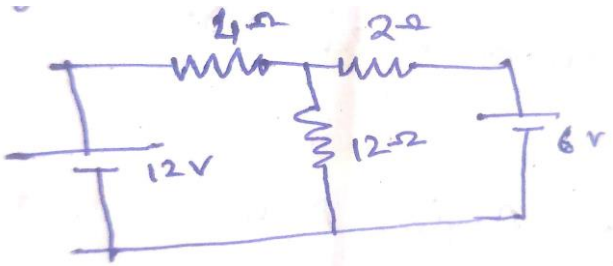
FYUGP B.Sc 2nd Semester Sessional Examination, 2025
Paper: Mathematical Physics & Electricity and Magnetism
Paper Code: PHY020104

Marks: 30 **Time: 90 minutes**

1. **Answer the following: (any two)** $2 \times 2 = 4$
   (a) Find the order and degree of the differential equation:
   i. $x^3\left(\frac{d^2y}{dx^2}\right)^2 + x\left(\frac{dy}{dx}\right)^4 = 0$ ii. $\frac{d^2y}{dx^2} + a^2x = 0$
   (b) On what factors the capacitance of a conductor depends ?
   (c) Explain the principle of a capacitor in brief.
   (d) State the Biot-Savart's law of magnetic induction.

2. **Answer the following: (any two)** $2 \times 3 = 6$
   (a) Solve the following differential equation by variable separable method:
   $$(1 + x^2)dy - xy\,dx = 0$$
   (b) (i)Define Gauss's Law. (ii) Derive the unit of electric flux. (iii) What is surface charge density?
   (c) The determinant of a 2x2 matrix is 2 and its trace is 4. Find the eigen values of the matrix.
   (d) If $[1,0,2]$ and $[2,0,-1]$ are the eigen vectors of a 3x3 symmetric matrix, then what will be the third eigen vector?
   (e) Obtain the differential form of Ampere's circuital law from its integral form.
   (f) Write the definition of voltage source and current source with schematic diagram.

3. **Answer the following: (any four)** $4 \times 5 = 20$
   (a) The equation of motion of a spherical particle falling under gravity through a viscous liquid with resistivity (γ) is given by $\frac{dv}{dt} = g - \gamma v$. Find the velocity of the particle at any instant of time t.
   (b) Solve the following homogeneous differential equation
   $$(x^2 - y^2)dx + 2xy\,dy = 0$$
   (c) Show that the angle subtended by a solid angle at the centre is 4π. Find the electric field intensity at a point outside a cylindrical charged conductor.
   (e) Obtain an expression for magnetic induction on the axis of a long current carrying solenoid.
   (f) For a given RC circuit, draw the charging and discharging curve with necessary mathematical expression.Also write the unit of time constant.
   (g) Making use of any convenient network theorem, calculate the current flowing through the 12 ohm resistor of the following circuit.



   (h) Calculate the capacitance of a parallel plate capacitor with dielectric as the medium between them.