



SIDDARTHA INSTITUTE OF SCIENCE AND TECHNOLOGY: PUTTUR
(AUTONOMOUS)

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QUESTION BANK (DESCRIPTIVE)

Subject with Code: Complex Variables & Numerical Methods
(23HS0833)

Course & Branch: B.Tech - EEE

Regulation: R23

UNIT – I
COMPLEX VARIABLE – DIFFERENTIATION

1	a) Define analytic function.	[L1][CO1]	[2M]
	b) State Cauchy-Riemann (C-R) equations in cartesian coordinates.	[L1][CO1]	[2M]
	c) Find where the function $w = \frac{1}{z}$ ceases to be analytic.	[L1][CO1]	[2M]
	d) Define harmonic function.	[L1][CO1]	[2M]
	e) Prove that $f(z) = \bar{z}$ is not an analytic at any point.	[L5][CO1]	[2M]
2	a) Show that z^2 is an analytic for all z .	[L2][CO1]	[5M]
	b) Determine p such that the function $f(z) = \frac{1}{2} \log(x^2+y^2) + i \tan^{-1} \left(\frac{px}{y} \right)$ is an analytic function.	[L5][CO1]	[5M]
3	a) Find whether $f(z) = \sin x \sin y - i \cos x \cos y$ is an analytic or not.	[L1][CO1]	[5M]
	b) Determine whether the function $f(z) = 2xy + i(x^2 - y^2)$ is analytic.	[L5][CO1]	[5M]
4	a) Show that $u = e^{-x}(x \sin y - y \cos y)$ is harmonic function.	[L2][CO1]	[5M]
	b) Show that $u = 2 \log(x^2 + y^2)$ is harmonic function.	[L2][CO1]	[5M]
5	Verify that $u = x^2 - y^2 - y$ is harmonic in the whole complex plane and find a conjugate harmonic function v of u ?	[L4][CO1]	[10M]
6	Prove that, if $u = x^2 - y^2 : v = \frac{-y}{x^2 + y^2}$ both u and v satisfy Laplace's equation, but $u + iv$ is not a analytic function.	[L5][CO1]	[10M]
7	Show that i) $\frac{\partial^2}{\partial x^2} + \frac{\partial^2}{\partial y^2} = 4 \frac{\partial^2}{\partial z \partial \bar{z}}$. ii) $\left(\frac{\partial^2}{\partial x^2} + \frac{\partial^2}{\partial y^2} \right) f(z) ^2 = 4 f'(z) ^2$ where $f(z)$ is an analytic function.	[L1][CO1]	[10M]
8	Prove that the function $f(z)$ defined by $f(z) = \frac{x^3(1+i) - y^3(1-i)}{x^2 + y^2}, (z \neq 0)$ and $f(z) = 0, (z = 0)$ is continuous and the Cauchy-Riemann equations are satisfied at origin.	[L5][CO1]	[10M]
9	Find 'a' and 'b' if $f(z) = (x^2 - 2xy + ay^2) + i(bx^2 - y^2 + 2xy)$ is analytic. Hence find $f(z)$ in terms of z .	[L1][CO1]	[10M]
10	a) Determine the analytic function whose real part is $e^x \cos y$.	[L5][CO1]	[5M]
	b) Find the analytic function whose imaginary part is $\frac{x-y}{x^2+y^2}$.	[L1][CO1]	[5M]
11	a) Find the analytic function $f(z)$ in terms of z whose real part is $x^3 - 3xy^2$.	[L1][CO1]	[5M]
	b) Find the analytic function whose imaginary part is $e^x(x \sin y + y \cos y)$.	[L1][CO1]	[5M]

