Q.P. Code: 20HS0834 **R20**

SIDDHARTH INSTITUTE OF ENGINEERING & TECHNOLOGY :: PUTTUR
(AUTONOMOUS)
Siddharth Nagar, Narayanavanam Road – 517583

QUESTION BANK (DESCRIPTIVE)

Subject with Code: NUMERICAL METHODS ANDTRANSFORMS (20HS0834) **Branches**: B.Tech-ECE
Year & Sem: II-B.Tech & I-Sem **Regulation:** R20

UNIT –I

NUMERICAL SOLUTION OF ALGEBRAIC AND TRANSCENDENTAL EQUATIONS & INTERPOLATION

1	Find a positive root of the equation $x^3 - x - 1 = 0$ by Bisection method.	[L1][CO2]	**[12M]**
2	Find real root of the equation 3x= e^x by Bisection method.	[L1][CO1]	**[12M]**
3	Find out the square root of 25 given $x_0 = 2.0,\ x_1 = 7.0$ using Bisection method.	[L1][CO2]	**[12M]**
4	Find a real root of the equation $xe^x - \cos x = 0$ using Newton – Raphson method.	[L1][CO1]	**[12M]**
5	Using Newton-Raphson method (i) Find square root of 28. (ii) Find cube root of 15.	[L3][CO2]	**[12M]**
6	a) Using Newton-Raphson method, find reciprocal of 12.	[L3][CO2]	**[6M]**
	b) Find a real root of the equation $x\tan x + 1 = 0$ using Newton – Raphson method.	[L1][CO1]	**[6M]**
7	Find the root of the equation x $\log_{10}(x)=1.2$ using False position method.	[L1][CO1]	**[12M]**
8	Find the root of the equation $x\,e^x = 2$ using Regula-falsi method.	[L1][CO1]	**[12M]**
9	From the following table values of x and $y=\tan x$. Interpolate the values of y when $x=0.12$ and $x=0.28$. <table><tr><td>x</td><td>0.10</td><td>0.15</td><td>0.20</td><td>0.25</td><td>0.30</td></tr><tr><td>y</td><td>0.1003</td><td>0.1511</td><td>0.2027</td><td>0.2553</td><td>0.3093</td></tr></table>	[L5][CO1]	**[12M]**
10	a) Using Newton's forward interpolation formula and the given table of values <table><tr><td>x</td><td>1.1</td><td>1.3</td><td>1.5</td><td>1.7</td><td>1.9</td></tr><tr><td>f(x)</td><td>0.21</td><td>0.69</td><td>1.25</td><td>1.89</td><td>2.61</td></tr></table>Obtain the value of $f(x)$ when $x=1.4$.	[L3][CO1]	**[6M]**
	b) Use Newton's backward interpolation formula to find f(32) given f(25)=0.2707, f(30)=0.3027, f(35)=0.3386, f(40)=0.3794.	[L3][CO1]	**[6M]**

