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PES UNIVERSITY

PES University, Bengaluru

(Established under Karnataka Act No. 16 of 2013)

UE21MA141B

JULY 2022: END SEMESTER ASSESSMENT (ESA) B TECH II SEMESTER
(Chemistry Cycle)

UE21MA141B – ENGINEERING MATHEMATICS 2

Time: 3 Hrs	Answer All Questions	Max Marks: 100

1	a)	Find the moments of inertia of the planar region bounded by the curves $y = x^2$ and $y = x + 2$, given that the density $\rho(x, y) = k$, a constant.	7
	b)	Find the volume of the tetrahedron bounded by the coordinate planes and the plane $\frac{x}{a} + \frac{y}{b} + \frac{z}{c} = 1$ using the substitution $x = au$, $y = bv$ and $z = cw$.	7
	c)	Evaluate $\int_0^3 \int_0^{\sqrt{4-y}} (x + y)dx\,dy$ by changing the order of integration.	6
2	a)	Show that the force field given by $\vec{F} = (y^2 \cos x + z^3)\hat{\imath} + (2y \sin x - 4)\hat{\jmath} + (3xz^2 + 2)\hat{k}$ is conservative and hence find its scalar potential ϕ.	7
	b)	Calculate the flux of $\vec{F} = x\hat{\imath} + y\hat{\jmath} + (1 - 2z)\hat{k}$ across the surface S using the outward normal, given that S is the portion of the surface that lies between $z - x^2 - y^2 = 0$ and below the plane $z = 1$ and above the x-y plane.	7
	c)	Evaluate $\int\int_S \vec{F}.\hat{n}\,ds$ over the sphere $x^2 + y^2 + z^2 = k^2$, using the divergence theorem where $\vec{F} = k[a x\hat{\imath} + b y\hat{\jmath} + c z\hat{k}]$. Is $\vec{F}$ irrotational ?	6
3	a)	i) If $L[t\,f(t)] = \frac{1}{s(s+1)}$, then find $L[f(3t)]$. ii) Find $L\left[\int_0^t u \sin 4u\,du\right]$	7
	b)	Find the Laplace transform of $\frac{1-\cos t}{t^2}$	7
	c)	Determine the Laplace transform of the triangular wave function $f(t) = \begin{cases} t, & 0 < t < c \\ 2c - t, & c < t < 2c \end{cases}$, $f(t + 2c) = f(t)$. Express the solution in terms of a hyperbolic function.	6
4	a)	Solve the differential equation $\frac{d^2i}{dt^2} + 4\,i(t) = \begin{cases} 4t, & 0 < t < 1 \\ 4, & t > 1 \end{cases}$, $i(0) = 1, i'(0) = 0$ using the Laplace transform technique.	7
	b)	Obtain the inverse Laplace transform of $\frac{1}{s^5(s+3)}$ using convolution theorem.	7
	c)	Obtain the inverse Laplace transform of $\frac{s+2}{(s^2+4s+5)^2}$.	6

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5	a)	Obtain the half range Fourier cosine series of $f(x) = x$ in $0 < x < 2$. Hence deduce the sum of the series $\frac{1}{1^4} + \frac{1}{3^4} + \frac{1}{5^4} + \cdots$	7
	b)	Find the complex form of the Fourier series of $f(x) = \cos ax$ in $-\pi < x < \pi$. Here the parameter $'a'$ is not an integer.	7
	c)	Find the Fourier series expansion and the amplitude of the first harmonic for the function $f(x)$ described by the following table:	6

x	0	1	2	3	4	5	6
$f(x)$	9	18	24	28	26	20	9