PRN:		Course Code :	MET2301

Second Year **B. Tech** End Semester Examination Winter 2024

Differential Calculus and Transforms

000952

Day and Date: Fri 29 NOV 2024 Max Marks: **100**

Time : 10:30AM To 01:30PM Duration: **03**hrs

Instructions: 1) All questions are compulsory.
2) Use of non-programmable calculator is allowed.

		Marks	Bloom's Level	CO
Q.1	**Attempt the following**			
a)	Solve $\frac{d^3y}{dx^3}+\frac{dy}{dx}=\sin x.$	08	L3	CO1
b)	Solve $\frac{d^2y}{dx^2}+4y=x^2+\sin(2x).$	08	L3	CO1
	OR			
b)	Solve $(D^3-3D^2+9D-27)y=\cos(3x).$	08	L3	CO1
Q.2	**Attempt the following**			
a)	The motion of a particle is given by $\frac{d^2s}{dt^2}+k^2\frac{ds}{dt}=0.$ At $t=0, s=s_0$ and $\frac{ds}{dt}=v_0$, Show that as time $t\to\infty$, $s=s_0+\frac{v_0}{k^2}$.	08	L4	CO2
b)	The whirling speed of a shaft with length l is given by $EI\frac{d^4y}{dx^4}-\frac{Ww^2}{g}y=W$, where $a^4=\frac{Ww^2}{gEI}$ and y is the displacement at a distance x from the one end. Find the displacement y at any distance x from one end.	08	L3	CO2
	OR			
b)	A body weighing $10kg$ is hung from a spring. A pull of $20kg$ weight will stretch the spring to $10cm$. The body is pulled down to $20cm$ below the static equilibrium position and then released. Fins the displacement of the body from its equilibrium position at time t sec ., the maximum velocity and period of oscillation	08	L4	CO2
Q.3	**Attempt any Two from the following**			
a)	Find the directional derivative of $\phi=x^2y^2+y^2z^2+z^2x^2$ at $(1,1,-2)$ in the direction of the tangent to the curve $x=e^{-t}$, $y=(2\sin t+1)$, $z=(t-\cos t)$ at $t=0$.	08	L3	CO3

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b)	Show that $\overline{f}=(z^2+2x+3y)i+(3x+2y+z)j+(y+2zx)k$ is irrotational but not solenoidal. Also obtain a scalar potential ϕ such that grad $\phi=\overline{f}$.	08	L3	CO3
c)	Find the unit tangent vector to the curve $x=t,\ y=t^2,\ z=t^3$ at $t=1$.	08	L3	CO3
Q.4	**Attempt any Two from the following**			
a)	Find $L\left\{\frac{d}{dt}\left(\frac{\sin t}{t}\right)\right\}$.	08	L2	CO4
b)	Evaluate $\int_0^\infty t^2e^{-t}\sin dt$	08	L2	CO4
c)	Find the Laplace Transform of $e^{-2t}(4\sin h\,3t-5\cos h\,3t)$	08	L2	CO4
Q.5	**Attempt any Two of the following**			
a)	Find $L^{-1}\left\{\frac{s^2+1}{s^3+3s+2s}\right\}$.	09	L3	CO5
b)	Find $L^{-1}\left[\frac{1}{(s+a)(s+b)}\right]$ by convolution theorem	09	L3	CO5
c)	Find $L^{-1}\left\{\frac{s}{\left(s^2+4\right)^2}\right\}$.	09	L3	CO5
Q.6	**Attempt any Two of the following**			
a)	Find a Fourier series to represent $f(x)=x^2$ in $(0,2\pi)$ and hence deduce that $\frac{\pi^2}{12}=\frac{1}{1^2}-\frac{1}{2^2}+\frac{1}{3^2}-\frac{1}{4^2}+\cdots$.	09	L3	CO6
b)	Obtain Fourier expansion for $f(x)=a^2-x^2$ in $(-a,a)$.	09	L3	CO6
c)	Obtain half range sine series for $f(x)=2x-1,\ 0<x<1$.	09	L3	CO6

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