

RAMAKRISHNA MISSION VIDYAMANDIRA

(Residential Autonomous College affiliated to University of Calcutta)

B.A./B.Sc. END SEMESTER EXAMINATION, MAY 2023

Date : 29/05/2023

PHYSICS [GENERAL]

Time : 11 am – 1 pm

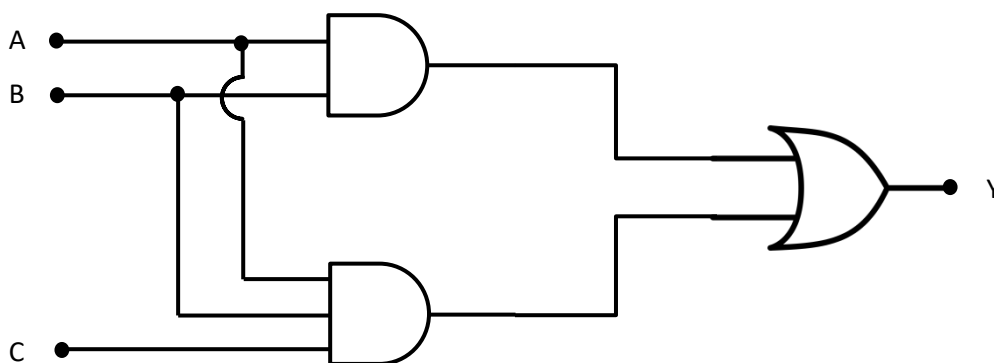
Paper : II / IV

Full Marks : 50

Answer **any five** questions:

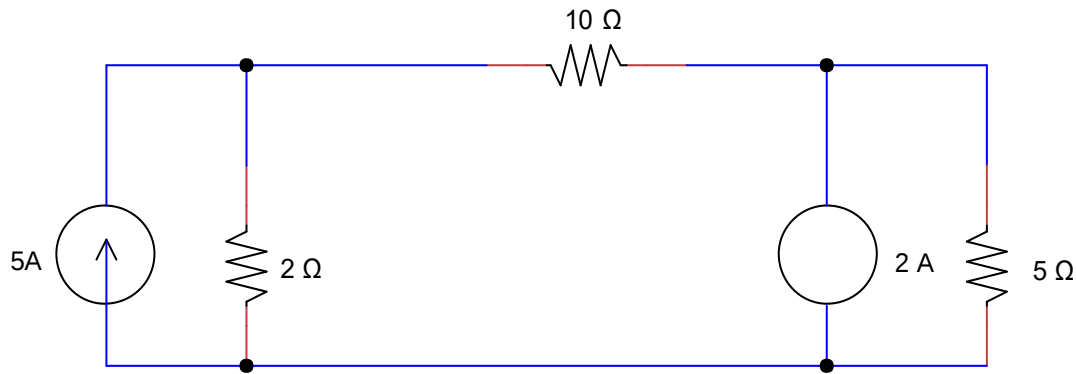
[5×10]

1. a) What is electric flux? Find an electric field at a point near an infinite plane sheet of charge. (1+3)
b) What is dielectric medium? (2)
c) Find a relation between $\vec{E}$, $\vec{P}$, $\vec{D}$ vectors have their conventional physical meaning. (4)
2. a) Find an expression for energy stored in the magnetic field in a coil carrying current. (3)
b) What is mutual inductance? (2)
c) Find an expression for co-efficient of mutual inductance for two co axial solenoids. (5)
3. a) How depletion region forms in a $p-n$ junction diode? (3)
b) How a zener diode work as a voltage regulator? (3)
c) Draw a circuit of full wave rectifier. (2)
d) What is the advantage of bridge rectifier over a full wave rectifier? (2)
4. a) Draw the circuit diagram of an 'OR' gate using diodes and explain its operation along with the truth table. (4)
b) Using NOR gate as universal gate, construct 'AND', 'OR' and 'NOT' gates in terms of Boolean expression. (3)
c) Obtain the Boolean expression for the output Y in the following logic circuit and simplify the expression. (3)



5. a) State and prove the equation of continuity. (1+4)
b) Current is flowing radially from inner to outer spherical surface of two co-centric spherical surfaces of inner and outer radii 'a' and 'b' respectively. The current density at a distance r ($a < r < b$) is given by $\vec{J}(r) = J_0 \left(\frac{r^2}{a^2} \right) e^{-\alpha t} \hat{r}$, J_0 and α are constant. Obtain the change density at r at time t . (5)

6. a) Using Thevenin's theorem, determine the current through the 5Ω resistor in the circuit given below: (5)



- b) State and prove maximum power transfer theorem for a source with an e.m.f E , internal resistance R_s and load resistance R_L in a network. (5)
7. a) An alternating (sinusoidal) e.m.f. of 2 Volt (rms) and frequency 50 Hz is applied to a series LCR circuit with $L = 40$ mH, $C = 0.033$ μ F and $R = 100\Omega$ (symbols having usual meaning). Deduce resonance frequency, current at resonance and Q-Factor of the circuit. (2+1+2)
- b) State the postulates of special theory of Relativity. (2)
- c) Write down the relativistic expression of kinetic energy. Show that it reduces to the classical expression when velocity is much less than the velocity of light. (1+2)
8. a) Find the interplanar distance of (200) plane and (111) plane of nickel crystal. The radius of nickel atom is $1.245\text{\AA}$. (5)
- b) State Heisenberg Uncertainty Principle. (2)
- c) Explain Nuclear Fission and Fusion. (3)

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