

**COURSE CODE – 2030502**

**PG DEGREE EXAMINATION – JAN 2009**

**M.SC (MATHS)**

**ANALYTICAL MECHANICS AND TENSOR ANALYSIS**

**(For the Candidates Admitted from Calendar Year 2007)**

**Time:3 hours**

**Max.Marks:75**

**Section – A**

**Answer All the questions:**

**15 × 1 = 15**

1. A collection of indices is used to make the.....development of tensor analysis compact.
2. The rank of a .....is the number.
3. A set of quantities  $B_k$  is called the components.....
4. Give an example for contraction.
5. The process of combining outer multiplication and contraction to produce a new tensor is called.....
6. Write metric tensor.
7. The tensor  $A^j$  is the associate to  $A_i$  and  $g_{ij}$  is the tensor calculus.
8. State stokes theorem.
9. Write inner product.
10. Give an example for pseudo tensors.
11. The product of a tensor a density is another tensor.....
12. This is actually a consequence of requiring that the parals.....
13. State stokes theorem.

14. This is clearly .....in Euclidean space.

15. What is eulers equation -----

**Section-B**

**Answer any Five Questions:**

**5 × 6 = 30**

16. a) By use of the summation convention rewrite

$$d\phi = \frac{\partial \phi}{\partial x} dx + \frac{\partial \phi}{\partial y} dy + \frac{\partial \phi}{\partial z} dz.$$

**(Or)**

b) Explain Riemann-Christoffel tensor.

17. a) By use of the Riemann metric, show that  $g_{ij} = g_{ji}$

**(Or)**

b) Show that the covariant derivative of  $g_{ij}$  is zero.

18. a) Compute  $\Gamma^i_{jk}$  in (i) Cartesian coordinates and ii) Cylindrical coordinates.

**(Or)**

b) Under what conditions will the Christoffel symbols be tensors?

19. a) How many equation in a four dimensional space are represented by  $R^a_{\beta\gamma\rho} = 0$  ?, Explain.

**(Or)**

b) Show that  $g_{ij} = 0$  for  $i \neq j$  is required for orthogonal Coordinate systems.

20. a) Explain equation of the Geodesic line

**(Or)**

b) Explain the fundamental metric tensor.

### Section – C

Answer any Two Questions:

2 × 15 = 30

21. Four polar coordinates show that the path of shortest Distance between two points on a Euclidean plane lies along a straight line.
22. Show that5 Euler's equation for one independent and one dependent variable can be written as  $\frac{\partial F}{\partial x} - \frac{d}{dx} (F - y^1 \frac{\partial F}{\partial y^1}) = 0$ .
23. Show that equation reduces to Newton's second law.
24. By use of the fundamental transformation law for the components of a tensor , show that the questions  $\delta^\nu_\mu A_\nu$  transform like the components of a tensor.
25. The tensor terms for grad  $\phi$  , div A , curl A and  $\nabla^2 \phi$  in terms of components are  $(curl A)_{ji} = \frac{\partial A_j}{\partial x^i} - \frac{\partial A_i}{\partial x^j} \nabla^2 \phi = g^{ij} (\frac{\partial^2 \phi}{\partial x^i \partial x^j} - \Gamma_{ij}^k \frac{\partial \phi}{\partial x^k})$ .
- i) Show that div A is a scalar.
- ii) Show that the above expressions yield the appropriate results for Cartesian and spherical coordinates.