

BACHELOR OF SCIENCE EXAMINATION 2018

(1st Year, 1st Semester)

GENERIC ELECTIVE-1(Physics)

Time: Two hours

Full Marks: 50

Answer any **FIVE** questions

1. (a) Find the divergence of $r^n \hat{r}$, where n is an integer and $\vec{r} = x\hat{i} + y\hat{j} + z\hat{k}$.
 (b) Show that curl of gradient of any scalar field $\phi(x, y, z)$ is always zero.
 (c) Calculate the line integral $\int \vec{F} \cdot d\vec{l}$, of the vector field $\vec{F} = x^2\hat{i} + 2yz\hat{j} + y^2\hat{k}$, from the origin (0,0,0) to the point (1,1,1) through the route: (0,0,0) $\rightarrow$ (1,0,0) $\rightarrow$ (1,1,0) $\rightarrow$ (1,1,1).
 3+3+4
2. (a) State and explain the Gauss's law in electrostatics.
 (b) Find the expression of potential due to an electric dipole at a large distance r .
 (c) Find the capacitance of a parallel-plate capacitor for which the plates are square with sides 1 cm long and they are held 1 mm apart. ($\epsilon_0 = 8.85 \times 10^{-12} \text{ C}^2 / \text{Nm}^2$).
 3+4+3
3. (a) State Biot-Savart Law.
 (b) Calculate the magnetic field at an external point due to an infinitely long current carrying wire.
 (c) When current flows through two parallel wires, the wires get either repelled or attracted. Explain why it happens so.
 2+5+3
4. (a) What do you mean by coherent source of light?
 (b) Derive an expression for the displacement of fringes when a thin glass plate is introduced in one of the paths of the interfering light rays.
 (c) In Young's experiment interference bands are produced on the screen placed at 1.5 m from the plane of two slits which are separated by a distance of 0.15 mm and illuminated by a light of wavelength 450 nm. Find the change in fringe width when the screen is brought nearer to the slit by 50 cm.
 2+4+4
5. (a) Why is an extended source of light necessary for Newton's ring experiment?
 (b) Write down an expression for the intensity pattern for diffraction of light due to a single slit and hence find the positions of secondary maxima and minima.
 (c) A screen is placed 50 cm from a single slit which is illuminated with 6000 Å light. If the distance between the first and third minima in the diffraction pattern is 3 mm, what is the width of the slit?
 2+5+3

6. (a) Draw a neat circuit diagram of a half-wave rectifier with a capacitor filter.

Explain its performance with suitable input-output graphs.

(b) Draw the circuit diagram of a common-emitter (C.E) transistor amplifier and sketch its output characteristics indicating different regions. 5+5

7. (a) Convert the decimal number 4.625 to its binary equivalent and the binary number 11.1101 to its decimal equivalent.

(b) What is an NAND gate? Why is it called a universal gate?

(c) Draw a circuit diagram of XOR gate and write the truth table.

2+ 5+3

8. Write short note on any **two**:

(a) Ampere's circuital law and its importance.

(b) Maxwell's electromagnetic equations.

(c) Newton's ring.

(d) Operational Amplifier (OP AMP) and its uses.

5+5