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F.E. Semester –II (Revised Course 2016-17)
EXAMINATION AUGUST 2021
Engineering Mathematics-II

[Duration : Two Hours] **[Total Marks : 60]**

Instructions:
1) Answer THREE FULL QUESTIONS with ONE QUESTION FROM EACH PART.
2) Assume suitable data, if necessary
3) Figures to the right indicate full marks

PART-A

Q.1
a) Evaluate $\int_0^\infty \frac{\log_e(1+\alpha t^2)dt}{t^2}$ by applying differentiation under the integral sign. **7**
b) Find the length of the Cycloid $x = (\theta + \sin\theta), y = (1 - \cos\theta)$ between $\theta = 0$ and $\theta = \pi$. **6**
c) Change the order of integration and evaluate $\int_0^1 \int_x^{2-x} 2x + 1 dydx$ **7**

Q.2
a) Evaluate $\int_0^1 (3t\bar{i} + 2\bar{k}) \times (t\bar{i} + 5\bar{j})dt$ **5**
b) Evaluate $\iiint \frac{dxdydz}{(x^2+y^2+z^2)}$ over the region $x^2 + y^2 + z^2 \leq 4$,and $y \geq 0, z \geq 0$. **8**
c) Write a single integral and evaluate $\int_{-1}^0 \int_0^{x+1} 3y + 2dxdy + \int_0^1 \int_0^{1-x} 3y + 2dxdy$ **7**

Q.3
a) Define curvature. Show that the curvature of $\overline{r(t)}$=2cost $\bar{i}$+2sint $\bar{j}$ is constant. **6**
b) Find the area of the surface generated by revolution of the curve $y = \sqrt{x+1}, 0 \leq x \leq 4$ about the x-axis. **7**
c) Evaluate $\int_{-1}^1 \int_0^x \int_0^{(x+y)} 2y + x\ dzdydx$ **6**

PART-B

Q.4
a) Find the directional derivative of $f(x,y,z) = x^2y + 2yz$ in the direction of $\hat{\imath} - \hat{\jmath} + \hat{k}$ at the point (1,-1,0). **5**
b) Find the work done in moving a particle in the force field **5**
$\bar{F} = (2y+3)\hat{\imath} + xz\hat{\jmath} + (yz-2)\hat{k}$ along the curve $x = 2t^2, y = t$ and z=t^2 from t=0 to t=1.
c) Solve the following **10**
i) $\frac{dy}{dx} = e^{2x-y} + 2xe^{-y}$
ii) $(1+x)\frac{dy}{dx} + y = x^2$

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Q.5 a) Verify Green's Theorem in a plane for $\oint(x+4y^2)dx+(x^2+3)dy$ along the boundary of the region $y \geq 0, y^2 \leq x$ and $x \leq 1$. 10

b) Solve the following 10

i) $(D^2-6D+9)y = 2e^{3x}$

ii) $x^2\frac{d^2y}{dx^2}+x\frac{dy}{dx}+y=(log_e x)^2$

Q.6 a) Define curl of vector field. Find the curl of $\varphi(x,y,z)=2xy\bar{\imath}+z\bar{\jmath}+y^2\bar{k}$. 5

b) Show that for a scaler field f and vector field φ div(fφ)=fdiv φ+$\nabla f.\varphi$ 5

c) Solve 10

i) $(D^2+4D+3)y = xe^{2x}$

ii) $(D^2+4)y = 3sin2x$

PART-C

Q.7 a) Find the length of $x = a(2cost - cos2t)$d $y = a(2sint - sin2t)$om $t = 0$ to $t = \frac{\pi}{2}$. Where a is a constant. 5

b) Evaluate $\int_0^1\int_0^x xe^{y/x}dydx$ 5

c) Find the equation of the line normal to the surface $2x+3z^2-y^2=10$ at the point (1,-2,2). 5

d) Solve -$(D^2+4D-12)y = sin^2x$ 5

Q.8 a) If $\overline{r(t)}$=2$cost\,\hat{\imath}+3t\,\hat{\jmath}+sint\,\hat{k}$ is the position vector of a particle in space at time 't' then find it's velocity and acceleration vectors at $t=\frac{\pi}{2}$. 5

b) Evaluate $\int_0^{\pi/2}\int_0^{\pi}\int_0^{1+cos\varphi}3\rho\sin\varphi\, d\rho d\theta d\varphi$ 6

c) Prove that for a scalar field φ, $Curl(\nabla\varphi)=0$. 4

d) Solve $\frac{dy}{dx} - y\tan x = y^4\sec x$ 5