

**TUTORIAL EXAMINATION'2021**  
**SEMESTER : 5 (Honours), PAPER : DSE-A(a)**  
**Advanced mathematical methods**  
**(Each question carries five marks)**

**Answer any three of the following**

1 . Define equivalence relation on a set  $S$  and hence on a group  $G$ . Show that equivalent relation leads to equivalent classes and the adjoint union of which is the set  $S$  itself. (2+3)

2. Explain the left coset of a group  $G$  with reference to the previous question. Suppose that  $G$  contains no subgroups different from  $\{G\}$ . Show that  $G$  is cyclic. (3+2)

3. Determine whether the following vectors in  $\mathbb{R}^3$  are linearly dependent:

(i)  $u = (0, 2, -4)$ ,  $v = (1, -2, -1)$ ,  $w = (1, -4, 3)$

(ii)  $u = (1, 2, 3)$ ,  $v = (4, -2, 7)$  (3+2)

4. (i) Find the Fourier coefficient  $c$  and projection of  $v$  along  $w$ , where  $v = (1, -2, 3, -4)$  and  $w = (1, 2, 1, 2)$  in  $\mathbb{R}^4$ . Also find the angle between  $v$  and  $w$ .

(ii) What is the condition for  $u = (1, 2, k, 3)$  and  $v = (3, k, 8, -5)$  in  $\mathbb{R}^4$  to be orthogonal.

(3+2) 2

5.(a) Find the rank of the tensor  $B_{\beta\delta}^{\alpha\beta\gamma\delta}$  .

2

(b) Verify whether  $B_{\gamma\delta}^{\alpha\beta} = B_{\alpha\delta}^{\gamma\beta}$  does mean that  $B$  is a symmetric tensor.

2

(c) Consider the relation  $P(\alpha, \beta, \gamma)Q^{\beta\gamma} = R^{\alpha}$  where  $Q$  is a second rank tensor and  $R$  is a vector. Explain what conclusion one should draw about the quantity  $P$

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**SEMESTER-5 (HONOURS) TUTORIAL EXAMINATION**

**PAPER-DSE(B)**

**EACH QUESTION CARRIES 5 MARKS**

**ANSWER ANY 3 OF THE FOLLOWING**

1. Show that length of drift tube of LINAC is proportional to square root of natural numbers.

2. Find the cyclotron frequency.

3. Find the Betatron condition.

4. Explain why the following processes are not allowed

*a)*  $p + \pi^0 \rightarrow p^- + \pi^+ + \pi^-$

*b)*  $n \rightarrow p + e^-$

*c)*  $e^- \rightarrow \nu_e + \gamma$

5. Show that pair production cannot occur in vacuum.

6. What is pair production ? Explain briefly.

7. Give an outline of semiconductor detectors.

8. Give a description of neutron detectors.

9. What is the result of scattering experiment of alpha by Rutherford? What is the conclusion of atomic structure from it?

10. Draw the plot of effective energy/nucleon versus atomic Mass. Explain the saturation.

11. What is the difference between elastic and inelastic collision? What do you mean by centre of mass frame?