UNIT –II
COMPLEX VARIABLE – INTEGRATION

1	a) Define Line integral	[L1][CO2]	[2M]
	b) State Cauchy's integral theorem.	[L1][CO2]	[2M]
	c) State Cauchy Integral formula.	[L1][CO2]	[2M]
	d) Expand e^z as Taylor's series in powers of $(z-3)$.	[L2][CO2]	[2M]
	e) State Cauchy Residue theorem.	[L1][CO2]	[2M]
2	a) Evaluate $\int_{(0,0)}^{(1,3)} 3x^2 y dx + (x^3 - 3y^2) dy$ along the curve $y = 3x$.	[L5][CO2]	[5M]
	b) Evaluate $\int_0^{1+i} (x^2 - iy) dz$ along the path $y = x$.	[L5][CO2]	[5M]
3	Evaluate $\int_0^{3+i} z^2 dz$, i) along the line $y = \frac{x}{3}$ ii) along the parabola $x = 3y^2$.	[L5][CO2]	[10M]
4	Show that $\int_c (z+1) dz = 0$ where 'c' is the boundary of the square whose vertices at the points $z = 0, z = 1, z = 1 + i, z = i$.	[L1][CO2]	[10M]
5	a) Evaluate $\int_c \frac{e^{2z}}{(z-1)(z-2)} dz$ where 'c' is the circle $ z = 3$.	[L5][CO2]	[5M]
	b) Evaluate $\int_c \frac{e^z}{(z-1)(z-4)} dz$ where 'c' is $ z = 2$.	[L5][CO2]	[5M]
6	Evaluate $\int_c \frac{z-3}{z^2+2z+5} dz$ where 'c' is the circle i) $ z = 1$ ii) $ z+1-i = 2$	[L5][CO2]	[10M]
7	a) Expand $f(z) = \sin z$ in Taylor's expansion of in powers of $\left(z - \frac{\pi}{4}\right)$.	[L2][CO2]	[5M]
	b) Expand $f(z) = \frac{1}{z^2 - z - 6}$ in Taylor's series about i) $z = -1$ ii) $z = 1$.	[L2][CO2]	[5M]
8	a) Find the Laurent expansion of $\frac{1}{z^2 - 4z + 3}$ for i) $1 < z < 3$ ii) $ z < 1$.	[L1][CO2]	[5M]
	b) Determine the poles of the function i) $\frac{z}{\cos z}$ ii) $\cot z$.	[L5][CO2]	[5M]
9	a) Find the poles of the function $f(z) = \frac{1}{(z+1)(z+3)}$ and residues at each poles.	[L1][CO2]	[5M]
	b) Find the residue of $f(z) = \frac{z^2}{(z-1)^2(z+2)}$ at each pole.	[L1][CO2]	[5M]
10	Evaluate $\oint_c \frac{4-3z}{z(z-1)(z-2)} dz$ where 'c' is circle $ z = \frac{3}{2}$ using residue theorem.	[L5][CO2]	[10M]
11	a) Evaluate $\oint_c \frac{z-3}{z^2+2z+5} dz$ where 'c' is circle given by $ z+1+i = 2$ using Residue theorem.	[L5][CO2]	[5M]
	b) Evaluate $\int_0^{2\pi} \frac{d\theta}{2+\cos\theta}$	[L5][CO2]	[5M]



UNIT –III**SOLUTION OF ALGEBRAIC & TRANSCENDENTAL EQUATIONS**

1	a) Find the root of the equation $x^2 - 5 = 0$ by using Bisection method.	[L1][CO3]	[2M]
	b) Write the formula to find the root of an equation by Regula Falsi method.	[L1][CO3]	[2M]
	c) Write the formula to find the root of an equation by Newton Raphson's method.	[L1][CO3]	[2M]
	d) Compare Jacoby and Gauss Seidel methods.	[L5][CO4]	[2M]
	e) Solve by Jacoby method [Only two iterations] $x + y = 3 ; 3x - 2y = 4$.	[L3][CO4]	[2M]
2	a) Find a positive root of the equation $x^3 - x - 1 = 0$ by Bisection method.	[L1][CO3]	[5M]
	b) Find out the square root of 25 given $x_0 = 2.0$, $x_1 = 7.0$ using Bisection method.	[L1][CO3]	[5M]
3	a) Find a positive root of the equation $x^4 - x - 10 = 0$ by iteration method.	[L1][CO3]	[5M]
	b) Solve $x^3 - 2x - 5 = 0$ for a positive root by iteration method.	[L3][CO3]	[5M]
4	Find the root of the equation $x e^x = 2$ using Regula-falsi method.	[L1][CO3]	[10M]
5	Find the root of the equation $x^3 - x - 4 = 0$ using False position method.	[L1][CO3]	[10M]
6	Find a real root of the equation $x \tan x + 1 = 0$ using Newton – Raphson method.	[L1][CO3]	[10M]
7	Find a real root of the equation $e^x \sin x = 1$ using Newton – Raphson method.	[L1][CO3]	[10M]
8	Solve the following system of equations by Jacobi method $27x + 6y - z = 85 ; x + y + 54z = 110 ; 6x + 15y + 2z = 72$.	[L3][CO4]	[10M]
9	Solve the following system of equations by Jacobi method $2x - 3y + 20z = 25 ; 20x + y - 2z = 17 ; 3x + 20y - z = -18$.	[L3][CO4]	[10M]
10	Apply Gauss-Siedel iteration method to solve the equations $20x + y - 2z = 17 ; 3x + 20y - z = -18 ; 2x - 3y + 20z = 25$.	[L3][CO4]	[10M]
11	Solve the following system of equations by Gauss-Siedel method $4x + 2y + z = 14 ; x + 5y - z = 10 ; x + y + 8z = 20$.	[L3][CO4]	[10M]



