NARASIMHA REDDY ENGINEERING COLLEGE
(Autonomous)
Approved by AICTE, New Delhi & Affiliated to JNTUH, Hyderabad
Accredited by NAAC with A Grade, Accredited by NBA

Course Title : Numerical Methods and Complex Variables

Course Code : 23MA301

Year & Sem : II – I

Regulation : NR23 (NRCM – NR23 Autonomous Syllabus)

QUESTION BANK

UNIT–I

LAPLACE TRANSFORMS

S.No		Questions	BT	CO	Po
Part – A (Short Answer Questions)					
1		Find L{(sint+cost)^2}.	L1,L2	CO1	Po1
2		Find L{(sin2t.cos3t)}	L1,L2	CO1	Po1
3		Find L{$\sqrt{t}e^{-3t}$}	L1,L2	CO1	Po1
4		Define Laplace transform of a function f(t).	L1	CO1	Po1
5		State First shifting theorem of Laplace transform	L1	CO1	Po1
6		Find L{$\frac{1-e^t}{t}$}	L1,L2	CO1	Po1
7		Find $L^{-1}\{\frac{S^2-3s+4}{s^3}\}$	L1,L2	CO1	Po1
8		Find $L^{-1}\{\frac{1}{(s+1)^2}\}$	L1,L2	CO1	Po1
9		If $L\{f(t) = \frac{9S^2-12S+15}{(s-1)^3}\}$, find L{f(3t)} using change of scale property.	L1,L2	CO1	Po1
10		Find $L^{-1}\{\frac{1}{S(S+2)}\}$	L1,L2	CO1	Po1
Part – B (Long Answer Questions)					
11	a)	Evaluate L{$\int_0^t te^{-t}sin2t\,dt$}.	L3,L5	CO1	Po1
	b)	Evaluate $L\{\frac{cos\sqrt{t}}{\sqrt{t}}\}$	L3,L	CO	Po1

			5	1	
12	a)	Find $L\{te^{-t}sin2tcos2t\}$	L2	CO 1	Po1
	b)	Using Laplace transform, evaluate $\int_0^\infty \frac{cosat-cosbt}{t}dt$	L2	CO 1	Po1
13	a)	Find $L\{t^2cos3t\}$	L2	CO 1	Po1
	b)	Find $L^{-1}\{\frac{s^2}{(s^2+4)(s^2+25)}\}$	L2	CO 1	Po1
14	a)	Using the Convolution theorem, find $L^{-1}\{\frac{s}{(s^2+a^2)^2}\}$	L3	CO 1	Po2
	b)	Find the inverse Laplace transform of $\{\frac{s+3}{(s^2+6s+13)^2}\}$	L2	CO 1	Po1
15		Solve the differential equation $\frac{d^2x}{dt^2}$ +9x = sint using laplace transform given that x(0)=1,x^1(0)=0	L5	CO 1	Po2
16		Using Laplace transform, evaluate $(D^2+5D+6)x = 5e^t$ given that x(0)=2,x^1(0)=1	L3	CO 1	Po2

