Avinashilingam Institute for Home Science and Higher Education for Women, Coimbatore-641043

Bachelor's Degree Examination – November 2017

III Semester

Class : II UG **Time :3 Hrs**

Major : Physics **Max.Marks :100**

15BPHC08 Mathematical Physics

Part – A **10x1=10**

Choose the correct answer

1. If 'a' is a constant vector, then $\nabla.(a\times r)$ is equal to ----------
   a. 3 b. 2
   c. 1 d. 0

2. $\oint v \, .d\ell$ = ----------
   a. $\iiint \nabla.\, v\, dv$ b. $\iint \nabla.\, v\, ds$
   c. $\iint_s (\nabla \times v).ds$ d. $\iiint \nabla \times v\, dv$

3. The line element ds in orthogonal curvilinear coordinator is ----------
   a. $ds^2 = h_1^2\, dn_1^2 + h_2^2\, dn_2^2 + h_3^2\, dn_3^2$
   b. $ds^2 = dn_1^2 + dn_2^2 + dn_3^2$
   c. $ds^2 = h_1\, dn_1^2 + h_2\, dn_2^2 + h_3\, dn_3^2$
   d. $ds^2 = h_1^2\, dn_1 + h_2^2\, dn_2 + h_3^2\, dn_3$

4. The value of div.v in terms of cylindrical coordinate surfaces is ----------
   a. $\frac{1}{r}\frac{\partial vr}{\partial r} + \frac{\partial v\theta}{\partial \theta} + \frac{1}{2}\frac{\partial vz}{\partial z}$ b. $\frac{\partial vr}{\partial r} + \frac{\partial v\theta}{\partial \theta} + \frac{1}{2}\frac{\partial vz}{\partial z}$
   c. $\frac{\partial vr}{\partial r} + \frac{vr}{r} + \frac{1}{r}\frac{\partial v\theta}{\partial \theta} + \frac{\partial vz}{\partial z}$ d. $\frac{1}{r}\frac{\partial vr}{\partial r} + \frac{vr}{r} + \frac{\partial v\theta}{\partial \theta}$

5. $\beta(2,1)$ is equal to ----------
   a. $\frac{1}{2}$ b. $\frac{-1}{2}$
   c. $\frac{3}{2}$ d. $\frac{-3}{2}$

6. The value of (3/2) is given by ----------
   a. $\pi/2$ b. $\sqrt{\pi}/2$
   c. 1 d. $1/2$

7. A cylinder rolling without sliding down an inclined plane is an example of ---------- constraint.
   a. Scleronomic b. Holomonic
   c. Rhenomic d. Non-holomonic

8. The sum of the Langrangian and the Hamiltonion is equal to ----------
   a. kinetic energy b. potential energy
   c. twice the kinetic energy d. twice the potential energy

9. In Bose-Einstein statistics, the energy at absolute zero is ----------
   a. 1 b. 0
   c. $\propto$ d. -1

10. In which of the statistics the particles have half-integral spin.
    a. Bose - Einstein b. Maxwell - Boltzmann
    c. Fermi - Dirac d. All the above

Part – B 5x6=30

Answer the following

Answer should not exceed 400 words or two pages

11. a. (i) If a = $\propto$ n i + β y j + r z k show that ∇(a,r)=2a.
(ii) Prove that div(u grad w) = u ∇^2 w + (grad u).(grad w) where u and w are scalars.

(or)

11. b. State and prove Green's theorem.

12. a. If u = 2 x + 3, v = y – 4 , w = z + 2 , show that u,v,w are orthogonal and find ds^2 and the metric coefficients h_1, h_2, h_3.

(or)

12. b. Calculate divergence in terms of orthogonal curvilinear coordinates.

13. a. Derive the relationship between the beta and gamma function.

(or)

13. b. Prove that relation.

$\int_0^{\pi/2} \frac{d\theta}{\sqrt{Sin\theta}} \times \int_0^{\pi/2} \sqrt{Sin\theta}\, d\theta = \pi$

14. a. State and Explain D' Alembert's Principle.

(or)

14. b. Give an account on the Hamilton – Jacobi theory.

15. a. Obtain Fermi – Dirac distribution law.

(or)

15. b. Compare Maxwell - Boltzmann and Bose – Einstein Statistics.

Part – C 5x12=60

Answer the following

Answer should not exceed 800 words or 4 pages

16. a. State and prove Gauss theorem.

(or)

16. b. Prove Stoke's theorem for the vector v(x + y, 2 x – z , y + z) taken over the triangle ABC cut from the plane 3 x + 2 y + z = 6 by the coordinate plane.

17. a. Explain orthogonal curvilinear coordinates. Obtain curl of a vector field v in terms of orthogonal curvilinear coordinates.

(or)

17. b. Calculate div.v in terms of spherical coordinates.

18. a. (i) Define beta function. Prove that β(m,n) = β(n,m)
(ii) Prove that β(m,n) = 2 $\int_0^{\pi/2} Sin^{2m-1}\theta . Cos^{2n-1}\theta d\theta$

(or)

18. b.(i) Discuss the properties of Gamma function.
(ii) Explain different forms of Gamma function.

19. a. State and discuss the principle of least action.

(or)

19. b. Explain generalized coordinates. Derive Lagrange's equation.

20. a. Explain Maxwell – Boltzmann Statistics.

(or)

20. b. Derive Planck's law from Bose – Einstein Statistics.