# SRM INSTITUTE OF SCIENCE & TECHNOLOGY RAMAPURAM CAMPUS DEPARTMENT OF MATHEMATICS CONTINUOUS ASSESSMENT – 3

* Required

Answer ALL Questions

Each question carries ONE mark.

1. *

Cauchy – Riemann equation in Cartesian co-ordinates are

(A) $u_x = v_y, u_y = -v_x$ (B) $u_x = -v_y, u_y = v_x$

(C) $u_x = v_y, u_y = v_x$ (D) $u_x = -v_y, u_y = -v_x$

- (●) A
- ( ) B
- ( ) C
- ( ) D

2. *

| The transformation $w = a\,z$, where $a$ is a real constant represents | |
|---|---|
| (A) magnification | (B) rotation |
| (C) reflection | (D) inversion |

- [x] A
- [ ] B
- [ ] C
- [ ] D

3. *

| The real part of $f\,(z) = e^{2\,z}$ is | |
|---|---|
| (A) $e^{x}\cos y$ | (B) $e^{x}\sin y$ |
| (C) $e^{2x}\cos 2y$ | (D) $e^{2x}\sin 2y$ |

- [ ] A
- [ ] B
- [x] C
- [ ] D

4. *

An analytic function with constant real part is

| | |
|---|---|
| (A) zero | (B) analytic |
| (C) harmonic | (D) constant |

- ○ A
- ○ B
- ○ C
- ◉ D

5. *

A mapping that preserves angles between every pair of curves through a point, both in magnitude and direction is called a ________________ mapping.

| | |
|---|---|
| (A) isogonal | (B) conformal |
| (C) regular | (D) formal |

- ○ A
- ◉ B
- ○ C
- ○ D

6. *

If $w = f(z) = u + iv$ is an analytic function with constant imaginary part, then $f(z)$ is

| | |
|---|---|
| (A) zero | (B) analytic |
| (C) harmonic | (D) constant |

- ( ) A
- ( ) B
- ( ) C
- (•) D

7. *

The points at which the function $f(z) = \frac{1}{z^2 - 1}$ fails to be analytic are

| | |
|---|---|
| (A) $z = \pm i$ | (B) $z = \pm 1$ |
| (C) $z = \pm 2$ | (D) $z = \pm 3$ |

- ( ) A
- (•) B
- ( ) C
- ( ) D

8. *

The fixed points of the transformation $w = \dfrac{z-1}{z+1}$ are

| | |
|---|---|
| (A) $\pm i$ | (B) $\pm 1$ |
| (C) $\pm 2$ | (D) $\pm 3$ |

- (●) A
- ( ) B
- ( ) C
- ( ) D

9. *

The harmonic conjugate of $u = e^x \cos y$ is

| | |
|---|---|
| (A) $e^x \sin y$ | (B) $e^{2x} \sin y$ |
| (C) $e^{2x} \cos 2y$ | (D) $e^{2x} \sin 2y$ |

- (●) A
- ( ) B
- ( ) C
- ( ) D

10. *

| The critical point of the transformation $w = z^2$ is | |
|---|---|
| (A) $z = 0$ | (B) $z = -i$ |
| (C) $z = 1$ | (D) $z = -1$ |

- (●) A
- ( ) B
- ( ) C
- ( ) D

11. *

| The function $f(z) = \bar{z}$ is | |
|---|---|
| (A) not analytic | (B) analytic |
| (C) constant | (D) equal to 1 |

- (●) A
- ( ) B
- ( ) C
- ( ) D

12. *

If $w = f(z) = u + iv$ is an analytic function, then

(A) $\nabla^2 |f(z)|^2 = 4|f'(z)|^2$ (B) $\nabla^2 |f'(z)|^2 = 4|f(z)|^2$

(C) $\nabla^2 |f'(z)| = 2|f(z)|$ (D) $\nabla^2 |f(z)|^2 = 2|f'(z)|^2$

- [x] A
- [ ] B
- [ ] C
- [ ] D

13. *

The transformation $w = f(z) = a\,z$, where $a$ is a complex constant represents

(A) magnification (B) rotation

(C) both magnification and rotation (D) reflection

- [ ] A
- [ ] B
- [x] C
- [ ] D

14. *

| If $w = f(z) = u + i\ v$ is an analytic function of $z$, then | |
|---|---|
| (A) $u$ and $v$ are not harmonic | (B) $u$ is not harmonic |
| (C) both $u$ and $v$ are harmonic | (D) $v$ is not harmonic |