UNIT–II

NUMERICAL METHODS-1

S.No		Questions	BT	CO	PO
Part – A (Short Answer Questions)					
1		Write the merits and demerits of the Newton Raphson method.	L1	CO2	Po1
2		Write the merits and demerits of the Regula-falsi method.	L1	CO2	Po1
3		Show that $\mu = \frac{1}{2}(E^{\frac{1}{2}} + E^{-\frac{1}{2}})$.	L2	CO2	Po1
4		Prove that $\nabla = 1 - E^{-1}$.	L1	CO2	Po1
5		Evaluate $\Delta^2 e^{2x+3}$.	L1	CO2	Po1
6		Show that $\Delta {f_i}^2 = (f_i + f_{i+1})\Delta f_i$.	L1	CO2	Po1
7		Define Newton Forward Interpolation formula.	L1	CO2	Po1
8		Define Newton Backward Interpolation formula.	L1	CO2	Po1
9		State Lagrange's Interpolation formula.	L1	CO2	Po1
10		Evaluate $\sqrt{28}$ to four decimal places by newton's iterative method	L2	CO2	Po2
Part – B (Long Answer Questions)					
11	a)	Find the real root for xtanx+1=0 using newton Raphson method	L3	CO2	Po1
	b)	find the real root of the equation $xe^x = cosx$ using the regula false method correct to four decimal places	L3	CO2	Po1
12		consider the following data for g(x)= $\frac{sinx}{x^2}$ *calculate* g(0.25) accurately using newton's forward method of interpolation x: 0.1, 0.2, 0.3, 0.4, 0.5 g(x): 9.9833, 4.9696, 3.2836, 2.4339, 1.9177	L2	CO2	Po1
13		Find Y(66) given that Y(50)=201,y(60)=225,y(70)=248 and y(80)=274 using newton's backward difference formula	L3	CO2	Po1
		Using Lagrange's Interpolation formula find y(10) from the following table x: 5, 6, 9, 11 y: 12, 13, 14, 16	L3	CO2	Po1

14	a)	Find the real root of $x^3 - x - 2 = 0$, using Newton Raphson method.	L2	CO2	Po1
	b)	Find the positive root of the equation $f(x) = x^3 - 2x - 5 = 0$, using Regula-falsi method.	L2	CO2	Po1
15		From the following table estimate the number of students who obtained marks between 40 & 45, Using Newton Forward Interpolation Marks: 30-40 | 40-50 | 50-60 | 60-70 | 70-80 No. of students: 31 | 42 | 51 | 35 | 31	L2	CO2	Po2
16		Given U_1=22, U_2=30,U_4=82,U_7=106,U_8=206 find U_6 use Lagrange's interpolation formula.	L2	CO2	Po2

UNIT–III

NAME NUMERICAL METHODS-II

S.No		Questions	BT	CO	PO
Part – A (Short Answer Questions)					
1		Write the Simpson's 1/3 and 3/8 rule.	L1	CO3	Po1
2		Evaluate $\int_1^2 e^{-(\frac{1}{2})x}$dx using trapezoidal rule given that x: 1 | 1.25 | 1.5 | 1.75 | 2 y: 0.6065 | 0.5352 | 0.4724 | 0.4169 | 0.3679	L3	CO3	Po1
3		The table below show the temperature f(t) as a function of time t: 1 | 2 | 3 | 4 | 5 | 6 | 7 f(t): 81 | 75 | 80 | 83 | 78 | 70 | 60 Evaluate $\int_1^7 f(t)dt$ using Simpson's 1/3 rule.	L2	CO3	Po1
4		Using Simpson's 3/8 rule estimate $\int_0^6 \frac{dx}{1+x^2}$, by dividing the range into 6 equal parts	L2	CO3	Po1
5		Estimate $\int_0^1 e^{-x^2}dx$ using Simpson's 1/3 rule taking h=0.1.	L3	CO3	Po1
6		Explain Picard's method.	L1	CO3	Po1
7		Write the merits and demerits of Euler's method.	L1	CO3	Po1
8		Write the Runge-kutta second order formulae.	L1	CO3	Po1
9		Write the Runge-kutta fourth order formulae.	L1	CO3	Po1
10		If $\frac{dy}{dx} = x + y, y(0) = 2$, then find y(0.1) by Euler's method.	L2	CO3	Po1
Part – B (Long Answer Questions)					
11	a)	Use the trapezoidal rule with n=4 to estimate $\int_0^1 \frac{dx}{1+x^2}$, correct to four decimal places	L2	CO3	Po1
	b)	Find the value of $\int_1^2 \frac{dx}{x}$ by simpson's 1/3 rule. Hence obtain approximate value of $\log_e 2$.	L2	CO3	Po1
12	a)	Evaluate $\int_0^1 x\sqrt{1+x^4}$ dx using simpson's 3/8 rule.	L3	CO3	Po1
	b)	Find y(0.1),y(0.2),Z(0.1),Z(0.2) given $\frac{dy}{dx} = x + z, \frac{dz}{dx} =$ x - y^2 and Y(0)=2,Z(0)=1 by using taylor's series method.	L3	CO3	Po1

