B. Sc. PHYSICS
SECOND SEMESTER
PHYSICS-II
BSP-721

(Use Separate Answer Scripts for Objective & Descriptive)

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

[PART-A: Objective]

Time : 20 min. **Marks : 20**

Choose the correct answer from the following: ***1X20=20***

1. The magnetic field outside the infinite solenoid is
   a. Zero
   b. $\frac{\mu_0 I}{2r}$
   c. $\frac{\mu_0 I}{4r}$
   d. $\frac{\mu_0 I}{r}$

2. $\vec{E} = -\vec{\nabla} U$. Here Negative sign signifies that
   (where $\vec{E}$ is the electric field and U is the electric potential)
   a. E is directed in the direction of decreasing U
   b. E is opposite to U
   c. E is negative
   d. E increases when U decreases

3. Which of the following substance have *positive permeability* and *negative susceptibility*?
   a. Diamagnetic
   b. Ferromagnetic
   c. paramagnetic
   d. Anti-ferromagnetic

4. Increase in temperature results in
   a. Adiabatic compression
   b. Adiabatic expansion
   c. Isothermal compression
   d. Isothermal expansion

5. Entropy of a system remains constant in
   a. Reversible process
   b. Irreversible process
   c. Adiabatic Process
   d. None of these

6. The value $\gamma(\frac{C_p}{C_v})$ for a diatomic gas molecule is
   a. 1.4 b. 1.66 c. 1.33 d. 1

7. The unit of entropy are
   a. Joules K^{-1} b. Joules K c. Joules d. K

8. The Ampere's law is based on which theorem?
   a. Gauss's divergence theorem
   b. Green's theorem
   c. Stoke theorem
   d. Maxwell theorem

9. The value of $\nabla \times B$ at a point outside the current loop is

a. $\mu_0 J$ b. $\frac{\mu_0 J}{2}$

c. Zero d. Infinity

10. The force experience by a charged particle moving in a magnetic field is independent of

a. Velocity of particle b. Charge on particle

c. Strength of magnetic field d. Mass of particle

11. Exchange of heat is absent in ..... process.

a. Isothermal b. Adiabatic c. Isochoric d. Isobaric

12. How many degrees of freedom are possessed by a diatomic gas?

a. 2 b. 3 c. 4 d. 5

13. The Gaussian surface for a line charge will be

a. Spherical b. Cube c. Cylindrical d. Cuboid

14. What is the name of the process whereby waves travel around corners and obstacles in their paths?

a. Refraction b. Reflection c. Diffraction d. Interference

15. The dimension of atomic polarizability is same with

a. Capacitance b. Electric field intensity

c. Volume d. Dipole moment

16. Which of the following is equivalent focal length of a combination of two lenses? (Symbols have usual meaning)

a. $F = \frac{f_1 + f_2 - d}{f_1 f_2}$ b. $F = \frac{f_1 f_2}{f_1 + f_2 - d}$

c. $F = \frac{f_1 f_2}{d - (f_1 + f_2)}$ d. $F = \frac{d - (f_1 + f_2)}{f_1 f_2}$

17. Which of the following is the net entropy change in Carnot's cycle?

a. Positive b. Zero

c. Negative d. Anything between 0 and 1

18. Which of the following quantities determine thermal equilibrium?

a. Entropy b. Temperature c. Volume d. Pressure

19. For symmetrical objects, it is easier to find the electric field using the

a. Coulomb's law b. Gauss's law

c. Ohm's law d. Lenz's law

20. The efficiency of a Carnot's heat engine working between temperatures 1270C and 270C is

a. $\frac{100}{127}$ b. $\frac{27}{127}$

c. $\frac{100}{400}$ d. $\frac{300}{400}$

PART-B : Descriptive

Time : 2 hrs. 40 min. Marks : 50

[Answer question no.1 & any four (4) from the rest]

1. a. An ideal heat engine of efficiency 0.75 discharges 2000W into the sink whose temperature is 100C. Calculate source temperature, work done by the engine in one minute and heat drawn from the source in one cycle. **5+3+2 =10**

   b. A body at 1500 K emits maximum energy of wavelength 200nm. If sun emits maximum energy of wavelength 500nm, what would be the temperature of the sun.

   c. Two stars radiate maximum energy at wavelength 3.6×10-7m and 4.8×10-7m respectively. What is the ratio of their temperature?

2. State Ampere's law. Using Ampere's law calculates the magnetic field at a point inside a long current carrying solenoid. **2+4+4 =10**

   Also prove that if the magnetic field induction $\vec{B}$ is not a function of time,

   $$curl\,\vec{B} = \mu_0 \vec{J}$$

   Where symbols have usual meaning.

3. Show that mean free path of the molecules of a gas is inversely proportional to the density of the gas. Calculate the mean free path of nitrogen molecule at 27^0C temperature and one atmospheric pressure. The molecular diameter of nitrogen is 3.5×10^{-8}cm. **5+5=10**

4. State and prove the Gauss's divergence theorem. Express it in differential form and show that $\nabla.\vec{E} = \frac{\rho}{\varepsilon_0}$ **2+8=10**

5. a. Explain reversible and irreversible thermodynamic processes with examples. **4+3+3 =10**

   b. Discuss the concepts of degrees of freedom and Brownian motion.

6. What is Black body? What do you mean by Black body radiation? Show that Wien's displacement law is a special case of Planck's law. Filament of a tungsten bulb is emitting radiation of maximum energy wavelength $\lambda_m=2.16\times10^{-5}$cm. Calculate filament temperature. **1+1+5+ 3=10**

7. **a.** State Fermat's principle. Using Fermat's principle establish the laws of reflection of light. **5+5=10**

b. Show that mean free path of the molecules of a gas is inversely proportional to the density of the gas.

8. **a.** Write the limitation of first law of thermodynamics and also state the second law of thermodynamics. **4+6=10**

b. A system is taken from A to B along the path ACB when 60 Joules of heat enter into it and system does 25 Joules of work.

i. How much heat will enter into the system along the path ADB when the work done along the path is 10 Joule?

ii. When the system returns from state B to A along path BA work done is 15 Joule. Calculate the amount of heat transfer.

= = *** = =