Jashore University of Science and Technology

Department of Physics

Bachelor of Science with Honours in Physics

First semester of first year

Course no.: PHY 1105 **Course title: Vector Analysis**
Assignment no.: 01 **Date: May 20, 2022**

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1. Let $\mathbf{A} = t\mathbf{i} - 3\mathbf{j} + 2t\mathbf{k}$, $\mathbf{B} = \mathbf{i} - 2\mathbf{j} + 2\mathbf{k}$, $\mathbf{C} = 3\mathbf{i} + t\mathbf{j} - \mathbf{k}$. Evaluate $\int_1^2 \mathbf{A} \cdot \mathbf{B} \times \mathbf{C}\, dt$.

2. If $\mathbf{F} = (5xy - 6x^2)\mathbf{i} + (2y - 4x)\mathbf{j}$, evaluate $\int_C \mathbf{F} \cdot d\mathbf{r}$ along the curve C in the xy plane, $y = x^3$ from the point $(1, 1)$ to $(2, 8)$.

3. Find the work done in moving a particle in the force field $\mathbf{F} = 3x^2\mathbf{i} + (2xz - y)\mathbf{j} + z\mathbf{k}$ along the space curve $x = 2t^2$, $y = t$ $z = 4t^2 - t$ from $t = 0$ ti $t = 1$.

4. Evaluate $\oint_C \mathbf{F} \cdot d\mathbf{r}$ where $\mathbf{F} = (x - 3y)\mathbf{i} + (y - 2x)\mathbf{j}$ and C is the closed curve in the xy plane, $x = 2\cos t$, $y = 3\sin t$ from $t = 0$ to $t = 2\pi$.

5. Prove that $\mathbf{F} = (y^2 \cos x + z^3)\mathbf{i} + (2y \sin x - 4)\mathbf{j} + (3xz^2 + 2)\mathbf{k}$ is a conservative force field.

6. Evaluate $\int_C \mathbf{A} \cdot d\mathbf{r}$ along the curve $x^2 + y^2 = 1$, $z = 1$ in the positive direction from $(0, 1, 1)$ to $(1, 0, 1)$ if $\mathbf{A} = (yz + 2x)\mathbf{i} + xz\mathbf{j} + (xy + 2z)\mathbf{k}$.

7. If $\mathbf{F} = 2y\mathbf{i} - z\mathbf{j} + x^2\mathbf{k}$ and S is the surface of the parabolic cylinder $y^2 = 8x$ in the first octant bounded by the planes $y = 4$ and $z = 6$, evaluate $\iint_S \mathbf{F} \cdot \mathbf{n}\, dS$.

8. Evaluate $\iint_S \mathbf{A} \cdot \mathbf{n}\, dS$ over the entire surface S of the region bounded by the cylinder $x^2 + z^2 = 9$, $x = 0$, $y = 0$, $z = 0$ and $y = 8$, if $\mathbf{A} = 6z\mathbf{i} + (2x + y)\mathbf{j} - x\mathbf{k}$.

9. Evaluate $\iint_S \phi\, \mathbf{n}\, dS$ if $\phi = 4x + 3y - 2z$ and S is the surface of $2x + y + 2z = 6$ bounded by $x = 0$, $x = 1$, $y = 0$ and $y = 2$.

10. Evaluate $\iiint_V (2x + y) dV$, where V is the closed region bounded by the cylinder $z = 4 - x^2$ and the planes $x = 0$, $y = 0$, $y = 2$ and $z = 0$.