- ○ A
- ○ B
- ◉ C
- ○ D

15. *

| If $w = f(z) = u + iv$ is analytic, then the family of curves $u = C_1$ and $v = C_2$ where $C_1$ and $C_2$ are constants | |
|---|---|
| (A) cut orthogonally | (B) intersect each other |
| (C) is parallel | (D) coincide |

- ◉ A
- ○ B
- ○ C
- ○ D

16. *

If $z_1$, $z_2$, $z_3$ and $z_4$ are four points in the z-plane, then the cross-ratio of these points is

(A) $\dfrac{(z_1-z_3)(z_4-z_2)}{(z_1-z_2)(z_3-z_4)}$ (B) $\dfrac{(z_1-z_2)(z_4-z_2)}{(z_1-z_2)(z_3-z_2)}$

(C) $\dfrac{(z_1-z_4)(z_3-z_2)}{(z_1-z_2)(z_3-z_4)}$ (D) $\dfrac{(z_1-z_2)(z_3-z_4)}{(z_1-z_4)(z_3-z_2)}$

- ○ A
- ○ B
- ○ C
- ◉ D

17. *

The invariant points of the transformation $w=\dfrac{6z-9}{z}$ are

(A) 3, 3 (B) 6, 9

(C) 0, 6 (D) 3, −3

- ◉ A
- ○ B
- ○ C
- ○ D

18. *

If a function $v(x,y)$ satisfies the equation $\frac{\partial^2 v}{\partial x^2}+\frac{\partial^2 v}{\partial y^2}=0$, then $v$ is said to be

| | |
|---|---|
| (A) analytic function | (B) harmonic function |
| (C) differential function | (D) continuous function |

- ○ A
- ◉ B
- ○ C
- ○ D

19. *

The condition for the function $f(z) = u + iv$ to be analytic in polar form is

| | |
|---|---|
| (A) $u_r = \frac{1}{r} v_\theta,\ v_r = -\frac{1}{r} u_\theta$ | (B) $u_r = -\frac{1}{r} v_\theta,\ v_r = \frac{1}{r} u_\theta$ |
| (C) $u_r = -\frac{1}{r} v_\theta,\ v_r = -\frac{1}{r} u_\theta$ | (D) $u_r = \frac{1}{r} v_\theta,\ v_r = \frac{1}{r} u_\theta$ |

- ◉ A
- ○ B
- ○ C
- ○ D

20. *

If $w = f(z) = u + iv$ is an analytic function with constant modulus, then $f(z)$ is

| | |
|---|---|
| (A) zero | (B) analytic |
| (C) harmonic | (D) constant |

- ○ A
- ○ B
- ○ C
- ◉ D

21. *

A point at which the mapping $w = f(z)$ is not conformal is called

| | |
|---|---|
| (A) fixed point | (B) critical point |
| (C) singular point | (D) regular point |

- ○ A
- ○ B
- ◉ C
- ○ D

22. *

The critical points of the transformation $w = z + \frac{1}{z}$ are

| | |
|---|---|
| (A) $\pm i$ | (B) $\pm 1$ |
| (C) $\pm 2$ | (D) $\pm 3$ |

- ○ A
- ◉ B
- ○ C
- ○ D

23. *

The transformation $w = \dfrac{az+b}{cz+d}$ where $a, b, c, d$ are complex constants is said to be bilinear, if

| | |
|---|---|
| (A) $ad-bc=0$ | (B) $ad-bc\neq 0$ |
| (C) $ad-bc<0$ | (D) $ad-bc>0$ |

- ○ A
- ◉ B
- ○ C
- ○ D

24. *

Any function which has continuous second order partial derivatives and which satisfies Laplace equation is called ____________

(A) Harmonic function (B) Beta function

(C) Gamma function (D) Alpha function

- (●) A
- ( ) B
- ( ) C
- ( ) D

25. *

The fixed points of the transformation $w = \frac{5z+4}{z+5}$ are

(A) $\pm i$ (B) $\pm 1$

(C) $\pm 2$ (D) $\pm 3$

- ( ) A
- ( ) B
- (●) C
- ( ) D

26. *

| The point $z_0$ at which a function $f(z)$ is not analytic is known as | |
|---|---|
| (A) zeros | (B) critical point |
| (C) singular point | (D) fixed point |

