

KHULNA UNIVERSITY OF ENGINEERING & TECHNOLOGY

Department of Mechanical Engineering

B. Sc. Engineering 1st Year 2nd Term Examination, 2017

Ph 1205

(Physics)

Time: 3 Hours.

Full Marks: 210

N.B. i) Answer any THREE questions from each section in separate scripts.

ii) Figures in the right margin indicate full marks.

iii) Assume reasonable data if any missing.

SECTION – A

- 1(a) Discuss the inertial and non-inertial frame of references. 06
- 1(b) What is proper time? Derive an expression for time dilatation without using Lorentz transformation. 10
- 1(c) Prove that the speed of light is constant for all observers regardless of their motion. 10
- 1(d) A rocket of proper length 400 meters is moving directly away from the earth. A light pulse sent from the earth is reflected from mirrors at the rear and front of the rocket. If the first of these reflected pulses is received back 120 sec after the emission and second one after 15 μ sec later. Calculate (i) the distance of the rocket from the earth, (ii) the velocity of the rocket and (iii) its apparent length. 09
- 2(a) What is red shift? Derive an expression for gravitational red shift when photon release from the planet and strike the earth surface. 12
- 2(b) Define phase and group velocity. Establish the relation between phase velocity and group velocity. 13
- 2(c) The phase velocity of a ripple on a liquid surface is $\sqrt{\frac{2\pi S}{\lambda\rho}}$, where S is the surface tension and ρ is the density of the liquid. Find the group velocity of the ripples. 10
- 3(a) Discuss spectral series of H_2 atom. Calculate the limiting values of wavelength of different spectral series of H_2 atom. 15
- 3(b) Discuss magnetic quantum number (m_j) and orbital magnetic moment of an electron. 10
- 3(c) Calculate the values of 4 quantum numbers of electrons staying in the principal quantum number $n = 3$. 10
- 4(a) Discuss different types of nuclear reaction. 08
- 4(b) State the laws of radioactive decay. Discuss secular and transient equilibrium. 12
- 4(c) Discuss C-N cycle of nuclear reaction? 07
- 4(d) A radioactive sample initially contains 4.00 mg of ${}_{92}U^{234}$. How much of it will remain unchanged after 62,000 years? What will be its activity at the end of that time? Given that $T = 2.48 \times 10^5$ years and $\lambda = 8.88 \times 10^{-14}$ /sec. 08

SECTION - B

- 5(a) What is space lattice? Discuss briefly the seven systems of crystal. 10
- 5(b) Define Miller indices. How to find it? Show that for a cubic lattice the interplaner distance between a set of (hkl) plane is given by $d_{hkl} = \frac{a}{(h^2 + k^2 + l^2)^{\frac{1}{2}}}$. 15
- 5(c) A diffraction pattern is obtained for lead with radiation of wavelength 1.54 \AA . The (220) reflection is observed at Bragg angle, 32° . What are the lattice parameter of lead and the radius of the atom? 10
- 6(a) Derive the Einstein's expressions for specific heat of solid at high and low temperature. 10
- 6(b) Discuss Fermi-Dirac distribution function and derive the expression for Fermi energy. 15
- 6(c) Calculate the Debye specific heat of copper at (i) 10K and (ii) at 300 K, given that the Debye characteristic frequency is $6.55 \times 10^{12} / \text{sec}$. 10
- 7(a) Obtain an expression for the energy of an electron using the Sommerfeld's free electron theory in one dimension. 10
- 7(b) Discuss Hall voltage, Hall co-efficient and Hall angle. 09
- 7(c) Discuss the importance of Hall effect. 06
- 7(d) Find the Hall coefficient and electron mobility for Germanium for a given sample (length 1cm, breadth 5mm and thickness 1mm). If a current of 5 mA flow from a 1.35 volts supply, develops a Hall voltage of 20 mV across the specimen in a magnetic field of 0.45 wb/m^2 . 10
- 8(a) Discuss spontaneous emission and stimulated emission. 12
- 8(b) Describe briefly the principle, construction and working principle of Helium - Neon laser. 13
- 8(c) A laser beam $\lambda = 6000 \text{ \AA}$ on earth is focused by a lens of diameter 2m on to a center on the moon. The distance of the moon is $4 \times 10^8 \text{ m}$. How big is the spot on the moon? Neglect the effect of earth's atmosphere. 10