13		Find the value of y at x=0.1 by picard's method, given that $\frac{dy}{dx} = \frac{y-x}{y+x}, y(0) = 1.$	L3	CO3	Po1
14	a)	Using Euler's method ,solve for y at x=2 from $\frac{dy}{dx}$=3x^2+1,y(1)=2, taking step size (i) 0.5 (II) 0.25	L3	CO3	Po1
	b)	Given $\frac{dy}{dx}$= -xy^2,Y(0)=2 compute Y(0.2) in steps of 0.1 using modified Euler's method	L3	CO3	Po1
15	a)	Given y'= x-y ,y(0)=1,compute y(0.2) with h=0.1 using modified Euler's method	L3	CO3	Po1
	b)	Use Runge-kutta method to evaluate Y(0.1) and y(0.2) given that y'= x+y, y(0)=1	L3	CO3	Po1
16	a) b)	Using Runge-kutta method of fourth order, solve $\frac{dy}{dx} = \frac{y^2-x^2}{y^2+x^2}$ $with\ y(0) = 1$ at x=0.2,0.4.	L3	CO3	Po1

UNIT–IV

COMPLEX VARIABLE (DIFFERENTIATION)

S.No		Questions	BT	CO	PO
Part – A (Short Answer Questions)					
1		Find all values of k such that f(z)=$e^x(cosky + isinky)$ is analytic.	L1	CO4	Po 1
2		Show that z^2 is analytic for all z.	L1	CO4	Po 1
3		Show that the function f(z)=sinxcoshy+icosxsinhy is continuous as well as analytic everywhere.	L1	CO4	Po 1
4		Define Cauchy-Reimann equations in polar form.	L1	CO4	Po 1
5		Define harmonic function.	L1	CO4	Po 1
6		Define analytic function.	L1	CO4	Po 1
7		Separate the real and imaginary parts of cotz.	L1	CO4	Po 1
8		Find the real and imaginary parts of e^{z^2}	L1	CO4	Po 1
9		Prove that $\overline{sinz} = sin\bar{z}$	L1	CO4	Po 1
10		Find all the roots of the equation sinz=2.	L2	CO4	Po 1
Part – B (Long Answer Questions)					
11	a)	State Cauchy-Riemann equation and if f(z) is a regular function of z, prove that $\left[\frac{\partial^2}{\partial x^2} + \frac{\partial^2}{\partial y^2}\right] \lvert f(z)\rvert^2 = 4\lvert f'(z)\rvert^2$	L2	CO4	Po 1
	b)	If Tan (log (x+iy))= a+ib , where a^2+b^2≠ 1 show that $\frac{2a}{1-a^2-b^2}$ =	L3	CO4	Po

		$Tan(\log(x^2+y^2))$.			1
12	a)	Define analytic function and show that both the real and imaginary parts of an analytic function satisfied Laplace's equation (are harmonic).	L2	CO4	Po 1
	b)	Define polar form of Cauchy-Riemann equation and prove that Z^n is analytic and hence find its derivative.	L2	CO4	Po 1
13		Prove that the function f(z) defined by f(Z)=$\begin{cases} \frac{x^3(1+i)-y^3(1-i)}{x^2+y^2}, z \neq 0 \\ 0, z=0 \end{cases}$ is continuous and the Cauchy-Riemann equation are satisfied at the origin ,yet f'(0) does not exist .	L2	CO4	Po 1
14	a)	If Tan(x+iy)= A+ iB, then prove that $A^2+B^2-2B\coth 2y+1=0$	L3	CO4	Po 1
	b)	Find k such that $f(x,y)=x^3+3kxy^2$ may be harmonic and find its conjugate.	L3	CO4	Po 1
15	a)	separate the real and imaginary parts of (i) cotz (ii) tanhz.	L2	CO4	Po 1
	b)	Show that $u(x,y) = e^{2x}(x\cos 2y - y\sin 2y)$ is harmonic and find its harmonic conjugate.	L3	CO4	Po 2
16	a)	Prove that $u = e^{-x}[(x^2-y^2)cosy + 2xysiny]$ is harmonic and find the analytic function whose real part is u	L3	CO4	Po 1
	b)	Find the ayalytic function whose imaginary part is $\frac{2sinxsiny}{cos2x+cosh2y}$	L3	CO4	Po 1