- ○ A
- ○ B
- ◉ C
- ○ D

27. *

| The singular points of $f(z) = \frac{z+3}{(z-3)(z-2)}$ are | |
|---|---|
| (A) $z = 1,3$ | (B) $z = 1,0$ |
| (C) $z = 1,2$ | (D) $z = 2,3$ |

- ○ A
- ○ B
- ○ C
- ◉ D

28. *

The residue of $f(z) = \frac{z}{z-1}$ at its pole is

| | |
|---|---|
| (A) 0 | (B) 1 |
| (C) $-1$ | (D) $2\pi i$ |

- ○ A
- ◉ B
- ○ C
- ○ D

29. *

The function $f(z) = \frac{1}{(z+2)^4 (z-3)^2 (z-1)}$ has pole of order 2 at the point

| | |
|---|---|
| (A) $z = 4$ | (B) $z = -3$ |
| (C) $z = 1$ | (D) $z = 3$ |

- ○ A
- ○ B
- ○ C
- ◉ D

30. *

If $f(z) = \frac{\sin z}{z}$, then the singular point of $f(z)$ is

| | |
|---|---|
| (A) $z = 0$ | (B) $z = \pi$ |
| (C) $z = 2\pi i$ | (D) $z = -2\pi i$ |

- (selected) A
- B
- C
- D

31. *

If $C : |z - a| = r$ is a circle, then $f(z)$ can be expanded as a Taylor's series if

(A) $f(z)$ is an analytic function at all points within $C$
(B) $f(z)$ is not an analytic function
(C) $f(z)$ is an analytic function outside $C$
(D) $f(z)$ is not an analytic function outside $C$

- (selected) A
- B
- C
- D

32. *

| The value of $\oint_C \frac{\cos z}{z-3} dz$ where C is a circle $\lvert z \rvert = 2$ is | |
|---|---|
| (A) 0 | (B) 1 |
| (C) $e$ | (D) $2\pi i$ |

- (selected) A
- B
- C
- D

33. *

| A singular point $z = z_0$ is called ________________ singular point of $f(z)$, if there is no other singular point in the neighbourhood of $z_0$. | |
|---|---|
| (A) removable | (B) isolated |
| (C) essential | (D) non-removable |

- A
- (selected) B
- C
- D

34. *

The singular points of the function $f(z) = \frac{1}{z\,(z-2)}$ are

(A) $z = 0, 2$ (B) $z = 1, 2$

(C) $z = -1$ (D) $z = 2\pi i$

- [x] A
- [ ] B
- [ ] C
- [ ] D

35. *

If $z = z_0$ is a pole of order $n$, then the residue of $f(z)$ is

(A) $\operatorname{Res}[f(z), z_0] = \frac{1}{(n-1)!} \lim_{z \to z_0} \frac{d^{n-1}}{dz^{n-1}} (z - z_0)^n f(z)$

(B) $\operatorname{Res}[f(z), z_0] = \frac{1}{n!} \lim_{z \to z_0} \frac{d^{n-1}}{dz^{n-1}} (z - z_0)^n f(z)$

(C) $\operatorname{Res}[f(z), z_0] = \frac{1}{(n-1)!} \lim_{z \to z_0} \frac{d^{n-1}}{dz^{n-1}} f(z)$

(D) $\operatorname{Res}[f(z), z_0] = \frac{1}{(n+1)!} \lim_{z \to z_0} \frac{d}{dz} (z - z_0) f(z)$

- [x] A

- B
- C
- D

36, *

The residue of $f(z) = \frac{1}{z-1}$ at its pole $z = 1$ is

| | |
|---|---|
| (A) 0 | (B) 1 |
| (C) $-1$ | (D) $2\pi i$ |

- A
- B (selected)
- C
- D

37. *

The value of $\oint_C \frac{e^z}{(z-1)^3}\, dz$, where $C : |z| = \frac{1}{2}$ is

| | |
|---|---|
| (A) 0 | (B) $\frac{1}{4}$ |
| (C) $\frac{1}{2}$ | (D) $\frac{1}{3}$ |

- A (selected)
- B
- C
- D

38. *

| The singularity of $f(z) = \frac{z}{(z-2)^3}$ is | |
|---|---|
| (A) $z = 2$ is a pole of order 2 | (B) $z = 2$ is a pole of order 3 |
| (C) $z = 2$ is a simple pole | (D) $z = 2$ is pole of order 1 |

