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

SIDDHARTH INSTITUTE OF ENGINEERING & TECHNOLOGY :: PUTTUR
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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

<table>
<tr><td>1</td><td>a) Define Algebraic equation and Transcendental equation.</td><td>[L1][CO2]</td><td>[4M]</td></tr>
<tr><td></td><td>b) Find a positive root of the equation $x^3 - x - 1 = 0$ by Bisection method.</td><td>[L3][CO2]</td><td>[8M]</td></tr>
<tr><td>2</td><td>a)What is the algorithm for the bisection method.</td><td>[L1][CO2]</td><td>[4M]</td></tr>
<tr><td></td><td>b) Find real root of the equation $3x= e^x$ by Bisection method.</td><td>[L3][CO1]</td><td>[8M]</td></tr>
<tr><td>3</td><td>a) Describe the formula for square root of a number by Newton – Raphson formula.</td><td>[L2][CO2]</td><td>[2M]</td></tr>
<tr><td></td><td>b) Find out the square root of 25 given $x_0 = 2.0,\ x_1 = 7.0$ using Bisection method.</td><td>[L3][CO2]</td><td>[10M]</td></tr>
<tr><td>4</td><td>a) State Newton – Raphson formula for solution of polynomial and transcendental equations.</td><td>[L1][CO2]</td><td>[2M]</td></tr>
<tr><td></td><td>b) Estimate a real root of the equation $xe^x - \cos x = 0$ by using Newton – Raphson method.</td><td>[L4][CO1]</td><td>[10M]</td></tr>
<tr><td>5</td><td>Using Newton-Raphson method
(i) Find square root of 28 (ii) Find cube root of 15.</td><td>[L3][CO2]</td><td>[12M]</td></tr>
<tr><td>6</td><td>a) Using Newton-Raphson method, find reciprocal of 12.</td><td>[L3][CO2]</td><td>[6M]</td></tr>
<tr><td></td><td>b) Find a real root of theequation$x \tan x + 1 = 0$using Newton – Raphson method.</td><td>[L3][CO1]</td><td>[6M]</td></tr>
<tr><td>7</td><td>a) Write formula for Regula-falsi method.</td><td>[L2][CO1]</td><td>[2M]</td></tr>
<tr><td></td><td>b) Predict a real root of the equation $x\ e^x = 2$ by using Regula-falsi method.</td><td>[L2][CO1]</td><td>[10M]</td></tr>
<tr><td>8</td><td>Find the root of the equation $x\log_{10}(x)=1.2$ using False position method.</td><td>[L3][CO1]</td><td>[12M]</td></tr>
<tr><td>9</td><td>a) Write the formula for Newton’s forward interpolation.</td><td>[L1][CO1]</td><td>[2M]</td></tr>
<tr><td></td><td>b) 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></td><td>[L5][CO1]</td><td>[10M]</td></tr>
<tr><td>10</td><td>a)Apply 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 $x=1.4$.</td><td>[L3][CO1]</td><td>[6M]</td></tr>
<tr><td></td><td>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.</td><td>[L3][CO1]</td><td>[6M]</td></tr>
</table>

UNIT –II

NUMERICAL SOLUTION OF ORDINARY DIFFERENTIAL EQUATIONS& NUMERICAL INTEGRATION

1	a) State Taylor's series formula for first order differential equation.	[L1][CO3]	**[2M]**
	b) Tabulate y(0.1) and y(0.2) using Taylor's series method given that $y^1 = y^2 + x$ and y(0) = 1	[L1][CO3]	**[10M]**
2	Evaluate by Taylor's series method, find an approximate value of y at x=0.1and 0.2 for the D.E $y^{11} + xy = 0$; $y(0) = 1$, $y^1(0) = 1/2$.	[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)	[L3][CO3]	**[6M]**
4	a) State Euler's formula for differential equation.	[L1][CO3]	**[2M]**
	b)Using Euler's method, find an approximate value of y corresponding to $x = 0.2$ given that $\frac{dy}{dx} = x + y$ and $y = 1$ when $x = 0$ taking step size $h = 0.1$	[L3][CO3]	**[10M]**
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 $y' = y^2 + x$, 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)=1,taking h=0.2	[L3][CO3]	**[6M]**
7	Using R-K method of 4th 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 4th order find y(0.1) and y(0.2) given that $\frac{dy}{dx} = x + y,$ $y(0) = 1$.	[L3][CO3]	**[12M]**
9	Evaluate $\int_0^1 \frac{1}{1+x} dx$ by (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) Evaluate $\int_0^4 e^x dx$ by Simpson's $\frac{3}{8}$rule with 12 sub divisions.	[L5][CO3]	**[6M]**
	b) Evaluate $\int_0^{\pi/2} sinx\ dx$ using Trapezoidal rule, Simpson's $\frac{1}{3}$ rule and compare with exact value.	[L5][CO3]	**[6M]**

