



WEST BENGAL STATE UNIVERSITY

B.Sc. Honours Part-II Examination, 2020

PHYSICS

PAPER: PHSA-III

Time Allotted: 2 Hours

Full Marks: 50

*The figures in the margin indicate full marks.
Candidates should answer in their own words and adhere to the word limit as practicable.
All symbols are of usual significance.*

UNIT-III-A

Question No. 1 is compulsory and answer *one* more question from the rest

1. Answer any *five* questions from the following: 3×5 = 15
- (a) Derive the differential form of Gauss's theorem in electrostatics from its integral form.
- (b) Check whether the following electric field is electrostatic
- $$\vec{E} = (x^2 + y^2)\hat{i} + (x^2 + y^2)\hat{j} + (x^2 + y^2)\hat{k}$$
- (c) Establish the continuity equation relating to the charge density and the current density at a point in a medium.
- (d) Using magnetic vector potential, $\vec{A} = e^{-x} \sin y \hat{i} + (1 + \cos y)\hat{j}$, calculate the magnetic induction.
- (e) Derive the boundary condition on the tangential component of the electric field at the surface of separation between two dielectric media of dielectric constants ϵ_1 and ϵ_2 .
- (f) What is magnetomotive force? What is its unit?
- (g) State reciprocity theorem in linear network theory.
- (h) You have an electrical bulb of resistance 100 Ohm and two voltage sources of 100 V, one has internal resistance 100 Ohm while the other has negligible internal resistance. Which source would you prefer to connect with the bulb to get brighter light? Give reason.
2. (a) Obtain first three terms of multipole expansion of the electrostatic potential due to an arbitrary localised charge distribution at a point outside the charge distribution. 4
- (b) Derive the electrostatic field due to a point charge q placed near a grounded infinite conducting plane. 3
- (c) State the uniqueness theorem of electrostatics. 1

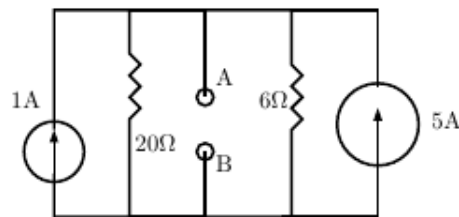
- (d) Find the steady current density that can give rise to a magnetic field 2

$$\vec{B} = 2y\hat{i} - 3x\hat{j}$$

3. (a) Show that the energy density in electrostatic field is $u = \frac{1}{2} \vec{E} \cdot \vec{D}$, where \vec{E} and \vec{D} are electrostatic field intensity and displacement vector respectively. 4

- (b) An electric dipole consists of two opposite charges of magnitude $q = 1 \mu\text{C}$ separated by a distance $d = 2 \text{ cm}$. The whole dipole is placed in an external field of 10^5 N/C . How much work must be done to turn the dipole from an orientation along the external field to one against the field? 2

- (c) Replace the current sources in the following circuit by equivalent voltage sources. Hence find Thevenin voltage across the terminals A, B. 4



UNIT-III-B

Question No. 4 is compulsory and answer *one* more question from the rest

4. Answer any *five* questions from the following: 3×5 = 15
- (a) What is the Q factor of an LCR ac circuit?
 - (b) Find the dimension of L/R.
 - (c) What is a rejector circuit and why is it called so?
 - (d) What is Poynting vector? What is its significance?
 - (e) Define dc and ac current gain parameters of a transistor.
 - (f) Plot the variation of space charge and electric field across the junction of a *p-n* junction diode.
 - (g) Subtract 10100_2 from 11011_2 using 1's complement method.
 - (h) What is avalanche breakdown?
5. (a) A fully charged capacitor is suddenly connected to a pure inductor L . Find out expressions for charge in the capacitor and current in the circuit as a function of time. 3
- (b) Explain why and how Ampere's circuital law for steady current was modified to include displacement current. 3
- (c) Find the skin depth of a conductor in terms of its conductance and the frequency of the incident electromagnetic wave. 4

6. (a) With respect to CE output characteristics of a transistor, indicate the active, saturation and the cut-off regions. 2
- (b) State the factors responsible for the shift of the operating point (Q -point) of a transistor amplifier. 2
- (c) If $(40)_{10} = (257)_n$, then find the value of n . 3
- (d) Show that $\overline{\overline{A + B + \overline{A + B}}} = A$. 3

N.B. : *Students have to complete submission of their Answer Scripts through E-mail / Whatsapp to their own respective colleges on the same day / date of examination within 1 hour after end of exam. University / College authorities will not be held responsible for wrong submission (at in proper address). Students are strongly advised not to submit multiple copies of the same answer script.*

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