiple choice questions, each carry **one** mark. Choose correct answer (a/ b/ c/ d) from given alternative responses and write it. **16**

- The energy of a charged capacitor is U . Another identical capacitor is connected parallel to the first capacitor. After disconnecting the battery, the energy of each of the capacitors will be
 - $\frac{U}{2}$
 - $\frac{U}{4}$
 - U
 - $\frac{3U}{2}$
- One variable capacitor is connected to a 100 V battery. If the capacitance is increased from $2\mu\text{F}$ to $20\mu\text{F}$, then the change in energy in the above system will be
 - $2.5 \times 10^{-2}\text{ J}$
 - $9 \times 10^{-2}\text{ J}$
 - $6.5 \times 10^{-2}\text{ J}$
 - $4 \times 10^{-2}\text{ J}$
- The distance between two point charges $4q$ and $-q$ is r . A third charge Q is placed at their midpoint. The resultant force acting on $-q$ is zero then $Q = \dots\dots\dots$
 - $-4q$
 - q
 - $-q$
 - $4q$
- Maximum power in a $0.5\ \Omega$ resistance connected with two batteries of 2 V emf and $1\ \Omega$ internal resistance in parallel, is
 - $\frac{8}{9}\text{ W}$
 - 1.28 W
 - 2.0 W
 - 3.2 W

5. Which of the following options for L , C and R give us the dimension of frequency ?

a) $\frac{1}{RC}$ b) $\frac{R}{L}$

c) $\frac{1}{\sqrt{LC}}$ d) $\frac{C}{L}$
6. An A.C. L - R circuit comprises of an inductor whose reactance $x_L = 3R$. Where R is resistance of the circuit. If a capacitor, whose reactance $x_C = R$ is connected in series, then what will be the ratio of the new and old power factor ?

a) $\sqrt{2}$ b) $\frac{1}{\sqrt{2}}$

c) 1 d) 2
7. X and Y coils are joined in a circuit in such a way that when the change of current in X is 0.5 A, the change in the magnetic flux in Y is 0.3 Wb. The mutual inductance of the system of two coils is H.

a) 0.8 b) 0.6

c) 0.2 d) 6
8. The electromagnetic waves in the range of wavelengths 0.3 cm to 1 m are used for the purpose of satellite communication. The range of frequencies corresponding to the above range of wavelengths is ($c = 3 \times 10^8 \text{ ms}^{-1}$)

a) 30 MHz to 10^4 MHz b) 3 MHz to 3×10^8 MHz

c) 300 MHz to 10^5 MHz d) 3 MHz to 10^6 MHz
9. Radii of curvature of both the sides of convex lens are 15 cm. If the refractive index of the material of the lens is 1.5. It's focal length in air is

a) 20 cm b) 10 cm

c) 30 cm d) 15 cm
10. The ratio of resolution power of telescope when light of wavelength $\lambda = 4000 \text{\AA}$ and $\lambda = 5000 \text{\AA}$ are used is

a) 5 : 4 b) 16 : 25

c) 4 : 5 d) 9 : 1

11. A proton and an α -particle are passed through same potential difference. If their initial velocity is zero the ratio of their de-Broglie wavelength after getting accelerated is

a) 1 : 2 b) $2\sqrt{2}$: 1
c) 2 : 1 d) 1 : 1
12. According to Bohr's hypothesis, the angular momentum of the electron in any stationary orbit L is proportional to

a) $\frac{1}{r}$ b) $\sqrt{r}$
c) r^2 d) r
13. The amplifier has voltage gain equal to 200 and it's input signal is $0.5 \cos(313 t) V$. The output signal will be equal to volt.

