B.Sc. ELECTRONICS
First Semester
APPLIED PHYSICS
(BSE - 102)

Duration: 3Hrs. **Full Marks: 70**

Part-A (Objective) =20
Part-B (Descriptive) =50

(PART-B: Descriptive)

Duration: 2 hrs. 40 mins. **Marks: 50**

Answer any *four* from *Question no.* 2 to 8
***Question no.* 1 is compulsory.**

1. What is stationary wave? Show analytically how they are formed due to superposition of two waves. Give two differences between stationary and progressive waves. (1+7+2=10)

2. (a) Explain deBroglie's concept of matter waves.
   (b) Obtain an expression for the deBroglie wavelength for a particle of mass m moving with velocity close to the velocity of light.
   (c)The most rapidly moving valence electron in metallic sodium at the absolute zero temperature has a kinetic energy 3eV. Show that its deBroglie wavelength is close to 7Å. (2+3+5=10)

3. State and prove Heisenberg's uncertainty principle. Discuss its physical significance. With the help of uncertainty principle, explain why electron cannot exist inside the nucleus. (4+3+3=10)

4. If a particle of mass m is confined in a field free region between impenetratable walls at $x = 0$ and $x = a$, then
   (a) Show that the stationary energy level of the particle is $E_n = \frac{n^2\pi^2\hbar^2}{2ma^2}$.

(b) Deduce the normalized wave function and graphically represent it for three values of $n(= 1, 2 \text{ and } 3)$. (5+5=10)

5. What is superconductivity? What is the major demerit of superconducting device? Explain Meissner effect with the proper diagram and with the help of Meissner's effect differentiate Type-I and Type-II superconductors. (2+3+5=10)

6. (a) Define moment of inertia and its significance.

   (b) State and prove parallel axis theorem for 2D rigid body.

   (c) Find out the MI of a circular ring about an axis passing through the centre an perpendicular to the plane.

(2+5+3=10)

7. (a) Define Y, K, n, σ.

   (b) Prove for a uniform rod, twisting couple is given by, $C = \frac{\pi n a^4}{2l}$, where symbols have their usual meaning.

(4+6=10)

8. (a) What do you mean by ultrasound? Write two application of it.

   (b) State and prove Sabine's law.

   (c) State two methods to reduce reverberation.

(3+5+2=10)

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BSE/15/20 2016/12

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Duration: 20 minutes **Marks – 20**

(PART A - Objective Type)

I. Choose the correct answer: **1×20=20**

1. The phase velocity of a wave is given by,
   (a) $v_p = dw\frac{dw}{dk}$ (b) $v_p = \frac{w}{k}$
   (c) $v_p = \lim_{\delta\lambda \to 0} \frac{\delta w}{\delta \lambda}$ (d) none of these

2. Operator for momentum in x-direction is,
   (a) $\hat{p}_x = \frac{\hbar}{i}\frac{\partial}{\partial t}$ (b) $\hat{p}_x = \frac{\hbar}{i}\frac{\partial}{\partial x}$
   (c) $\hat{p}_x = \frac{i}{\hbar}\frac{\partial}{\partial x}$ (d) $\hat{p}_x = \frac{i}{\hbar}\frac{\partial}{\partial t}$

3. The dimension of wave function $\varphi(r,t)$ of a wave is given by,
   (a) $[L^3]$ (b) $[L^{-1/2}]$ (c) $[L^{-3/2}]$ (d) $[L^{-2/3}]$

4. If the wave function of a particle is $\varphi(r,t)$, then $|\varphi(r,t)|^2$ will give the
   (a) Probability (b) probability density
   (c) both (d) none of these

5. The lowest energy of a particle in one dimensional box is given by,
   (a) $E_1 = \frac{\pi^2\hbar^2}{2ma^2}$ (b) $E_1 = \frac{\pi^2\hbar^2}{4ma^2}$
   (c) $E_1 = \frac{\hbar^2 m}{4\pi a^2}$ (d) $E_1 = \frac{m^2 a^2}{2\pi a^2}$