UNIT –II

NUMERICAL SOLUTION OF ORDINARY DIFFERENTIAL EQUATIONS & NUMERICAL INTEGRATION

1	Tabulate y(0.1), y(0.2) and y(0.3) using Taylor's series method given that $y^1 = y^2 + x$ and y(0) = 1.	[L6][CO3]	**[12M]**
2	Evaluate by Taylor's series method, find an approximate value of y at x=0.1and 0.2 for the D.E $y^{11} - x(y^1)^2 + y^2 = 0$; $y(0) = 1$, $y^1(0) = 0$.	[L5][CO3]	**[12M]**
3	a) Solve $y^1 = x + y$, given y(1)=0 find y(1.1) and y(1.2) by Taylor's series method.	[L3][CO3]	**[6M]**
	b) Solve by Euler's method $\frac{dy}{dx} = \frac{2y}{x}$ given y(1)=2 and find y(2).	[L6][CO3]	**[6M]**
4	Using Euler's method, find an approximate value of y corresponding to x=0.3 given that $\frac{dy}{dx} = x + y$ and y=1 when x=0, taking step size h=0.1.	[L1][CO3]	**[12M]**
5	Using modified Euler's method find y(0.2) and y(0.4). Given $y^1 = y + e^x$, y(0)=0.	[L3][CO3]	**[12M]**
6	a) Solve by Euler's method $y^1 = y^2 + x$, y(0)=1 and find y(0.1) and y(0.2).	[L3][CO3]	**[6M]**
	b) Using Runge – Kutta method of fourth order, compute y(0.2) from $y^1 = xy$, y(0)=1and taking h=0.2.	[L3][CO3]	**[6M]**
7	Using R-K method of 4^{th} order, solve $\frac{dy}{dx} = x^2 - y$, y(0)=1. Find y(0.1) and y(0.2).	[L3][CO3]	**[12M]**
8	Using R-K method of 4^{th} order find y(0.1) and y(0.2) given that $\frac{dy}{dx} = x + y$, y(0)=1.	[L3][CO3]	**[12M]**
9	Evaluate $\int_0^1 \frac{1}{1+x}dx$ (i) by Trapezoidal rule and Simpson's $\frac{1}{3}$ rule. (ii) Using Simpson's $\frac{3}{8}$ rule and compare the result with actual value.	[L5][CO3]	**[12M]**
10	a) Compute $\int_0^4 e^x dx$ by Simpson's $\frac{3}{8}$ rule with 12 sub divisions.	[L5][CO3]	**[6M]**
	b) Compute $\int_0^{\pi/2} sinx\, dx$ using Trapezoidal rule, Simpson's $\frac{1}{3}$ rule and compare with exact value.	[L5][CO3]	**[6M]**

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UNIT –III
LAPLACE TRANSFORMS

1	a) Find the Laplace transform of $f(t) = e^{3t} - 2e^{-2t} + \sin 2t + \cos 3t + \sinh 3t - 2\cosh 4t + 9.$	[L1][CO4]	**[6M]**
	b) Find the Laplace transform of $f(t) = \cosh at \sin bt$	[L1][CO4]	**[6M]**
2	a) Find the Laplace transform of $f(t) = \left(\sqrt{t} + \frac{1}{\sqrt{t}}\right)^3$.	[L1][CO4]	**[6M]**
	b) Find the Laplace transform of $e^{4t}\sin 2t \cos t$.	[L1][CO4]	**[6M]**
3	a) Find the Laplace transform of $f(t) = \cos t.\cos 2t.\cos 3t$.	[L1][CO4]	**[6M]**
	b) Find $L\{e^{-4t}\sinh 3t\}$ using change of scale property.	[L3][CO4]	**[6M]**
4	a) Find the Laplace transform of $t^2 e^{2t} \sin 3t$.	[L1][CO4]	**[6M]**
	b) Find the Laplace transform of $\frac{1-\cos at}{t}$	[L1][CO4]	**[6M]**
5	a) Find the Laplace transform of $\int_0^t e^{-t} \cos t \, dt$.	[L1][CO4]	**[6M]**
	b) Find the Laplace transform of $e^{-4t}\int_0^t \frac{\sin 3t}{t} dt$.	[L1][CO4]	**[6M]**
6	a) Show that $\int_0^\infty t^2 e^{-4t} .\sin 2t \, dt = \frac{11}{500}$, Using Laplace transform.	[L2][CO4]	**[6M]**
	b) Using Laplace transform, evaluate $\int_0^\infty \frac{\cos at - \cos bt}{t} dt$.	[L5][CO4]	**[6M]**
7	a) Find $L^{-1}\left\{\frac{3s-2}{s^2-4s+20}\right\}$ by using first shifting theorem.	[L1][CO4]	**[6M]**
	b) Find $L^{-1}\left\{\log\left(\frac{s-a}{s-b}\right)\right\}$	[L1][CO4]	**[6M]**
8	a) Find $L^{-1}\left\{\frac{1}{\left(s^2+5^2\right)^2}\right\}$, using Convolution theorem.	[L1][CO4]	**[6M]**
	b) Find $L^{-1}\left\{\frac{s^2}{\left(s^2+4\right)\left(s^2+25\right)}\right\}$, using Convolution theorem.	[L1][CO4]	**[6M]**
9	a) Find the Inverse Laplace transform of $\frac{1}{s\left(s^2+a^2\right)}$	[L1][CO4]	**[6M]**
	b) Find $L^{-1}\left\{s \log\left(\frac{s-1}{s+1}\right)\right\}$	[L1][CO4]	**[6M]**
10	a) Using Convolution theorem, Find $L^{-1}\left\{\frac{s}{(s^2+a^2)^2}\right\}$	[L3][CO4]	[6M]
	b) Using Convolution theorem, Find $L^{-1}\left\{\frac{1}{(s+a)(s+b)}\right\}$	[L3][CO4]	[6M]