- ○ A
- ◉ B
- ○ C
- ○ D

39. *

| The value of $\oint_C \frac{3z^2+7z+1}{z+1} dz$ where C is $\lvert z \rvert = \frac{1}{2}$ using Cauchy's residue theorem is | |
|---|---|
| (A) 0 | (B) $2\pi i$ |
| (C) $-2\pi i$ | (D) 1 |

- ◉ A
- ○ B
- ○ C
- ○ D

40. *

The value of $\oint_C \frac{dz}{z-1}$ where C is the circle $|z-1|=1$ is

| | |
|---|---|
| (A) 0 | (B) $2\pi i$ |
| (C) $-2\pi i$ | (D) $\pi i$ |

- ○ A
- ◉ B
- ○ C
- ○ D

41. *

The annular region for the function $f(z) = \frac{1}{z(z-1)}$ is

| | |
|---|---|
| (A) $0 < \lvert z \rvert < 1$ | (B) $1 < \lvert z \rvert < 2$ |
| (C) $2 < \lvert z \rvert < 3$ | (D) $\lvert z \rvert > 1$ |

- ◉ A
- ○ B
- ○ C
- ○ D

42. *

The value of $\oint_C \frac{1}{z-4} dz$ where C is $|z-2| = 1$ by Cauchy's integral formula is __________.

| | |
|---|---|
| (A) $\pi i$ | (B) $4\pi i$ |
| (C) 0 | (D) $2\pi i$ |

- ○ A
- ○ B
- ◉ C
- ○ D

43. *

If $f(z)$ is analytic inside and on $C$, then the value of $\oint_C \frac{f(z)}{(z-a)^2} dz$, where $C$ is a simple closed curve and '$a$' is any point within $C$ is

| | |
|---|---|
| (A) 0 | (B) $2\pi i\, f'(a)$ |
| (C) $-2\pi i\, f(a)$ | (D) 1 |

- ○ A
- ◉ B
- ○ C
- ○ D

44. *

| The value of $\oint_C \frac{z}{z-2}\,dz$ where C is the circle $|z| = 3$ is | |
|---|---|
| (A) 0 | (B) $4\pi i$ |
| (C) $-2\pi i$ | (D) 1 |

- ( ) A
- (•) B
- ( ) C
- ( ) D

45. *

| The residue of $f(z) = \frac{z-2}{z(z-1)}$ at $z = 1$ is | |
|---|---|
| (A) 0 | (B) $-2$ |
| (C) 2 | (D) $-1$ |

- ( ) A
- ( ) B
- ( ) C
- (•) D

46. *

If $f(z)$ is analytic inside and on $C$, then the value of $\oint_C \frac{f(z)}{(z-a)^n} dz$, where $C$ is a simple closed curve and '$a$' is any point within $C$ is

| | |
|---|---|
| (A) 0 | (B) $\frac{2\pi i}{n!} f^n(a)$ |
| (C) $-\frac{2\pi i}{n!} f^{n+1}(a)$ | (D) $\frac{2\pi i}{(n-1)!} f^{n-1}(a)$ |

- [ ] A
- [ ] B
- [ ] C
- [x] D

47. *

If $f(z)$ is analytic and $f'(z)$ is continuous at all points inside and on a simple closed curve $C$, then $\oint_C f(z)\,dz =$

| | |
|---|---|
| (A) 0 | (B) $2\pi i$ |
| (C) $-2\pi i$ | (D) 1 |

- [x] A
- [ ] B
- [ ] C

D

48. *

| The value of $\oint_C \frac{2z}{z-1} dz$ where $C$ is $\lvert z \rvert = 1$ by Cauchy's integral formula is | |
|---|---|
| (A) 1 | (B) $4\pi i$ |
| (C) 0 | (D) $2\pi i$ |

A

B (selected)

C

D

49. *

| The value of $\oint_C \frac{z^2}{(z-1)^2(z+1)} dz$, where $C : \lvert z \rvert = \frac{1}{2}$ is | |
|---|---|
| (A) 0 | (B) $\frac{1}{4}$ |
| (C) $\frac{1}{2}$ | (D) $\frac{1}{3}$ |

A (selected)

B

C

D

50. *

The function $f(z) = \dfrac{z+1}{(z-1)(z+2)}$ has a zero at

| | |
|---|---|
| (A) $z = 1$ | (B) $z = 2$ |
| (C) $z = -2$ | (D) $z = -1$ |

- ○ A
- ○ B
- ○ C
- ◉ D

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