Assignment Booklet

BACHELOR'S DEGREE PROGRAMME

(BSCG/BSCM)
ELECTRICITY AND MAGNETISM

Valid from 1st January, 2026 to 31st December, 2026

ignou
THE PEOPLE'S
UNIVERSITY

School of Sciences
Indira Gandhi National Open University
Maidan Garhi, New Delhi-110068
(2026)

Dear Student,

Please read the section on assignments in the Programme Guide for B. Sc. that we sent you after your enrolment. A weightage of 30 per cent, as you are aware, has been earmarked for continuous evaluation, **which would consist of one tutor-marked assignment** for this course. The assignment is in this booklet, and it consists of two parts, Part A and B. The total marks of all the parts are 100, of which 35% are needed to pass it.

Instructions for Formatting Your Assignments

Before attempting the assignment, please read the following instructions carefully:

1) On top of the first page of your answer sheet, please write the details exactly in the following format:

ROLL NO.: ……………………………………………

NAME: …………………………………………………

ADDRESS: ……………………………………………

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COURSE CODE:………………………….

COURSE TITLE: …………………………

ASSIGNMENT CODE: …………………..

STUDY CENTRE: ………………………..   **DATE:** …………………………………...

PLEASE FOLLOW THE ABOVE FORMAT STRICTLY TO FACILITATE EVALUATION AND TO AVOID DELAY.

2) Use only foolscap size writing paper (but not of very thin variety) for writing your answers.

3) Leave 4 cm margin on the left, top and bottom of your answer sheet.

4) Your answers should be precise.

5) Solve Part A and Part B of this assignment, and **submit the complete assignment answer sheets containing Parts A and B within the due date.**

6) The assignment answer sheets are to be submitted to your Study Centre as per the schedule. **Answer sheets received after the due date shall not be accepted.**

   We strongly suggest that you retain a copy of your answer sheets.

7) This assignment is **valid from 1ˢᵗ January, 2026 to 31ˢᵗ December, 2026**. If you have failed in this assignment or fail to submit it by 31ˢᵗ December, 2026, then you need to get the assignment for the year 2027, and submit it as per the instructions given in the Programme Guide.

8) **You cannot fill the examination form for this course** until you have submitted the assignment for the course. For any queries, please contact: srjha@ignou.ac.in, slamba@ignou.ac.in,

   We wish you good luck.

Tutor Marked Assignment
ELECTRICITY AND MAGNETISM

Note: Attempt all questions. The marks for each question are indicated against it.

PART A

1. a) The height of a hill is given by $z = 100 - x^2 y^2$. Calculate the maximum rate of change (also called the steepest ascent) in the height of the hill at the point (2,1). What is its direction? (5)

    b) Consider a rigid body rotating about a fixed axis with a constant angular velocity $\vec{\omega}$, directed along the axis of rotation. The velocity $\vec{v}$ of a particle on the rigid body is $\vec{\omega} \times \vec{r}$. Calculate $\vec{\nabla} \times \vec{v}$. (5)

    c) Calculate the net work done by a force $\vec{F} = (6x - 2y)\hat{i} + (x^2)\hat{j}$ in taking a particle along the straight line between the points (5, −3) to (0,0) and then along the straight line between the points (0,0) to (5,3). Is the force conservative? Explain. (10)

    d) Calculate the flux of a vector field $\vec{F} = 2x\hat{i} + y\hat{j} + 3z\hat{k}$ through the surface of a cube defined by $0 \le x \le 2 ; 0 \le y \le 2 ; 0 \le z \le 2$. (5)

2. a) Two positively charged particles having charges 10 μC and − 5 μC, respectively, are kept at a distance of 1 m from each other. Determine the force on each charge and the electric field due to each charge. Show the force and electric field vectors on appropriate diagrams. What is the resultant force at a point midway from the two charges along the straight line joining them? (2+2+4+2)

    b) State Gauss's Law. What does spherically symmetric charge distribution mean? Use Gauss's Law to determine the electric field of a solid metallic sphere of radius R having volume charge density ρ at a point outside the sphere. (2+2+6)

    c) Three capacitors are connected to each other as shown below:
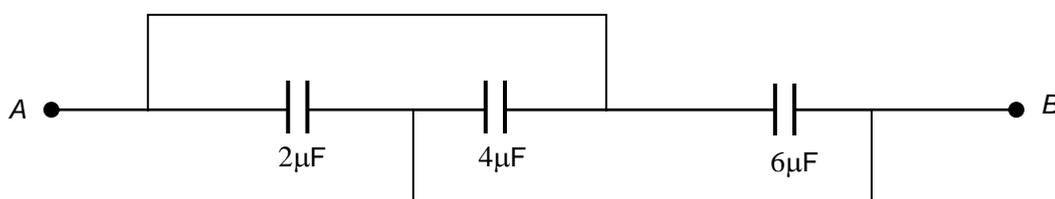
    Calculate the equivalent capacitance between points A and B. (5)

PART B

3. a) What do you understand by linear conductors? Discuss the conditions under which metals do not behave as linear conductors. (5)

    b) The number density of electrons in the aluminium metal is 9.64×10^{28} m^{-3}. Calculate the drift velocity of electrons in a aluminium wire of cross-sectional area 2.0 mm^2 in which a current of 4 A is flowing. (5)

c) Using Biot-Savart's law, obtain an expression for the magnetic field due to electric current flowing in a long straight wire at a distance R from the wire along a line perpendicular to the wire. (10)

d) Discuss the *B-H* curve for a ferromagnet. (5)

4. a) Using Maxwell's equations in free space, derive the wave equation for the *x*-component of the electric field vector. (10)

   b) A uniform plane wave of 100 MHz travelling in free space strikes a large block of a material having $\varepsilon = 9\varepsilon_0$, $\mu = 4\mu_0$ and $\sigma = 0$ normal to the surface. If the incident electric field vector is given by

   $$\vec{E} = 1000\cos(\omega t - \beta y)\hat{z} \text{ Vm}^{-1}$$

   write the complete expressions for the incident, reflected and transmitted field vector (15)

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