JAYPEE UNIVERSITY OF INFORMATION TECHNOLOGY, WAKNAGHAT

TEST 3- 2025

Ph.D.-I Semester (Mathematics)

COURSE CODE (CREDITS): 18P1WGE101 (3) MAX. MARKS: 25

COURSE NAME: RESEARCH METHODOLOGIES (Department-specific)

COURSE INSTRUCTOR: P K PANDEY MAX. TIME: 2 Hours

Note: *(a) All questions are compulsory.*

(b) The candidate is allowed to make suitable numeric assumptions wherever required for solving problems.

Q.No.	Question	Marks
Q1	Write the *Frenet- Serret* formula, and for the helix: $$\vec{r}(s) = \langle 2\cos\frac{s}{\sqrt{13}}, 2\sin\frac{s}{\sqrt{13}}, \frac{3s}{\sqrt{13}}\rangle$$ Compute the *Frenet frame* T, N, B, κ, τ.	4
Q2	Compute the curvature and torsion of the curve: $\vec{r}(t) = \langle e^t\cos t, e^t\sin t, e^t\rangle, t \in \mathbb{R}$; at $t = 0$.	4
Q3	Compute the curvature and torsion of the curve: $\vec{r}(t) = \langle \cos^2 t, \sin t\cos t, \sin t\rangle, t \in \mathbb{R}$; at $t = \frac{\pi}{4}$.	4
Q4	Consider a surface, given by: $\vec{r}(u,v) = \langle u\cos v, u\sin v, u^2 + v\rangle;\ (u,v) \in \mathbb{R}^2$ Show that the above surface is smooth about $(u,v) = (1,0)$. Find the unit normal and tangent plane to the given surface at $(u,v) = (1,0)$.	4
Q5	Consider a solar collector surface, given by: $\vec{r}(u,v) = \langle u\cos v, u\sin v, u^2\rangle;\ 0 \le u \le 1, 0 \le v \le 2\pi$. Compute the surface area of the above surface patch.	4
Q6	Define the first fundamental form. Compute the first fundamental of a sphere of radius R. Also, give some applications of the first fundamental form.	5

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