

18MAB102T-CLAT3 - B SLOT - Advanced Calculus and Complex Analysis

Date of Examination: 29/07/2021

Time: 9.00 am - 10.40 am

Max. Mark: 50 Max. time:100 Min

The respondent's email (**null**) was recorded on submission of this form.

*** Required**

1. Email *

2. Name of the Student *

3. Registration Number *

4. Department *

18MAB102T-CLAT3 - B SLOT -Advanced Calculus and Complex Analysis

MCQ Questions
Each question carry one mark

5. *

A single valued continuous function $f(z) = u + iv$ is analytic in a region R if it satisfy the C-R equations at each point and also possess one of the following

a. $u_x = v_y$

b. $v_x = u_y$

c. continuous u_x, u_y in a region R

d. continuous u_x, u_y, v_x, v_y at each point of the region R

Mark only one oval.

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6. *

If $f(z) = r^2(\cos 2\theta + i \sin p\theta)$ is analytic, then the value of p is

a. $\frac{1}{2}$

b. 0

c. 2

d. 1

Mark only one oval.

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7. *

$f(z) = |z|^2$ is analytic at

- a. at the origin
- b. at infinity
- c. at all points of z -plane
- d. nowhere

Mark only one oval.

- ☐ a
- ☐ b
- ☐ c
- ☐ d

8. *

If $f(z) = u + iv$ is an analytic function of z then the Cauchy Riemann equations is

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. $u_x = -v_y, u_y = v_x$

Mark only one oval.

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9. *

If $w = z + \frac{1}{z}$ then $\frac{dw}{dz}$ is

a. $1 + \frac{1}{z^2}$

b. $1 - \frac{1}{z^2}$

c. $1 + \frac{1}{z}$

d. $1 - \frac{1}{z}$

Mark only one oval.

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10. *

If $f(z)$ is analytic with the real part $e^x \cos y$ then $f'(z)$ is equal to

a. $\cos z$

b. $-e^z$

c. e^z

d. $\sin z$

Mark only one oval.

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11. *

The mapping $w = z + c$ gives

- a. Translation
- b. Rotation
- c. inversion
- d. reflection

Mark only one oval.

- ☐ a
- ☐ b
- ☐ c
- ☐ d

12. *

Under the mapping $w = \frac{1}{z}$, the image of $|z| \leq 1$ is

a. $|w| \geq 1$

b. $|w| = 1$

c. $|w| > 1$

d. $|w - 1| = 1$

Mark only one oval.

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13. *

Critical point of the map $w^2 = (z - \alpha)(z - \beta)$ are

a. $z = \frac{1}{2}(\alpha + \beta)$

b. $z = \frac{\alpha\beta}{2}$

c. $z = (\alpha + \beta)$

d. $z = \frac{1}{2}(\alpha - \beta)$

Mark only one oval.

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14. *

If $u + iv$ is analytic then $v - iu$ is

- a. analytic
- b. not analytic
- c. analytic only at the origin
- d. analytic except at the origin

Mark only one oval.

- ☐ a
- ☐ b
- ☐ c
- ☐ d

15. *

Construction of an analytic functions $f(z)$ when real part is given using Milne's Thomson method $u_x = \phi_1(x, y)$, $u_y = \phi_2(x, y)$,

$$v_x = \Psi_2(x, y), v_y = \Psi_1(x, y)$$

a. $f(z) = \int [\phi_1(z, 0) - i\phi_2(z, 0)]dz + c$

b. $f(z) = \int [\phi_1(z, 0) + i\phi_2(z, 0)]dz + c$

c. $f(z) = \int [\Psi_1(z, 0) + i\Psi_2(z, 0)]dz + c$

d. $f(z) = \int [\Psi_1(z, 0) - i\Psi_2(z, 0)]dz + c$

Mark only one oval.

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☐ d

16. *

$$\nabla^2 \{ \log |f(z)| \} =$$

a. 2

b. 0

c. 1

d. 3

Mark only one oval.

☐ a☐ b☐ c☐ d

17. *

The region in which $f(z) = (x - y)^2 + 2i(x + y)$ is analytic

a. $x + y = 1$

b. $x = 1$

c. $x - y = 1$

d. $y = 1$

Mark only one oval.

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☐ d

18. *

Find an analytic function $f(z)$ whose real part is $u = e^x \sin y$

a. $e^z + c$

b. $-e^z + c$

c. $-(1+i)e^z + c$

d. $-ie^z + c$

Mark only one oval.

