Mathematical Engineering II

(Partial)

Final Exam

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Question 1: Solve the following by writing just the final answer:

(a) if $f = xy\sin z^2$, $\vec{F} = \langle x^2+y^2, y^2+z^2, z^2+xy \rangle$

Find: $\nabla(\nabla \cdot \vec{F}) = \ldots\ldots$

$\nabla \cdot (\nabla \times \nabla f) = \ldots\ldots$

(b) Solve: $2U_{xx} + 5U_x - 3U = 0$

(c) if $r(t) = \langle \cos t, \sin t, \frac{t}{\pi} \rangle$ then evaluate $\oint_C (\nabla f) \cdot d\vec{r}$ given $f = \frac{x^2+y^2+z^2}{2}$.

(d) for the circle $(x-1)^2+y^2=4$, evaluate $\oint_C (3y\,dx - 5x\,dy)$

(e) find the fourier sine transform for:

$$f(x) = \begin{cases} 3, & 0<x<1 \\ 0, & x>1 \end{cases}$$

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Question 2:

Evalnate: $\iint \vec{F} \cdot \hat{n}\, dA$ for the portion of the surface $z = \sqrt{y^2+x^2}$ between $z=1$ & $z=3$ given that: $\vec{F} = \langle yz, y, z^2 \rangle$.

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Question 3:

Solve: $U_{xx}+U_{yy}=0$ for the conditions: $U_x(0,y)=0$, $U_x(1,y)=0$, $u(x,1)=0$, $u(x,0)=f(x)$

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Question 4: Using fourier transform solve:

$$u_{xx} = u_{tt} \quad \text{where } 0<x<\infty$$

$$u(x,0)=0 \;,\; u(0,t)=0 \;,\; u_x(0,t)=0$$

$$u(x,0)=\begin{cases} 3 \;, & 0<x<1 \\ 0 \;, & x>1 \end{cases}$$

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Question 5:

(a) Show that: $\int_0^\infty \frac{\omega - \sin\omega}{\omega^2} \sin(\omega x)\, d\omega = \begin{cases} \frac{\pi}{2}(1-x), & 0<x<1 \\ 0, & x>1 \end{cases}$

(b) Evaluate: $\int_0^\infty \frac{\omega - \sin\omega}{\omega^2} \sin\left(\frac{\omega}{2}\right)$?

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Good Luck.