UNIT–V

COMPLEX VARIABLE (INTEGRATION)

S.No		Questions	BT	CO	PO
Part – A (Short Answer Questions)					
1		Evaluate $\int_0^{1+i}(x-y^2+ix^3)dz$ along the real axis from z=0 to z=1.	L2	CO5	Po1
2		Evaluate $\int_c \frac{z^2-z+1}{z-1}dz$ *where* $C: \lvert z\rvert = 1/2$.	L3	CO5	Po1
3		State Cauchy's Integral theorem.	L1	CO5	Po1
4		Evaluate $\int_c \frac{e^z}{(z+1)^2}dz$ *around* $C: \lvert z-1\rvert = 3$.	L3	CO5	Po1
5		Evaluate $\int_1^3 (Z-2)^3 dz$	L1	CO5	Po1
6		State Taylor's theorem.	L1	CO5	Po1
7		State Laurent's theorem.	L1	CO5	Po1
8		State Cauchy's Residue theorem.	L1	CO5	Po1
9		Determine the pole of the function cotz.	L1	CO5	Po1
10		Find the residue of $\frac{ze^z}{(z-1)^3}$ *at* its pole.	L2	CO5	Po1
Part – B (Long Answer Questions)					
11	a)	Evaluate $\int_c (y^2+2xy)dx + (x^2-2xy)dy$ where c is the boundary of the region by $y=x^2$ and $x=y^2$.	L3	CO5	Po1
	b)	State Cauchy's theorem and verify Cauchy's theorem for the function f(z)=	L3	CO5	Po1

		$3z^2$+iz-4 if c is the square with vertices at $1 \pm i \; and \; -1 \pm i$.			
12	a)	Evaluate $\int_c \frac{logz}{(z-1)^3} dz$ where c: $\|z-1\|$=1/2 using cauchy's integral formula.	L3	CO5	Po1
	b)	Using Cauchy's integral formula, evaluate $\int_c \frac{z^4}{((z+1)(z-i)^2} dz \; where$ c is the ellipse $9x^2 + 4y^2$=36.	L3	CO5	Po1
13	a)	Evaluate $\int_c \frac{z^3 - sin3z}{(z-\frac{\pi}{2})^3} dz$ with c:$\|z\|$=2 using cauchy's integral formula.	L5	CO5	Po1
	b)	Find the Laurent series expansion of the function f(z)=$\frac{z^2-6z-1}{(z-1)(z-3)(z+2)} \; in$ the region 3<$\|z+2\|$<5.	L3	CO5	Po2
14	a)	Obtain the Taylor's series to represent the function $\frac{z^2-1}{(z+2)(z+3)}$ in the region $\|z\| < 2$.	L2	CO5	Po1
	b)	Evaluate $\oint_c \frac{4-3z}{z(z-1)(z-2)} dz \; where \; c \; is$ the circle $\|z\| = \frac{3}{2}$ using residue theorem.	L3	CO5	Po2
15		Show that $\int_0^{2\pi} \frac{1}{2+cos\theta} d\theta = \frac{2\pi}{\sqrt{3}}$.	L3	CO5	Po1
16		Evaluate $\int_{-\infty}^{\infty} \frac{x^2}{(x^2+1)(x^2+4)} dx$ using residue theorem.	L3	CO5	Po2

* **Blooms Taxonomy Level (BT)** (L1 – Remembering; L2 – Understanding; L3 – Applying; L4 – Analyzing; L5 – Evaluating; L6 – Creating)

Course Instructor **Head of the Dept.**