☐ a☐ b☐ c☐ d

19. *

Find the analytic function $f(z)$ where $v = x^4 - 6x^2y^2 + y^4$

a. $iz^4 + c$

b. $iz^3 + c$

c. $-iz^4 + c$

d. $-iz^3 + c$

Mark only one oval.

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☐ c

☐ d

20. *

If $u(x, y)$ is a real part of analytic function and satisfies $u_{xx} + u_{yy} = 0$, then u is

- a. Harmonic
- b. Analytic
- c. Differentiable
- d. continuous

Mark only one oval.

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21. *

The invariant point of the transformation $w = \frac{1}{z+2i}$ is

a. $z = i$

b. $z = -i$

c. $z = 1$

d. $z = -1$

Mark only one oval.

☐ a

☐ b

☐ c

☐ d

22. *

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

a. $z = \pm 1$

b. $z = \pm i$

c. $z = \pm 2$

d. $z = 1$

Mark only one oval.

☐ a☐ b☐ c☐ d

23. *

The critical points of the transformation $w = \frac{1}{2}\left(z + \frac{1}{z}\right)$

a. $z = \pm 1$

b. $z = \pm i$

c. $z = \pm 2$

d. $z = 1$

Mark only one oval.

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24. *

The bilinear transformation that maps the points $z = 0, 1, \infty$ into the points $w = -5, -1, 3$ respectively is

a. $w = \frac{3z-5}{z-1}$

b. $w = \frac{3z-5}{z+1}$

c. $w = \frac{2z+5}{z+1}$

d. $w = \frac{z-5}{z+1}$

Mark only one oval.

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☐ c

☐ d

25. *

The invariant points of the transformation $w = \frac{2z-5}{z+4}$ are

a. $z = \pm i$

b. $-1 \pm 2i$

c. $1 \pm 2i$

d. $-1 \pm i$

Mark only one oval.

☐ a

☐ b

☐ c

☐ d

26. *

An analytic function with constant modulus is

- a. Zero
- b. constant
- c. Analytic
- d. harmonic

Mark only one oval.

- ☐ a
- ☐ b
- ☐ c
- ☐ d

27. *

 $w = \log z$ is

- a. analytic at all points
- b. not analytic at the origin
- c. nowhere analytic
- d. analytic at infinity

Mark only one oval.

- ☐ a
- ☐ b
- ☐ c
- ☐ d

28. *

If $f(z) = u + iv$ is analytic at a point then which of the following is not true?

- a. $u_x = v_y$ at the point
- b. $u_y = -v_x$ at the point
- c. $u_{xx} + u_{yy} \neq 0$ at the point
- d. u_x, u_y, v_x, v_y are continuous at the point

Mark only one oval.

☐ a☐ b☐ c☐ d

29. *

The bilinear transformation which maps the points $\infty, i, 0$ into $0, i, \infty$ respectively is

a. $w = z$

b. $w = -z$

c. $w = -\frac{1}{z}$

d. $w = \frac{1}{z}$

Mark only one oval.

☐ a☐ b☐ c☐ d

30. *

A continuous curve which does not have a point of self-intersection is called
a

- a. Curve
- b. Closed curve
- c. Simple closed curve
- d. Multiple curve

Mark only one oval.

- ☐ a
- ☐ b
- ☐ c
- ☐ d

31. *

The zero's of $f(z) = \frac{z^2+1}{1-z^2}$ are

a. 0

b. $\pm i$

c. ± 1

d. 1

Mark only one oval.

☐ a

☐ b

☐ c

☐ d

32. *

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

- a. $f(a)$
- b. $2\pi i f(a)$
- c. $\pi i f(a)$
- d. 0

Mark only one oval.

- ☐ a
- ☐ b
- ☐ c
- ☐ d

33. *

If $f(z)$ is analytic inside and on C , then the value of $\oint_C \frac{f(z)}{(z-a)^5} dz$, where C is the simple closed curve and a is any point within C is

a. $2\pi i \frac{f^{(5)}(a)}{5!}$

b. $2\pi i f(a)$

c. $2\pi i \frac{f^{(4)}(a)}{4!}$

d. 0

Mark only one oval.

☐ a

☐ b

☐ c

☐ d

34. *

The value of $\oint_C \frac{e^{-z}}{z+1} dz$ where C is the circle $|z| = \frac{1}{3}$ is

a. 0

b. $2\pi i e$ c. $\frac{\pi}{2} i e$ d. $\pi i e$

Mark only one oval.