UNIT –III

LAPLACE TRANSFORMS

1	a) What is the Linear Property of Laplace Transform	[L1][CO4]	**[2M]**
	b) Find the Laplace transform of $f(t) = e^{3t} - 2e^{-2t} + sin2t + cos3t + sinh3t - 2cosh4t + 9.$	[L3][CO4]	**[4M]**
	c) Find the Laplace transform of $f(t) = cosh\ at\ sin\ bt$	[L3][CO4]	**[6M]**
2	a) Find the Laplace transform of $f(t) = \left(\sqrt{t} + \frac{1}{\sqrt{t}}\right)^3.$	[L3][CO4]	**[6M]**
	b) State First Shifting Theorem	[L1][CO4]	**[2M]**
	c) Find the Laplace transform of $e^{4t} sin2t\ cost.$	[L3][CO4]	**[4M]**
3	a) State Change of Scale Property	[L1][CO4]	**[2M]**
	b) Find the Laplace transform of $f(t) = cost.cos2t.cos3t$	[L3][CO4]	**[6M]**
	c) Find $L\{e^{-3t} sinh3t\}$	[L3][CO4]	**[4M]**
4	a) Find the Laplace transform of $t^2 e^{2t} \sin 3\,t.$	[L3][CO4]	**[6M]**
	b) Find the Laplace transform of $\frac{1-cos\,at}{t}$	[L3][CO4]	**[6M]**
5	a) Find the Laplace transform of $\int_0^t e^{-t} \cos t\ dt.$	[L3][CO4]	**[6M]**
	b) Find the Laplace transform of $e^{-4t} \int_0^t \frac{\sin 3t}{t} dt.$	[L3][CO4]	**[6M]**
6	a) Show that $\int_0^\infty t^2\ e^{-4t}.\sin 2\,tdt = \frac{11}{500}$, Using Laplace transform.	[L1][CO4]	**[6M]**
	b) Using Laplace transform, evaluate $\int_0^\infty \frac{\cos at - \cos bt}{t} dt.$	[L3][CO4]	**[6M]**
7	a) Find $L^{-1}\left\{\frac{3s-2}{s^2-4s+20}\right\}$ by using first shifting theorem.	[L3][CO4]	**[6M]**
	b) Find $L^{-1}\left\{\log\left(\frac{s-a}{s-b}\right)\right\}$	[L3][CO4]	**[6M]**
8	a) State Convolution Theorem	[L1][CO4]	**[2M]**
	b) Find $L^{-1}\left\{\frac{1}{(s^2+5^2)^2}\right\}$, using Convolution theorem.	[L3][CO4]	**[4M]**
	c) Find $L^{-1}\left\{\frac{s^2}{(s^2+4)(s^2+25)}\right\}$, using Convolution theorem.	[L3][CO4]	**[6M]**
9	a) Find the Inverse Laplace transform of $\frac{1}{s(s^2+a^2)}$	[L3][CO4]	**[6M]**
	b) Find $L^{-1}\left\{s\ log\left(\frac{s-1}{s+1}\right)\right\}$	[L3][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]**

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.$\frac{d^2x}{dt^2} + 2\frac{dx}{dt} + x = 3te^{-t}$usingLaplace 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) Express Fourier Series with Coefficients in the interval $(0,2\pi)$.	[L2][CO5]	**[2M]**
	b) Obtain the Fourier series expansion of f(x) = x^2 in the interval $(0,2\pi)$.	[L3][CO5]	**[4M]**
	c) 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 -π < x < π.	[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 $f(x) = \lvert sin\,x\rvert$, expand f(x) as a Fourier series in the interval $(-\pi,\pi)$	[L2][CO5]	**[6M]**
	b) Write the formula for Half Range Fourier Cosine Series	[L1][CO5]	**[2M]**
	c) Find the half range cosine series for $f(x) = x$ in the interval $0\leq x \leq \pi$.	[L1][CO5]	**[4M]**
8	Expand the function $f(x) = \lvert x\rvert$ 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 $f(x) = \lvert x\rvert$ as a fourier series in the interval $(-2,2)$.	[L2][CO5]	**[6M]**

10	a) Write the formula for Half Range Fourier Sine Series	[L1][CO5]	**[2M]**
	b) Find the half range sine series expansion of $f(x) = x^2$when $0 < x < 4$.	[L1][CO5]	**[4M]**
	c) Find the half range cosine series expansion of $f(x) = x(2-x)$in $0 \leq x \leq 2$.	[L1][CO5]	**[6M]**

UNIT –V
FOURIER TRANSFORMS

1	a) State Fourier integral theorem	[L1][CO6]	**[2M]**
	b) Using Fourier integral theorem, Show that $e^{-ax} - e^{-bx} = \frac{2(b^2-a^2)}{\pi}\int_0^\infty \frac{\lambda \sin\lambda x \, d\lambda}{(\lambda^2+a^2)(\lambda^2+b^2)}$, $a, b > 0$	[L3][CO6]	**[10M]**
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 $i)\ \int_{-\infty}^{\infty} \frac{sinap\ cospx}{p} dp \quad ii)\ \int_{-\infty}^{\infty} \frac{sinp}{p} dp \quad iii)\ \int_0^\infty \frac{sinp}{p} dp.$	[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) Write the formula for Fourier cosine transform	[L1][CO6]	**[2M]**
	b) 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]	**[4M]**
	c) 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^nf(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]**
	a) Find the Fourier cosine transform of $e^{-ax}\ cos\ a\ x, a > 0$	[L1][CO6]	**[6M]**

9	b) Find the Fourier cosine transform of f(x) = $\begin{Bmatrix} x, for\ 0 < x < 1 \\ 2 - x, for\ 1 < x < 2 \\ 0, for\ x > 2 \end{Bmatrix}$	[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