

**5m/PHY-302 Syllabus-2023**

**2 0 2 5**

( Nov-Dec )

**FYUP : 5th Semester Examination**

**MINOR**

**PHYSICS**

**( Modern Physics—I )**

**PHY-302**

*Marks : 75*

*Time : 3 hours*

*The figures in the margin indicate full marks  
for the questions*

Answer *any ten* questions

1. (a) Discuss briefly about the photoelectric effect and Compton effect. 2½+2½=5  
(b) Let  $E_1$ ,  $E_2$ ,  $E_3$  and  $E_4$  represent the energies of a photon associated with ultraviolet, X-ray, infrared and visible light. Arrange the given energies in increasing order and justify your answer. 2½
  
2. (a) State the de Broglie hypothesis of matter wave. 3

( 2 )

- (b) Let  $\lambda_1$  and  $\lambda_2$  represent the de Broglie wavelengths of two moving particles of masses  $M$  and  $4M$  with same kinetic energy. If  $\lambda_1 = 1 \text{ \AA}$ , then find the value of  $\lambda_2$ . 4½
3. (a) Consider a car (mass = 1000 kg) and an electron (mass =  $9.1 \times 10^{-31}$  kg) each moving with the same speed of 40 m/sec. If there is 1% uncertainty in measurement of their momentum, then find the uncertainty in their positions. Give that the value of Planck constant (h) is  $6.63 \times 10^{-34}$  Joule sec. 2+2=4
- (b) Calculate the minimum uncertainty in the energy of the excited state of an atom if the lifetime of the excited state is about  $10^{-8}$  sec. 3½
4. (a) Discuss the key differences between crystalline and amorphous solids. Give one example of each. 3½+1=4½
- (b) Define the electrical conductivity and specify its units. Discuss the classification of solids based on their electrical conductivities. 1+2=3
5. (a) Using the band theory, explain why metals are good conductor whereas insulators are bad conductor of electricity. 4

( 3 )

- (b) Explain the temperature dependent variation of the electrical conductivity of an intrinsic semiconductor. Plot the qualitative graph between conductivity and temperature. 2½+1=3½
6. (a) Discuss the mechanism of heat transfer in solid. Explain why metals are better conductor of heat than insulators. 2+2=4
- (b) Define thermal conductivity and give its unit. Explain why we feel cold when we touch a metal in winter. 1+½+2=3½
7. (a) Define the following terms and give their units : 1½×3=4½
- (i) Magnetic susceptibility
- (ii) Magnetization
- (iii) Magnetic flux
- (b) A paramagnetic material of magnetic susceptibility ( $\chi$ ),  $2 \times 10^{-5}$  is placed in a magnetic field  $0.1 \times 10^{-4} \text{ Am}^{-1}$ . Calculate the magnetization of the material. 3
8. (a) Discuss briefly about the ferromagnetic, antiferromagnetic and ferrimagnetic materials. 4½
- (b) Discuss the Bloch  $T^{3/2}$  law and Curie-Weiss law for ferromagnetic materials. 1½+1½=3

( 4 )

9. (a) Describe the characteristic properties of superconductors. Write their three applications.  $3+1\frac{1}{2}=4\frac{1}{2}$
- (b) Discuss briefly the key differences between type-I and type-II superconductors. Give one example of each.  $2+1\frac{1}{2}+1\frac{1}{2}=3$
10. (a) Explain qualitatively the origin of magnetic moment in an atom. Out of H, He, Na, Ne, Ar and Fe, identify the atom(s) with non-zero magnetic moment with proper explanations.  $2+2\frac{1}{2}=4\frac{1}{2}$
- (b) Using the Bohr model, find the energy required to excite the hydrogen atom from its ground state to second excited state. 3
11. (a) Discuss the characteristic properties of light emitted by the LASER.  $5\frac{1}{2}$
- (b) Describe briefly the difference between spontaneous and stimulated emission of radiation. 2
12. (a) Discuss the conditions for LASER action.  $3\frac{1}{2}$
- (b) State and explain the Pauli exclusion principle. Obtain the net spin of helium and lithium atoms in their ground state.  $2+1+1=4$

26D/814

( Continued )

( 5 )

13. (a) Describe the liquid-drop model of nucleus.  $4\frac{1}{2}$
- (b) Let  $R_1$  and  $R_2$  represent the radii of two different nuclei with  $A = 27$ ,  $Z = 12$  and  $A = 64$ ,  $Z = 29$  respectively. Find the value of  $\frac{R_1}{R_2}$ . 3
14. (a) What is binding energy? Calculate the binding energy of an alpha particle both in MeV and in joule. Given that—
- (i) 1 a.m.u. = 931 MeV;
- (ii) masses (in a.m.u.) of  $\alpha$ -particle, proton and neutron are 4.001506, 1.007825 and 1.008665, respectively.  $1+3=4$
- (b) What is radioactivity? Describe the different types of radioactive decay.  $\frac{1}{2}+3=3\frac{1}{2}$
15. (a) Discuss the difference between nuclear fission and nuclear fusion. Give one example of each.  $1+1+1=3$
- (b) Describe the construction and working principle of a nuclear reactor.  $2+2\frac{1}{2}=4\frac{1}{2}$

\*\*\*

26D—900/814

5m/PHY-302 Syllabus-2023