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UNIT –IV
APPLICATIONS OF LAPLACE TRANSFORMS & FOURIER SERIES

1	a) Using Laplace transform method to solve $y^1 - y = t$, $y(0) = 1$.	[L3][CO5]	**[6M]**
	b) Solve the D.E. $\frac{d^2x}{dt^2} + 2\frac{dx}{dt} + x = 3te^{-t}$ using Laplace Transform given that $x(0) = 4; \frac{dx}{dt} = 0.at, t = 0$	[L3][CO5]	**[6M]**
2	Using Laplace transform method to solve $y^{11} - 3y^1 + 2y = 4t + e^{3t}$ where $y(0) = 1, y^1(0) = 1$.	[L6][CO5]	**[12M]**
3	a) Obtain the Fourier series expansion of f(x) = x^2 in the interval $(0,2\pi)$.	[L3][CO5]	**[6M]**
	b) Obtain the Fourier series expansion of f(x) =$(x - x^2)$ in the interval $[-\pi, \pi]$. Hence show that $\frac{1}{1^2} - \frac{1}{2^2} + \frac{1}{3^2} - \frac{1}{4^2} - - - - -= \frac{\pi^2}{12}$.	[L3][CO5]	**[6M]**
4	a) Obtain the Fourier series expansion of $f(x) = (\pi - x)^2$ in $0 < x < 2\pi$ and deduce that $\frac{1}{1^2} + \frac{1}{2^2} + \frac{1}{3^2} + \frac{1}{4^2} - - - - -= \frac{\pi^2}{6}$.	[L3][CO5]	**[6M]**
	b) Find the Fourier series for the function $f(x) = x$ in $-\pi < x < \pi$.	[L1][CO5]	**[6M]**
5	Find a Fourier series to represent the function $f(x) = e^x$ for $-\pi < x < \pi$ *and* hence derive a series for $\frac{\pi}{\sinh\pi}$.	[L1][CO5]	**[12M]**
6	Find the Fourier series to represent the function $f(x) = x^2$ for $-\pi < x < \pi$ and hence show that (i) $\frac{1}{1^2} - \frac{1}{2^2} + \frac{1}{3^2} - \frac{1}{4^2} - - - - -= \frac{\pi^2}{12}$. (ii) $\frac{1}{1^2} + \frac{1}{2^2} + \frac{1}{3^2} + \frac{1}{4^2} - - - - -= \frac{\pi^2}{6}$. (iii) $\frac{1}{1^2} + \frac{1}{3^2} + \frac{1}{5^2} + \frac{1}{7^2} - - - - -= \frac{\pi^2}{8}$.	[L1][CO5]	**[12M]**
7	a) If $f(x) = \|\sin x\|$, expand f(x) as a Fourier series in the interval $(-\pi, \pi)$.	[L2][CO5]	**[6M]**
	b) Find the half range cosine series for $f(x) = x$ in the interval $0 \leq x \leq \pi$.	[L1][CO5]	**[6M]**
8	Expand the function $f(x) = \|x\|$ in $-\pi < x < \pi$ as a Fourier series and deduce that $\frac{1}{1^2} + \frac{1}{3^2} + \frac{1}{5^2} + \frac{1}{7^2} - - - - -= \frac{\pi^2}{8}$.	[L2][CO5]	**[12M]**
9	a) Expand $f(x) = e^{-x}$ as a fourier series in the interval $(-1,1)$.	[L2][CO5]	**[6M]**
	b) Expand $f(x) = \|x\|$ as a fourier series in the interval $(-2,2)$.	[L2][CO5]	**[6M]**
10	a) Find the half range sine series expansion of $f(x) = x^2$ when $0 < x < 4$.	[L1][CO5]	**[6M]**
	b) Find the half range cosine series expansion of $f(x) = x(2 - x)$ in $0 \leq x \leq 2$.	[L1][CO5]	**[6M]**

