Maulana Azad National Institute of Technology Bhopal
Department of Mathematics, Bioinformatics and Computer Applications
Assignment-2

Programme	B.Tech	Semester	Semester II (2024-25)
Course code	MTH24110	Section	All
Course Title	Mathematics-II	Department	MBC

Q. No.	Question Text	CO	BT
1.	Find the Laplace transform of a. $f(t) = \sin(mt)\sin(nt)$ where $m, n \in \mathbb{R}$ b. $f(t) = e^{-2t}\int_0^t \frac{\sin(\tau)}{\tau} d\tau$	3	1,2,3,5
2.	Using Convolution Theorem for Laplace Transform, find the inverse Laplace transform of the following function $\frac{s^2}{(s^2+a^2)(s^2+b^2)}$	3	1,2,3,5
3.	Discuss the application of Laplace transform to solve the variable coefficient initial value problem $$ty'' + 2y' + ty = \cos(t)$$ with initial conditions $$y(0) = 1, y'(0) = 2.$$	3	3,4,5
4.	Using the application of Laplace transform solve the following initial value problem. $$\frac{d^3y}{dx^3} - 3\frac{d^2y}{dx^2} + 3\frac{dy}{dx} - y = x^2 e^x$$ with initial conditions $y(0) = 1$, $y'(0) = 0$ and $y''(0) = 2$.	3	3,4,5
5.	Solve the following integral equation using the method of Laplace transform. $$t^2 = \int_0^t e^{\tau} x(\tau) d\tau$$	3	3,4,5

Q. No.	Question Text	CO	BT
6.	Suppose we have a mass spring system $x''(t)+x(t)=f(t)$, $x(0)=0$, $x'(0)=0$ where $$f(t)=\begin{cases} 0 & ,\ 0<t<1 \\ 1 & ,\ 1\leq t<5 \\ 0 & ,\ t\geq 5 \end{cases}$$ Find the displacement of the spring as a function of time and hence evaluate $x(5)$.	3	3,4,5
7.	Given the initial value problem $y''+4y=3\sin(t)$ with initial conditions $y(0)=1$ and $y'(0)=-1$. Find the solution of the system using the method of Laplace transform.	3	3,4,5
8.	Given that $f:(0,\infty)\to\mathbb{R}$ is a continuous function and $c>0$ is a fixed real number such that $-c\leq f(t)\leq c$ for every $t>0$. Does f satisfy the sufficient conditions for the existence of Laplace transform? Give explanation in support of your answer.	3	2,3,4
9.	Check whether the following functions satisfy the sufficient conditions for existence of Laplace transform. a. $f(t)=e^{\cos(t)}$ b. $f(t)=e^{7t^3-5t^2+1}$ c. $f(t)=\begin{cases} e^{9t^2-5} & ,0<t<20 \\ e^{9t} & ,t\geq 20 \end{cases}$ d. $f(t)=\begin{cases} e^{9t} & ,0<t<20 \\ e^{9t^2-5} & ,t\geq 20 \end{cases}$	3	2,3,4
10.	For a function $f:(0,\infty)\to\mathbb{R}$, we are given its Laplace Transform $\mathcal{L}(f(t))(s)=F(s)$. If $a>0$ is a fixed real number, what will be the Laplace transform of a. $g(t)=\begin{cases} f(t) & ,0<t<a \\ 0 & ,t\geq a \end{cases}$ b. $g(t)=\begin{cases} 0 & ,0<t<a \\ f(t) & ,t\geq a \end{cases}$ c. $g(t)=\begin{cases} f(t) & ,0<t<a \\ e^{5t}f(t) & ,t\geq a \end{cases}$	3	2,4,6

Course Outcome (CO)

CO1: Demonstrate the ability to solve linear systems and perform matrix operations, including determining the rank, eigenvalues, and eigenvectors.
CO2: Apply the Cayley-Hamilton theorem to solve matrix-related problems.
CO3: Solve ordinary differential equations using Laplace transforms and interpret inverse Laplace transforms for engineering applications.
CO4: Develop proficiency in Fourier series and Fourier transforms and their application in signal analysis.
CO5: Analyze and solve partial differential equations (PDEs), including boundary value problems for heat and wave equations.

Bloom Taxonomy (BT)

1-Remember; 2-Understand; 3-Apply; 4-Analyze; 5-Evaluate; 6-Create