6. In case of a semiconductor the energy gap between the valence band and conduction band
   (a) Is more than that of conductors (b) is less than that of conductors
   (c) overlaps (d) none of these

7. Critical temperature(T_c) of superconductor varies with its isotopic mass (M) as
   (a) $T_c = M^{-1/2}$ (b) $T_c = 1/M^2$
   (c) $T_c = \sqrt{M}$ (d) $T_c = M^{3/2}$

8. The numerical aperture of an optical fibre having core refractive index n_1 and cladding refractive index n_2 is given by,
   (a) $NA = \sqrt{n_1 + n_2}$ (b) $NA = \sqrt{n_1^2 + n_2^2}$
   (c) $NA = \sqrt{\frac{n_1+n_2}{2}}$ (d) $NA = \sqrt{n_1^2 - n_2^2}$

9. The MI of a uniform rod of length L about an axis passing through the centre and perpendicular to the plane is,
(a) $ML^2/12$ (b) $ML^2/3$ (c) $ML^2/4$ (d) none of these

10. A particle of mass m describes a circle of radius r. the centripetal acceleration of the particle is $4/r^2$. What will be the momentum of the particle is
(a) 2m/r (b) $2m/\sqrt{r}$ (c) 4m/r (d) $4m/\sqrt{r}$

11. The time period of a compound pendulum of length 20cm and radius of gyration about the centre of gravity is 10cm is
(a) $2\pi\sqrt{2}$ s (b) $2\pi\sqrt{2.5}$ s
(c) 2π s (d) $2\pi\sqrt{3}$ s

12. The relation between Y,K,n is
(a) $\frac{9}{Y}=\frac{1}{K}+\frac{3}{n}$ (b) $\frac{9}{Y}=\frac{1}{n}+\frac{3}{k}$
(c) $\frac{1}{Y}=\frac{9}{K}+\frac{3}{n}$ (d) none of these

13. Dimensional formula of stress is same as
(a) force (b) impulse
(c) pressure (d) strain

14. Absorption coefficient is given by the ratio between
(a) $\frac{sound\ energy\ absorbed}{sound\ energy\ incident}$ (b) $\frac{sound\ energy\ incident}{sound\ energy\ absorbed}$
(c) $\frac{sound\ energy\ absorbed}{sound\ energy\ reflected}$ (d) $\frac{sound\ energy\ reflected}{sound\ energy\ incident}$

15. A sine wave travelling to right is represented by the equation y=asin(kx-wt). The velocity of the wave is given by,
(a) k/w (b) wt (c) w/k (d) kt

16. Production of beat is due to
(a) Interference (b) Diffraction
(c) Polarization (d) Refraction

17. Doppler's effect is exhibited by,
(a) sound wave only (b) light wave only
(c) both light and sound wave (d) ultrasonics

18. The reverberation time of a room of volume of $2800m^3$ and total absorption coefficient of 70 is
(a) 40 s (b) 0.66 s (c) 6.6 s (d) 0.4 s

19. The radius vector is $2\hat{\imath}+\hat{\jmath}+\hat{k}$ while linear momentum $2\hat{\imath}+3\hat{\jmath}-\hat{k}$. The angular momentum is
(a) $2\hat{\imath}-4\hat{k}$ (b) $4\hat{\imath}-8\hat{k}$
(c) $2\hat{\imath}-4\hat{\jmath}+2\hat{k}$ (d) $4\hat{\imath}-8\hat{\jmath}$

20.A motor car is approaching towards a crossing with a velocity 72 km/hr. the frequency of sound of its horn as heard by a police man standing on the crossing is 260Hz. The real frequency of the horn is, (velocity of sound in air is 332m/s)

(a) 257Hz (b) 244 Hz (c) 201Hz (d) 276 Hz

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