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UNIT –V
FOURIER TRANSFORMS

1	Using Fourier integral theorem, Show that $$e^{-ax}-e^{-bx}=\frac{2(b^2-a^2)}{\pi}\int_0^{\infty}\frac{\lambda\ \sin\lambda x\ d\lambda}{(\lambda^2+a^2)(\lambda^2+b^2)},\quad a,b>0$$	[L3][CO6]	**[12M]**
2	Find the Fourier transform of f(x) $=\begin{cases}1; \lvert x\rvert<a\\ 0, \lvert x\rvert>a\end{cases}$ and hence evaluate i) $\int_{-\infty}^{\infty}\frac{\text{sinap cospx}}{\text{p}}\,\text{dp}$ ii) $\int_{-\infty}^{\infty}\frac{\text{sinp}}{\text{p}}\,\text{dp}$ iii) $\int_{0}^{\infty}\frac{\text{sinp}}{\text{p}}\,\text{dp}$	[L1][CO6]	**[12M]**
3	Find the Fourier transform of f(x) $=\begin{cases}a^2-x^2, \lvert x\rvert<a\\ 0, \lvert x\rvert>a>0\end{cases}$. Hence show that $\int_0^{\infty}\frac{\sin x-x\cos x}{x^3}dx=\frac{\pi}{4}$.	[L1][CO6]	**[12M]**
4	a) Find the Fourier transform of f(x) =. $e^{-\frac{x^2}{2}}, -\infty<x<\infty$	[L1][CO6]	**[6M]**
	b) If F(p) is the complex Fourier transform of f(x) , then prove that the complex Fourier transform of f(x) = $cosax$ is $\frac{1}{2}[F(p+a)+F(p-a)]$	[L5][CO6]	**[6M]**
5	a) Find the Fourier cosine transform of f(x) defined by $f(x)=\begin{cases}cosx & ;0<x<a\\ 0 & ;x\geq a\end{cases}$	[L1][CO6]	**[6M]**
	b) If F(P) is the complex Fourier transform of f(x) , then prove that the complex Fourier transform of $F\{f(x-a)\}=e^{ipa}.F(P)$.	[L5][CO6]	**[6M]**
6	Find the Fourier sine and cosine transforms of f(x)=$\frac{e^{-ax}}{x}$ and deduce that $\int_0^{\infty}\frac{e^{-ax}-e^{-bx}}{x}\sin px\,dx=\tan^{-1}\left(\frac{p}{a}\right)-\tan^{-1}\left(\frac{p}{b}\right)$.	[L1][CO6]	**[12M]**
7	Find the Fourier sine and cosine transforms of f(x)=$e^{-ax}, a>0$ and hence deduce the integrals (i) $\int_0^{\infty}\frac{p\sin px}{a^2+p^2}dp$ (ii) $\int_0^{\infty}\frac{\cos px}{a^2+p^2}dp$	[L1][CO6]	**[12M]**
8	a) Prove that F[x^n f(x)] = $(-i)^n\frac{d^n}{dp^n}[F(p)]$	[L5][CO6]	**[6M]**
	b) Prove that F_s { x f(x) } = $-\frac{d}{dp}[F_c(p)]$	[L5][CO6]	**[6M]**
9	a) Find the Fourier cosine transform of $e^{-ax}\cos ax, a>0$	[L1][CO6]	**[6M]**
	b) Find the Fourier cosine transform of f(x) = $\begin{cases}x,\ for\ \ 0<x<1\\ 2-x,\ for\ \ 1<x<2\\ 0,\ for\ \ x>2\end{cases}$	[L1][CO6]	**[6M]**
10	Find the finite Fourier sine and cosine transform of f(x) defined by $f(x)=2x\ \ where\ 0<x<2\pi$.	[L1][CO6]	**[12M]**

Prepared by: Dept. of Mathematics