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PES University, Bengaluru
(Established under Karnataka Act No. 16 of 2013)

UE18/19MA151

DECEMBER 2021: END SEMESTER ASSESSMENT (ESA) B TECH II SEMESTER

UE18/19MA151 – ENGINEERING MATHEMATICS- II

Time: 3 Hrs	Answer All Questions	Max Marks: 100

1	a)	A particle moves along the curve $x = t^3 + 1$, $y = t^2$, $z = t + 5$ where t is time. Find the components of its velocity and acceleration at time $t = 1$ in the direction of the vector $\hat{\imath} + 3\hat{\jmath} + 2\hat{k}$.	6
	b)	Evaluate $\int_S (4x\,\hat{\imath} - 2\,y^2\,\hat{\jmath} + z^2\,\hat{k}).\hat{n}\,dS$ where S is the surface taken over the region bounded by $x^2 + y^2 = 4$, $z = 0$ and $z = 3$ using Gauss Divergence theorem.	7
	c)	Evaluate $\int\int_S \nabla \times \vec{F}\,.\,\hat{n}\,dS$ where $\vec{F} = (y^2 + z^2 - x^2)\,\hat{\imath} - (z^2 + x^2 - y^2)\,\hat{\jmath} + (x^2 + y^2 - z^2)\,\hat{k}$ and S is the surface $x^2 + y^2 - 2\,a\,x + a\,z = 0$ above the plane $z = 0$.	7
2	a)	Prove that $\int_0^1 \frac{dx}{(1-x^n)^{\frac{1}{n}}} = \frac{\pi}{n\sin\left(\frac{\pi}{n}\right)}$	6
	b)	Show that $J_0^2 + 2J_1^2 + 2J_2^2 + 2J_3^2 + \ldots\ldots = 1$	7
	c)	If n is a positive integer then show that $J_n(x) = \frac{1}{n}\int_0^{\pi}\cos(n\theta - x\sin\theta)\,d\theta$.	7
3	a)	Find the Laplace transform of the square wave function $F(t) = \begin{cases} E & for\ 0 \le t \le \frac{T}{2} \\ -E & for\ \frac{T}{2} \le t \le T \end{cases}$ and $F(t+T) = F(t)$	6
	b)	Use Laplace transforms to evaluate $\int_0^{\infty}\left[\frac{\cos 6t - \cos 4t}{t}\right] dt$	7
	c)	Represent $F(t)$ in terms of Unit-Step function and hence find the Laplace Transform of $F(t) = \begin{cases} 0, & for\ t < 1 \\ t^2, & for\ t \ge 1 \end{cases}$	7
4	a)	Find $L^{-1}\left[\frac{(3s+7)}{s^2-2s-3}\right]$	6
	b)	Find inverse Laplace transform of $\frac{s}{(s^2+4)^2}$ using convolution theorem.	7
	c)	A particle is moving along the x-axis according to the law $\frac{d^2x}{dt^2} + 6\frac{dx}{dt} + 25x = 0$ If the particle started at $x = 0$ with an initial velocity of 12 feet per second, determine x in terms of t, using Laplace transformation method.	7

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5	a)	Find the Complex form of the Fourier series for the function $f(x) = \sin x$ in $0 < x < \pi$, $f(x+\pi) = f(x)$.	6
	b)	Find the Fourier Series of the function $f(x) = \frac{\pi - x}{2}$ in $0 < x < 2\pi$. Hence deduce that $\frac{\pi}{4} = 1 - \frac{1}{3} + \frac{1}{5} - \frac{1}{7} + \cdots$..	7
	c)	If $f(x) = \begin{cases} x & for\ 0 < x < \frac{\pi}{2} \\ \pi - x & for \frac{\pi}{2} < x < \pi \end{cases}$ then show that $f(x) = \frac{4}{\pi}\left[\sin x - \frac{1}{3^2}\sin 3x + \frac{1}{5^2}\sin 5x - + \cdots ...\right]$	7