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Code No. : 13165 N/O (M)

**VASAVI COLLEGE OF ENGINEERING (AUTONOMOUS), HYDERABAD**

Accredited by NAAC with A++ Grade

**B.E. III-Semester Main and Backlog Examinations, Jan./Feb.-2024****Complex Variables (OE-I)**

Time: 3 hours

Max. Marks: 60

Note: Answer all questions from **Part-A** and any **FIVE** from **Part-B****Part-A (10 × 2 = 20 Marks)**

Q. No.	Stem of the question	M	L	CO	PO
1.	If $f(z) = \frac{z}{ z }$ for $z \neq 0$ and $f(0) = 0$ , check for its continuity at $z=0$ .	2	2	1	1,2,12
2.	Show that $f(z) = \operatorname{Re}(z)$ is continuous but not differentiable.	2	2	1	1,2,12
3.	Evaluate $\int  z ^2 dz$ along the real axis from $z = 0$ to $z = 2$	2	2	2	1,2,12
4.	State Cauchy's Integral formula.	2	1	2	1,2,12
5.	Define (i) singular point (ii) pole of order 'm' for a complex function	2	1	3	1,2,12
6.	Find out the zero(s) of the function $f(z) = \frac{z-2}{z^2} \sin \frac{1}{z-1}$	2	2	3	1,2,12
7.	State Cauchy's Residue theorem	2	1	4	1,2,12
8.	Determine poles of the function $\frac{z^2}{(z-1)(z-2)^2}$	2	2	4	1,2,12
9.	State necessary and sufficient condition for a complex function $f(z) = u + iv$ to be analytic.	2	1	1	1,2,12
10.	Evaluate $\int_0^{4+2i} \bar{z} dz$ along the curve $z = t^2 + it$ .	2	2	2	1,2,12
<b>Part-B (5 × 8 = 40 Marks)</b>					
11. a)	Find the values of 'a' and 'b' so that the function $f(z) = x^2 + ay^2 - 2xy + i(bx^2 - y^2 + 2xy)$ is analytic.	4	1	1	1,2,12
b)	Prove that $u(x, y) = \frac{1}{2} \log(x^2 + y^2)$ is harmonic. Find its harmonic conjugate.	4	2	1	1,2,12
12. a)	Evaluate $\oint_c \frac{4-3z}{z(z-1)(z-2)} dz$ where 'c' is the circle $ z  = \frac{3}{2}$	4	4	2	1,2,12
b)	State and prove Cauchy's theorem.	4	1	2	1,2,12
13. a)	Expand the function $\frac{1}{z^2-3z+2}$ in the region (i) $ z  < 1$ (ii) $1 <  z  < 2$	4	3	3	1,2,12
b)	Classify all the singular points of the function $\frac{1}{z-z^3}$	4	2	3	1,2,12

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14. a)	Determine the poles of the following function and residues at each pole. $f(z) = \frac{z-1}{(z+1)^2(z-2)}$	4	2	4	1,2,12
b)	Find the sum of the residues of the function $f(z) = \frac{\sin z}{z \cos z}$ at its poles inside the circle $ z  = 2$ .	4	4	4	1,2,12
15. a)	Find an analytic function whose imaginary part is $e^{-x}(x \cos y + y \sin y)$	4	2	1	1,2,12
b)	Evaluate $\oint_C \frac{e^z}{(z^2 + \pi^2)^2} dz$ where $C$ is $ z  = 4$	4	4	2	1,2,12
16. a)	Find the Laurent's series which represent the function $\frac{z^2-1}{(z+2)(z+3)}$ in (i) $2 <  z  < 3$ (ii) $ z  > 3$	4	3	3	1,2,12
b)	Evaluate $\oint_C \frac{1+z}{z(2-z)} dz$ using residue theorem where $C$ is the circle $ z  = 1$	4	4	4	1,2,12
17.	Answer any <b>two</b> of the following:				
a)	If $u - v = (x - y)(x^2 + 4xy + y^2)$ and $f(z) = u + iv$ is an analytic function of $z = x + iy$ , find $f(z)$ in terms of $z$ .	4	2	1	1,2,12
b)	Evaluate $\oint_C \frac{z+1}{z^2-9} dz$ ; $C:  z+3  = 1$	4	4	2	1,2,12
c)	Find Taylor's series expansion of $f(z) = \frac{z+1}{(z-3)(z-4)}$ about the point $z =$	4	3	3	1,2,12
	2. Also determine the region of convergence.				

M : Marks; L: Bloom's Taxonomy Level; CO; Course Outcome; PO: Programme Outcome

i)	Blooms Taxonomy Level - 1	20%
ii)	Blooms Taxonomy Level - 2	40%
iii)	Blooms Taxonomy Level - 3 & 4	40%

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