a) $100 \cos(313t + 90^\circ)$ b) $0.5 \cos(313t + 200)$
c) $100 \cos(313t + 180^\circ)$ d) $100 \cos(493t)$
14. The collector current of the NPN transistor is equal to 10 mA. If 90% of the electron from the emitter reaches collector, then

a) $I_E \approx 9 \text{ mA}, I_B \approx 1 \text{ mA}$ b) $I_E \approx 11 \text{ mA}, I_B \approx 9 \text{ mA}$
c) $I_E \approx 11 \text{ mA}, I_B \approx 1 \text{ mA}$ d) $I_E \approx 1 \text{ mA}, I_B \approx 1 \text{ mA}$
15. If the height of a TV transmitter tower is doubled, then the region covered by this transmitter

a) becomes four times b) becomes three times
c) becomes doubles d) no change
16. For efficient transmission of a 100 MHz frequency wave, the minimum length of an antenna should be

a) $3/4 \text{ m}$ b) 10 m
c) 100 m d) 3 m

Section - B

Question Nos. 17 to 32 are very short answer type questions, each carry **one** mark.

- 17.** What is the energy stored in a capacitor of capacitance 5 pf, charged to 1000 V?

OR

What is capacitor ?

18. Define mobility (μ).

OR

What is called superconductivity ?

19. Why a small soft iron cylindrical core is placed in galvanometer ?

20. State the Gauss's law for magnetism.

21. What are eddy currents ?

22. How much current is lagging behind the voltage in phase in an a.c. circuit with only inductor ?

23. What would be charge on nucleus of ${}_8O^{16}$ atom ? Charge of proton = $1.6 \times 10^{-19} C$.

24. What is Hertzian dipole ?

25. Two lens of power 2.5 D and 1.5 D are joined together. Calculate the power of new lens formed.

OR

What are coherent sources ?

26. State the Brewster's law.

27. On which factor the maximum energy of emitted photoelectron depends in photoelectric effect ?

OR

Define threshold frequency.

28. Which laws of conservation are obeyed in nuclear reactions ?

OR

Write full form of MASER.

29. Which negative sign means in equation $A_v = -g_m \cdot R_L$?

30. Name any two fundamental gates.

31. What do you mean by depletion barrier ?

32. The maximum electron density of a layer of the ionosphere is $\frac{1}{9} \times 10^{12} m^{-3}$. Calculate the critical frequency of this layer.

Section - C

Question Nos. 33 to 48 are short answer type questions, each question carries two marks.

32

- 33. Derive an expression of torque $\vec{\tau} = \vec{P} \times \vec{E}$ on an electric dipole when placed in an uniform electric field.
- 34. Define : Static electric potential. Derive an expression for electric potential at a point due to a point charge.
- 35. Accepting single valuedness of electric potential and with necessary diagram, derive Kirchhoff's second law for a closed loop.

OR

Explain the principle of it with a necessary circuit diagram.

- 36. Give appropriate circuit diagram for charging process of a secondary cell. Obtain an expression of charging current.
- 37. What is a toroid ? Using Ampere's circuital law, obtain an expression for magnetic field inside the toroid.

OR

Obtain an expression for magnetic force acting on two very long parallel and straight conducting wires carrying currents.

- 38. Draw the graph of $B \rightarrow H$ (Hysteresis cycle) and explain in brief for any ferromagnetic material.

- 39. On what factors does self inductance of coil depend ? From $L = \frac{N\phi}{I}$

derive $E = -L \cdot \frac{dI}{dt}$. Using that formula define self inductance and also its unit.

- 40. Write a note on Green house effect. Explain the function of ozone layer.
- 41. Obtain the differential equation for charge Q , when voltage applied to an A.C. circuit with L - C - R in series in $V = V_m \cos \omega t$.
- 42. Obtain an expression for equivalent focal length of a combination of two thin convex lenses. Also write formula for equivalent focal length for combination of more lenses.

43. For Fraunhofer diffraction by single slit, explain first order maximum and derive necessary condition for it.
44. Explain how a wave theory fails to explain the photoelectric effect.

OR

Explain experimental arrangement of Davison-Germer's experiment.

45. Using exponential law of radioactive decay, obtain the expressions for mean lifetime and half life time.
46. Give limitations of the Bohr Model.
47. Draw the circuit diagram of 'NOT' gate using transistor and also circuit symbol. Discuss any one case and give Boolean equation.

