Reg. No. : ....

Name : ....

K17U 2672

III Semester B.Sc. Hon's (Mathematics) Degree (Reg.) Examination, November 2017
BHM302 : VECTOR CALCULUS (2016 Admission)

Time : 3 Hours Marks : 60

SECTION – A

(Answer **any 4** questions out of **5** questions. **Each** question carries **1** mark.) **(4×1=4)**

1. Define the continuity of a vector function r(t) at a point t = to in its domain.
2. State quotient rule for gradients.
3. State first form of Fubini's theorem.
4. Define the potential function for a vector field F.
5. Define the curvature function of a curve.

SECTION – B

(Answer **any 6** questions out of **9** questions. **Each** question carries **2** marks) **(6×2=12)**

6. A glider is soaring upward along the helix r (t) = (Cost) i + (Sint) j + t k. How long is the glider's path from t = 0 to t = 2π.
7. Find T and N for the circular motion r (t) = (Cos 2 t) i + (Sin 2 t) j.
8. Find the curvature of a circle.
9. Find the volume of the region bounded above by the elliptical paraboloid $z = 16 - x^2 - y^2$ and below by the square R : $0 \leq x \leq 2, 0 \leq y \leq 2$.
10. Find the work done by the conservative field F = yzi + xzj + xyk = ∇ f, where f (x, y, z) = x y z along any smooth curve (joining the points A (– 1, 3, 9) to B (1, 6, – 4).

P.T.O.

11. Find the circulation of the field F = (x – y) i + xj around the circle r (t) = (cost) i + (Sin t) j, $0 \leq t \leq 2\pi$.

12. Integrate F (x, y, z) = x^2 over the cone $z = \sqrt{x^2 + y^2}$, $0 \leq z \leq 1$.

13. State Divergence Theorem.

14. State first form of Fubini's theorem.

SECTION – C

(Answer **any 8** questions out of 12 question. **Each** question carries **4** marks.) **(8×4=32)**

15. Find the unit tangent vector of the curve r(t) = (3 cost) i + (3 sint) j + t^2k representing the path of the glider.

16. Find the curvature for the helix r (t) = (a cost) i + (a sint) j + (b t) k, a, b >, 0, $a^2 + b^2 \neq 0$.

17. Find the derivative of f (x, y) = x e^y + cos (xy) at the point (2, 0) in the direction of v = 3i – 4j.

18. Find the area enclosed by the lemniscale $r^2 = 4 \cos 2\theta$.

19. Find the volume of the solid region bounded above by the paraboloid.
    $z = 9 - x^2 - y^2$ and below by the unit circle in the xy-plane.

20. Evaluate $\iint_R e^{x^2+y^2} dydx$ where R is the region (semicircular) bounded by the X-axis and the curve $y = \sqrt{1 = x^2}$.

21. Find the Jacobian for the polar coordinate transformation $x = r\cos\theta$, $y = r\sin\theta$ and find the Cartesian integral $\iint_R f(x, y)\,dx\,dy$ as a polar integral.

22. Find the volume of the ice cream cone cut from the solid sphere $\rho \leq 1$ by the cone $\varphi = \pi/3$

23. Integrate f (x, y) = $x - 3y^2 + z$ over the line segment joining (0, 0, 0) to (1, 1, 1).

24. Evaluate $\int_C F.dr$ where F (x, y, z) = zi + xyj – y^2 k along the curve C given by $r(t) = t^2 i + tj + \sqrt{t}k$, $0 \leq t \leq 1$.

25. State normal form of Green's theorem and verify for the field F (x, y) = (x – y) i + x j and the region bounded by the unit circle.

26. Find the surface area of a sphere of radius 'a'.

SECTION – D

(Answer **any 2** questions out of **4** questions. **Each** question carries **6** marks) **(2×6=12)**

27. Find the tangent line and normal line of the surface f (x, y, z) = $x^2 + y^2 + z - 9 = 0$ at the point P (1, 2, 4).

28. Show that F = (e^x cosy + yz) i + (xz – e^x siny) j + (x y + z) k is a conservative field over its natural domain and find the potential function for it also.

29. Find the center of mass of a thin semi spherical shell of radius 'a' and constant density 'δ'.

30. State and prove cross product rule of vector functions for differentiation.

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