UNIT –IV

INTERPOLATION

1	a) Write Newton's forward interpolation formulae.	[L1][CO5]	[2M]												
	b) Construct a forward difference table for the function $y = x^2$ for $x = 0, 1, 2, 3$.	[L3][CO5]	[2M]												
	c) Write Lagrange's interpolation formulae.	[L1][CO5]	[2M]												
	d) State the two normal equation used in fitting a straight line.	[L1][CO5]	[2M]												
	e) Write the normal equations used in fitting a second degree polynomial.	[L1][CO5]	[2M]												
2	a) Using Newton's forward interpolation formula and the given table of values <table><tr><td>x</td><td>1</td><td>1.4</td><td>1.8</td><td>2.2</td></tr><tr><td>f(x)</td><td>3.49</td><td>4.82</td><td>5.96</td><td>6.5</td></tr></table> Obtain the value of $f(x)$ when $x=1.6$.	x	1	1.4	1.8	2.2	f(x)	3.49	4.82	5.96	6.5	[L3][CO5]	[5M]		
	x	1	1.4	1.8	2.2										
f(x)	3.49	4.82	5.96	6.5											
b) Applying Newton's forward interpolation formula, compute the value of $\sqrt{5.5}$ given that $\sqrt{5} = 2.236 ; \sqrt{6} = 2.449 ; \sqrt{7} = 2.646 ; \sqrt{8} = 2.828$.	[L3][CO5]	[5M]													
3	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>	x	0.10	0.15	0.20	0.25	0.30	y	0.1003	0.1511	0.2027	0.2553	0.3093	[L5][CO5]	[10M]
x	0.10	0.15	0.20	0.25	0.30										
y	0.1003	0.1511	0.2027	0.2553	0.3093										
4	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 $x=1.4$.	x	1.1	1.3	1.5	1.7	1.9	f(x)	0.21	0.69	1.25	1.89	2.61	[L3][CO5]	[5M]
	x	1.1	1.3	1.5	1.7	1.9									
f(x)	0.21	0.69	1.25	1.89	2.61										
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][CO5]	[5M]													
5	Using Lagrange's interpolation formula, find the value of $y(10)$ from the following table: <table><tr><td>x</td><td>5</td><td>6</td><td>9</td><td>11</td></tr><tr><td>y</td><td>12</td><td>13</td><td>14</td><td>16</td></tr></table>	x	5	6	9	11	y	12	13	14	16	[L3][CO5]	[10M]		
x	5	6	9	11											
y	12	13	14	16											
6	The values of a function $f(x)$ are given below for certain values of x . Find the values of $f(2)$ using Lagrange's interpolation formula. <table><tr><td>x</td><td>0</td><td>1</td><td>3</td><td>4</td></tr><tr><td>y</td><td>5</td><td>6</td><td>50</td><td>105</td></tr></table>	x	0	1	3	4	y	5	6	50	105	[L1][CO5]	[10M]		
x	0	1	3	4											
y	5	6	50	105											