OR

Draw a circuit diagram for NPN transistor as CE amplifier. Discuss input circuit.

48. Which are (any four) the advantages of optical fibre communication ?

Section - D

Question Nos. 49 to 60 are short answer type questions, each question carries **36** three marks.

49. Two spheres having same radius and mass are suspended by two strings of equal length from the same point, in such a way that their surfaces touch each other. On depositing total $4 \times 10^{-7} C$ charge on them, they repel each other in such a way that in equilibrium the angle between their strings becomes 60° . If the distance from the point of suspension to the center of sphere is 20 cm, find the mass of each sphere $k = 9 \times 10^9 SI$, $g = 10 ms^{-2}$.

OR

- i) A 900 pF magnitude of capacitor is charged with the help of 100 V battery. Calculate the steady electric energy on it.
- ii) The above capacitor is disconnected from the battery and is connected to another identical capacitor. What will be the total energy of the system ?

50. 0.366 A current is obtained when 4Ω resistor is connected with an unknown battery having r as an internal resistance. 0.149 A current is obtained if the above battery is connected to 10Ω resistor. Calculate the emf and the internal resistance of the battery.
51. A battery having an emf E and an internal resistance r is connected with a resistor R . Prove that the power in the external resistance is maximum when $R = r$.
52. A very long straight wire is carrying a current of 10 A. If an electron is moving parallel to this wire in a direction opposite to the current at a distance of 40 cm from the wire, with a velocity of $5 \times 10^5 \text{ ms}^{-1}$, find the force of attraction experienced by the electron.
 $(e = 1.6 \times 10^{-19} \text{ C}, \mu_0 = 4\pi \times 10^{-7} \text{ SI})$
53. The region inside a current carrying toroidal winding is filled with tungsten of susceptibility 7×10^{-5} . What is the percentage increase in the magnetic field in presence of material with respect to the magnetic field without it ?
54. A conducting loop of radius r is placed concentric with another loop of a much larger radius R , so that both loops are coplanar. Find the mutual inductance of the system of two loops. Take $R \gg r$.

OR

Prove that the average value of an AC voltage source given by

$$V = V_m \sin \omega t \text{ is equal to } \frac{2V_m}{\pi} \text{ for half period of its cycle.}$$

55. A narrow beam of light is incident at 53° angle made with the normal on a glass plate of refractive index 1.6. If the thickness of plate is 20 mm, calculate the lateral shift of the beam when it emerges out from the plate. $(\sin 53^\circ = 0.8)$

OR

An object is moving towards concave mirror along its principal axis with uniform velocity V_0 . Prove that when the object is at distance

$$U \text{ from concave mirror, velocity of image is } V_i = -\left(\frac{R}{2U - R}\right)^2 V_0.$$

R is the radius of curvature of the mirror.

56. In Young experiment width of one slit is 3 times that of another. If we assume that the intensity of light is proportional to the width of the slit, find the ratio of maximum to minimum intensity.
57. Find the energy of photon in each of the following :
- i) Microwaves of wavelength 1.5 cm.
 - ii) Red light of wavelength 660 nm.
 - iii) Radiowaves of frequency 96 MHz.
58. Calculate the quantum number for which the radius of the orbit of electron in Be^{3+} would be equal to that for the ground state of electron in a hydrogen atom. Also compare the energy of the two states.
59. If the activity of 1g of Ra^{226} sample is 3.7×10^{10} Bequerel, calculate its half life. Take Avogadro number = $6.02 \times 10^{23} mol^{-1}$.
60. The current gain of a Common Base (CB) circuit is equal to α and current gain of a Common Emitter (CE) circuit is equal to β . Find the relationship between α and β .

OR

In a tuned collector oscillator circuit an output signal of 1 MHz frequency is obtained. The value of capacitance $C = 100 pF$, what should be the value of the capacitor if a signal of 2 MHz frequency is to be obtained ?