# B.Sc. 5th Semester (Programme) Examination, 2020-21

## Subject: PHYSICS

**Course ID: 52418**                    **Course Code : SP/PHS/501/DSE-1A**

Course Title:  Advanced Mathematical Physics

**Time: 2 Hour**                                        **Full Marks: 40**

*The figures in the right hand side margin indicate full marks.*
*Candidates are required to give their answers in their own words*
*as far as practicable.*

1.  **Answer** *any five* **of the following questions:**                    **(2×5=10)**

 (a) Write down some applications of Gaussian Distribution.

 (b) Show that the gradient of a scaler field is a covariant vector.

 (c) Discuss kernel of a function.

 (d) Show that any tensor of rank 2 can be expressed as the sum of a symmetric and anti-symmetric tensors of rank 2.

 (e) Show that $\frac{\partial x^p}{\partial x^q} = \delta_q^p$.

 (f) Prove that kronecker delta is a mixed tensor of rank 2.

 (g) Let G be an abelian group. Prove that the subset $H = \{g \in G : g^2 = e\ (identity\ element)\}$ forms a subgroup of G.

 (h) There are 3 arrangements of the word DAD, namely DAD, ADD, and DDA. How many arrangements are there of the word PROBABILITY?

2.  **Answer** *any four* **of the following questions:**                    **(5×4=20)**

 (a) Discuss briefly homomorphism and isomorphism of groups.

 (b) Define stress, strain and elasticity tensors.

 (c) Show that the set Z of all integers form a group with respect to binary operation  *

   defined by          a * b = a + b + 1          ∀  a, b  Є Z

   is an abelian group.

(d) (i) Explain continuous and discrete probability distributions. (ii) State Baye's

theorem. $\qquad$ 3+2=5

(e) Prove that the angles $\theta_{12}$, $\theta_{23}$ and $\theta_{31}$ between the coordinates curves in a three dimensional coordinate system are given by

$$\cos \theta_{12} = \frac{g_{12}}{\sqrt{g_{11}g_{22}}} \ , \qquad \cos \theta_{23} = \frac{g_{23}}{\sqrt{g_{22}g_{33}}} \ , \qquad \cos \theta_{12} = \frac{g_{31}}{\sqrt{g_{33}g_{11}}}.$$

(f) Two dice are rolled
A= 'sum of two dice equals 3'
B= 'sum of two dice equals 7'
C= 'at least one of the dice shows a 1'
(a) What is $(A|C)$ ?
(b) What is $P(B|C)$
(c) Are A and C independent? $\qquad$ 2+2+1=5

3. **Answer** *any one* **of the following questions:** (10×1=10)

a) (i) Distinguished between symmetric and antisymmetric tensors. (ii) What do you mean by contraction of a tensor? (iii) A covariant tensor has components xy, 2y- $z^2$, xz in rectangular co-ordinates. Find its covariant components in spherical co-ordinates.

(iv) What is Einstein's summation convention? 4+2+3+1=10

b) Let $X \sim N(\mu, \sigma^2)$ for some $\mu \in \textbf{\textit{R}}, \sigma \in \textbf{\textit{R}} > 0$, where N is the Gaussian distribution. Prove that $var(X) = \sigma^2$.

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