7	By method of least squares fit a straight line to the following data ;	[L3][CO5]	[10M]																				
	<table><tr><td>X</td><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td></tr><tr><td>y</td><td>14</td><td>27</td><td>40</td><td>55</td><td>68</td></tr></table>	X	1	2	3	4	5	y	14	27	40	55	68										
X	1	2	3	4	5																		
y	14	27	40	55	68																		
8	Fit a straight line $y = a + bx$ for the following data	[L3][CO5]	[10M]																				
	<table><tr><td>X</td><td>6</td><td>7</td><td>7</td><td>8</td><td>8</td><td>8</td><td>9</td><td>9</td><td>10</td></tr><tr><td>Y</td><td>5</td><td>5</td><td>4</td><td>5</td><td>4</td><td>3</td><td>4</td><td>3</td><td>3</td></tr></table>	X	6	7	7	8	8	8	9	9	10	Y	5	5	4	5	4	3	4	3	3		
X	6	7	7	8	8	8	9	9	10														
Y	5	5	4	5	4	3	4	3	3														
9	Fit a second degree polynomial to the following data by method of least square	[L3][CO5]	[10M]																				
	<table><tr><td>X</td><td>0</td><td>1</td><td>2</td><td>3</td><td>4</td></tr><tr><td>y</td><td>1</td><td>1.8</td><td>1.3</td><td>2.5</td><td>6.3</td></tr></table>	X	0	1	2	3	4	y	1	1.8	1.3	2.5	6.3										
X	0	1	2	3	4																		
y	1	1.8	1.3	2.5	6.3																		
10	Obtain a second degree polynomial to the data by method of least square	[L3][CO5]	[10M]																				
	<table><tr><td>X</td><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td></tr><tr><td>Y</td><td>10</td><td>12</td><td>8</td><td>10</td><td>14</td></tr></table>	X	1	2	3	4	5	Y	10	12	8	10	14										
X	1	2	3	4	5																		
Y	10	12	8	10	14																		
11	Find the curve of best fit of the type $y = ae^{bx}$ to the following data by method of least squares	[L1][CO5]	[10M]																				
	<table><tr><td>X</td><td>1</td><td>5</td><td>7</td><td>9</td><td>12</td></tr><tr><td>Y</td><td>10</td><td>15</td><td>12</td><td>15</td><td>21</td></tr></table>	X	1	5	7	9	12	Y	10	15	12	15	21										
X	1	5	7	9	12																		
Y	10	15	12	15	21																		



UNIT –V**SOLUTION OF INITIAL VALUE PROBLEMS TO ORDINARY DIFFERENTIAL EQUATIONS**

1	a) Write Taylor's formula for $y(x_1)$ to solve $y' = f(x,y)$ with $y(x_0) = y_0$.	[L1][CO6]	[2M]
	b) State Euler formula to solve $y' = f(x,y)$, $y(x_0) = y_0$ at $x = x_0 + h$.	[L1][CO6]	[2M]
	c) Find $y^{(1)}(x)$, by Picard's method, given that $\frac{dy}{dx} = 1 + xy$; $y(0) = 1$.	[L1][CO6]	[2M]
	d) If $\frac{dy}{dx} = y - x$; $y(0) = 2, h = 0.2$ then Find the value of k_1 in R-K method of fourth order.	[L1][CO6]	[2M]
	e) Write the formula for Runge – Kutta method of fourth order.	[L1][CO6]	[2M]
2	Tabulate $y(0.1)$, $y(0.2)$ and $y(0.3)$ using Taylor's series method given that $y' = y^2 + x$ and $y(0) = 1$	[L3][CO6]	[10M]
3	Solve $y' = x + y$, given $y(1) = 0$ find $y(1.1)$ and $y(1.2)$ by Taylor's series method.	[L3][CO6]	[10M]
4	Find an approximate value of y for $x = 0.1, x = 0.2$ by Picard's method, given that $\frac{dy}{dx} = x + y$, $y(0) = 1$.	[L1][CO6]	[10M]
5	Find the values of $y(0.1)$ and $y(0.2)$ by Picard's method given that $y' = y - x^2$, $y(0) = 1$.	[L1][CO6]	[10M]
6	Solve by Euler's method $\frac{dy}{dx} = \frac{2y}{x}$ given $y(1)=2$ and find $y(2)$ and $y(3)$.	[L3][CO6]	[10M]
7	Solve by Euler's method $y' = y^2 + x$; $y(0) = 1$. and find $y(0.1)$ and $y(0.2)$	[L3][CO6]	[10M]
8	Using modified Euler's method find $y(0.2)$ and $y(0.4)$, given $y' = y + e^x$, $y(0) = 0$	[L3][CO6]	[10M]
9	Using Runge – Kutta method of fourth order, compute $y(0.2)$ from $y' = xy$; $y(0) = 1$, taking $h = 0.2$	[L3][CO6]	[10M]
10	Using Runge – Kutta method of fourth order, solve $\frac{dy}{dx} = x^2 - y$, $y(0) = 1$. Find $y(0.1)$ and $y(0.2)$.	[L3][CO6]	[10M]
11	Using Runge – Kutta method of fourth order, find $y(0.1)$ and $y(0.2)$ given that $\frac{dy}{dx} = x + y$, $y(0) = 1$.	[L3][CO6]	[10M]

Prepared by: Dept. of Mathematics



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