

AHSANULLAH UNIVERSITY OF SCIENCE AND TECHNOLOGY

Department : Arts and Sciences

Program : Bachelor of Science in Computer Science and Engineering

Semester Final Examination, Spring 2017

Year : 1st Semester : 1st

Course No. : PHY 1115 Course Title: Physics

Time: 3 (Three) hours

Full Marks: 70

Instruction : Use separate answer scripts. Answer the questions of groups A & B in Part A and group C in Part B.

There are 7 (seven) questions. Answer any 5 (five) taking at least 1 (one) from each group. Marks allotted are indicated in the right margin.

Group A A

1. a. What are magnetic field and magnetic force? Show the directions of magnetic force 3 on a negative charge, q moving with velocity v in a magnetic field, B .
b. Explain the Biot-Savart Law. How does it differ from Ampere's law? 3
c. A flat strip of copper of width d and negligible thickness carries a current i . Find the 5 magnetic field at a perpendicular distance R from the center of the strip.
d. An electron in a uniform magnetic field, B has a velocity, 3 $v = (40 \text{ km/s})\hat{i} + (35 \text{ km/s})\hat{j}$. It experiences a force, $F = (-4.2 \text{ fN})\hat{i} + (4.8 \text{ fN})\hat{j}$. If $B_x = 0$, calculate the magnetic field.
2. a. State and explain Faraday's law of induction. 3
b. Define self inductance. Calculate the inductance for a section of length l near the 4 center of a long solenoid having a cross-sectional area A .
c. Derive an equation which describes the rise of current in a circuit containing a 4 resistor R and an inductor L in series. Show the graphical presentation of the current with respect to time.
d. A solenoid has an inductance of 53 mH and a resistance of 0.37 Ω . If it is connected 3 to a battery, how long will it take for the current to reach one half its final steady-state value?
3. a. What do you understand by energy bands of solids? Explain the important energy 4 bands in solids.
b. Define semiconductor in terms of energy band. Explain the effect of temperature on 6 resistivity of a semiconductor.
c. What is $p-n$ junction? Explain the properties of $p-n$ junction. 4

Group B

4. a. State and explain Huygens' principle. 3
- b. Define interference of light. Calculate the positions of bright and dark fringes produced on the screen in the Young's double-slit experiment. 5
- c. What are Newton's rings? How are these rings obtained? 3
- d. The distance between the first and tenth minima of double-slit pattern is 18 mm. The screen is 50 cm away from the slits separated by 0.15 mm. What is the wavelength of light used? 3
5. a. What do you understand by diffraction pattern? Deduce an expression of diffraction pattern produced by single slit. 7
- b. Distinguish between the diffraction pattern and interference pattern. 2
- c. Explain the production of polarized light by reflection from a glass surface. 3
- d. At what angle of incidence will the light reflected from water of refractive index 1.33 be completely polarized? 2

Group C

6. a. Define simple harmonic motion. Two simple harmonic motions of same frequency and amplitude but in perpendicular directions are compounded. Find the resultant motions if the phase differences are $\pi/4$ and $3\pi/4$ between the individual vibrations. 6
- b. What is damped harmonic oscillation? Discuss the conditions under which the oscillations become dead beat, critically damped and oscillatory. 5
- c. Two simple harmonic motions acting simultaneously on a particle are given by 3

$$y_1 = \sin(\omega t + \frac{\pi}{6})$$

$$y_2 = 3 \sin(\omega t + \frac{\pi}{3})$$

Calculate amplitude, phase constant and time period of the resultant vibration.

7. a. What is phase velocity? Show that for a single wave in any medium the phase velocity and wave velocity are equal. 4
- b. What is meant by energy density of a plane progressive wave? Show that the energy density of a plane progressive wave is $E = 2\pi^2 n^2 a^2 \rho$, where the symbols have their usual meaning. 7
- c. The apparent frequency of the whistle of an engine changes in the ratio 6:5 as the engine passes a stationary observer. If the velocity of sound is 352 m/sec, calculate the velocity of the engine. 3

$$y = a \sin(\omega t + \delta)$$

$$y = a \sin(\omega t + \delta)$$