

K17U 2672

Reg. No.:

Name:.....

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.)

 $(4 \times 1 = 4)$

- 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

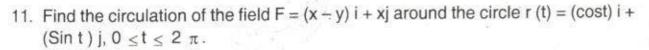
(Answer any 6 questions out of 9 questions. Each question carries 2 marks) (6x2=12)

- 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 $t = 2\pi$.
- 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 $R: 0 \le x \le 2, 0 \le y \le 2$.
- 10. Find the work done by the conservative field $F = yzi + xzj + xyk = \nabla f$, 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.







- 12. Integrate F $(x, y, z) = x^2$ over the cone $z = \sqrt{x^2 + y^2}$, $0 \le z \le 1$.
- 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 $r(t) = (3 \cos t) i + (3 \sin t) j + t^2 k$ 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 y = 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 $\iint_{R} e^{x^2+y^2} dy dx$ 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 $\phi = \pi/3$
- 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 y² k along the curve C given by $r(t) = t^{2} i + tj + \sqrt{tk}, 0 \le t \le 1.$



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- 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) (2x6=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 $F = (e^x \cos y + yz) i + (xz e^x \sin y) j + (xy + z) k$ 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.