Ref. No. EX/INT/P/I/V/21/2017
Form A : Paper-setting Blank

Inter B.Sc. 1st. semester 2017 -
.....**EXAMINATION, 2017**
(1st/2nd Semester/Repeat/Supplementary/Annual/Bi-Annual)

Physics (HO5)
SUBJECT.....

Group A
PAPER..... .....

Full Marks 25
Time : Two hours

Answer any two from question no 1 to 3 and
Answer any two from question no 4 to 6

1 Two infinite grounded metal plates lie parallel to XZ plane, one at y=0 and other at y=a. The left end at x=0 is closed off with two infinite stripe insulated from the two plates, one at y= 0 to y= a/2 is held at a constant potential V_0 and other from y=a/2 to y=a is at potential $-V_0$. Find the potential in the infinite slot. 7

2 A specified charge density $\sigma(\theta) = K \cos\theta$ is glued over the surface of a spherical shell of radius R. Find the resulting potential inside and outside the sphere. 7

3 The space between the plates of a parallel- plate capacitor is filled with two slabs of linear dielectric material. Each slab has thickness a, so the total distance between the plates is 2a. Slab 1 has a dielectric constant of 2 and slab 2 has a dielectric constant1.5. The free charge density on the top is σ and on the bottom plate - σ .

a) Find the electric displacement D in each slab.
b) Find the electric field E in each slab.
c) Find the polarization P in each slab.
b) Find the potential difference between the plates.
e) Find the location and amount of all bound charge.

4 Calculate the value of bound current when the magnetization is non uniform.

Derive surface current K_b and volume current J_b in terms of magnetization M. 2+3.5

5 Derive the physical interpretation of bound current.

A long copper rod of radius R carries a uniformly distributed free current (I). Find H inside and outside the road. 2.5+3

6 A sphere of homogeneous linear dielectric material is placed in an otherwise uniform electric field E_0. Find the electric field inside the sphere. 5.5

BACHELOR OF SCIENCE INTER-B.SC EXAMINATION, 2017.
(2nd Year, 1st Semester)
PHYSICS (Honours)
Paper HO-5
(Ref. No. *EX/INT/P/I/V/21/2017*)

Time: Two Hours
Full Marks: 50
(25 Marks for each group)

Use separate Answer Scripts for Groups A and B

Group - B (Mathematical Methods)

*Answer **any ONE out of Questions 1 and 2**. Each carries TEN marks.*
*Then answer **any THREE out of Questions 3, 4, 5 and 6**. Each carries FIVE marks.*

1. A solid circular disc has radius R and mass M. Consider a chord that subtends an angle 60 degrees at the centre of the disc. Find the moment of inertia of the disc about an axis that passes along this chord.

   Marks: 10

2. (a) Using the generating function for Legendre polynomials, show that for $-1 < x_0 < 1$,

$$\int_{x_0}^{1} P_l(x)dx = \frac{1}{2l+1}\left[P_{l-1}(x_0) - P_{l+1}(x_0)\right]$$

   (b) Consider a sphere of radius R whose upper hemisphere is maintained at a constant potential V_0 and the lower hemisphere is grounded, the two hemispheres being insulated from each other along the equator. Find the functional form of the electrostatic potential *outside* the sphere.

   Marks: 3 + 7 = 10

3. (a) Show that the origin is an ordinary point of the Legendre differential equation.

   (b) Find the radius of convergence, about the origin, of the polynomials that satisfy the differential equation $y'' - 2xy' + 2py = 0$, where primes denote derivatives with respect to x, and p is a positive number.

   Marks: 2 + 3 = 5

4. With the help of the Rodrigue's formula and the orthonormality relation for Hermite polynomials, find the value of $\sum_n a_n \int_0^\infty x^4 e^{-x^2} H_n(x)dx$.

   Marks: 5

5. Find the eigenvalues and eigenvectors of the Hermitian matrix $\begin{pmatrix} \cos\theta & \sin\theta e^{-i\phi} \\ \sin\theta e^{i\phi} & -\cos\theta \end{pmatrix}$.

   Marks: 5

6. A and B are two commuting matrices. One eigenvalue of A is p-fold degenerate. Show that you can form linear combinations of these p eigenfunctions of A that are also eigenfunctions of B.

   Marks: 5