B.Sc.DEGREE EXAMINATION,APRIL 2020
II Year IV Semester
Vector Calculus and Fourier Transforms

Time : 3 Hours **Max.marks :75**

Section A $(10 \times 2 = 20)$ Marks

Answer any **TEN** questions

1. Define Unit Normal Vector.
2. Define Solenoidal Vector.
3. Define Line Integral.
4. If $\overrightarrow{F} = 3xy\overrightarrow{i} - y^2\overrightarrow{j}$ evaluate $\int_c \overrightarrow{F}.d\overrightarrow{r}$ where C is the curve on the xy plane $y = 2x^2$ from (0,0) to (1,2)
5. State Gauss Theorem.
6. Evaluate by Stoke's theorem,$\int_c (e^x dx + 2ydy - dz)$ where C is the curve $x^2 + y^2 = 4^2, z = 2$
7. State Linearity Property.
8. Define Dirichlet's Condition.
9. Define Parseval's Identity.
10. State Unit step function.
11. If $\overrightarrow{r} = t^2 \overrightarrow{i}$ – t $\overrightarrow{j}$ + (2t+1) $\overrightarrow{k}$ then find the velocity at t=0.
12. Define Fourier Transforms.

Section B $(5 \times 5 = 25)$ Marks

Answer any **FIVE** questions

13. Find the unit tangent vector to the curve $x =$ 3t + 2, $y =$ 5t^2, $z =$ 2t – 1 at the point where t = 1.
14. Prove that $\nabla \mathrm{r}^n$= n$r^{n-2}\overrightarrow{r}$ where $\overrightarrow{r}$ is the position vector.
15. If $\overrightarrow{F} = yz\overrightarrow{i} + zx\overrightarrow{j} + xy\overrightarrow{k}$, find $\int_c \overrightarrow{F}.d\overrightarrow{r}$ where c is given by $x = t,\ y = t^2.z = t^3$ from P (0,0,0) to Q (2,4,8).
16. Find the Fourier cosine integral representation of the function $f\,(x)$=xe^{-2x} , x>0.
17. State and prove Fourier Transform of Unit impulse Function.

18. Find $\int_c \overrightarrow{F}.d\overrightarrow{r}$ where $\overrightarrow{F} = \left(x^2 - y^2\right)\overrightarrow{i} + 2xy\overrightarrow{j}$ and c is a square bounded by the co-ordinate axes and the lines $x = a$ and $y = a$
19. Prove that $\nabla\times\nabla\Phi = \vec{0}$

Section C $(3 \times 10 = 30)$ Marks

Answer any **THREE** questions

20. Prove that $\nabla^2 \mathrm{f}(\vec{r}) = \left(\frac{\partial^2 f}{2} + 2\right)$
21. Find the total work done in moving a particle in a force field given by $\overrightarrow{F} = 3xy\overrightarrow{i} - 5z\overrightarrow{j} + 10x\overrightarrow{k}$ along the curve $x = t^2 + 1, y = 2t^2, z = t^3$ from t =1 to t = 2.
22. Verify Gauss divergence theorem for $\overrightarrow{F} = \left(x^3 - \ yz\right)\overrightarrow{i} - 2x^2y\overrightarrow{j} + 2\overrightarrow{k}$,taken over the cube bounded by x = 0,y = 0, z = 0, x = a, y = a, z = a.
23. Find the Fourier transform of f(x) defined by $f\left(x\right) = \begin{cases} x^2, & |x| < 0 \\ 0, & |\,x| \geq 0 \end{cases}$
24. State and Prove Convolution Theorem.

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