☐ a☐ b☐ c☐ d

35. *

The value of $\oint_C \frac{e^{2z}}{(z+1)^3} dz$ where C is the circle $|z| = 2$ is

a. 0

b. $2\pi i e^{-2}$

c. $8\pi i e^{-2}$

d. $4\pi i e^{-2}$

Mark only one oval.

☐ a☐ b☐ c☐ d

36. *

The value of $\oint_C \frac{1}{2z-3} dz$ where C is the circle $|z| = 1$ is

a. 0

b. $2\pi i$

c. $\frac{\pi}{2}i$

d. πi

Mark only one oval.

☐ a☐ b☐ c☐ d

37. *

The value of $\oint_C \frac{z^2}{(z-2)^2} dz$ where C is the circle $|z| = 3$ is

a. 0

b. $2\pi i$ c. $4\pi i$ d. $8\pi i$

Mark only one oval.

☐ a☐ b☐ c☐ d

38. *

Let $C_1: |z - a| = R_1$ and $C_2: |z - a| = R_2$ be two concentric circles ($R_2 < R_1$), the annular region is defined as

- a. Within C_1
- b. Within C_2
- c. Within C_2 and outside C_1
- d. Within C_1 and outside C_2

Mark only one oval.

☐ a☐ b☐ c☐ d

39. *

The part $\sum_{n=1}^{\infty} b_n(z-a)^{-n}$ consisting of negative integral powers of $(z-a)$ is called as

- a. The analytic part of the Laurent's series
- b. The principal part of the Laurent's series
- c. The real part of the Laurent's series
- d. The imaginary part of the Laurent's series

Mark only one oval.

- ☐ a
- ☐ b
- ☐ c
- ☐ d

40. *

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

- a. $f(z)$ is a function on C
- b. $f(z)$ is an analytic function within C
- c. $f(z)$ is not an analytic function within C
- d. $f(z)$ is an analytic function outside C

Mark only one oval.

- ☐ a
- ☐ b
- ☐ c
- ☐ d

41. *

Expansion of $\frac{\sin z}{(z-\pi)}$ in Taylor's series about $z = \pi$ is

a. $\frac{(z-\pi)}{1!} - \frac{(z-\pi)^3}{3!} + \frac{(z-\pi)^5}{5!} - \dots$

b. $\frac{(z-\pi)^2}{2!} - \frac{(z-\pi)^4}{4!} + \frac{(z-\pi)^6}{6!} - \dots$

c. $-1 + \frac{(z-\pi)^2}{3!} - \frac{(z-\pi)^4}{5!} + \dots$

d. $\frac{(z-\pi)}{2!} + \frac{(z-\pi)^3}{4!} - \frac{(z-\pi)^5}{6!} + \dots$

Mark only one oval.

☐ a

☐ b

☐ c

☐ d

42. *

The annular region for the function $f(z) = \frac{1}{z^2 - z - 6}$ is

a. $0 < |z| < 1$

b. $1 < |z| < 2$

c. $2 < |z| < 3$

d. $|z| < 3$

Mark only one oval.

☐ a

☐ b

☐ c

☐ d

43. *

The Laurent's series expansion $-\frac{1}{2}\sum \frac{(z+2)^n}{4^n} - \sum \frac{3^n}{(z+2)^n}$ for the function

$f(z) = \frac{z}{(z-1)(z-2)}$ is valid in the region

- a. $|z + 2| < 3$
- b. $1 < |z + 2| < 2$
- c. $3 < |z + 2| < 4$
- d. $|z + 2| > 4$

Mark only one oval.

- ☐ a
- ☐ b
- ☐ c
- ☐ d

44. *

If $f(z)$ is not analytic at $z = z_0$ and there exists $\lim_{z \rightarrow z_0} f(z)$ and is finite then

- a. The point $z = z_0$ is isolated singularity of $f(z)$
- b. The point $z = z_0$ is a removable singularity of $f(z)$
- c. The point $z = z_0$ is essential singularity of $f(z)$
- d. The point $z = z_0$ is non isolated singularity of $f(z)$

Mark only one oval.

- ☐ a
- ☐ b
- ☐ c
- ☐ d

45. *

Let $z = a$ is a simple pole for $f(z)$ and $b = \lim_{z \rightarrow a} (z - a)f(z)$, then

- a. b is a simple pole
- b. b is removable singularity
- c. b is a residue at a of order n
- d. b is a residue at $z = a$

Mark only one oval.

- ☐ a
- ☐ b
- ☐ c
- ☐ d

46. *

Let $z = a$ is a pole of order m for $f(z)$, then the residue is

- a. $\lim_{z \rightarrow a} [(z - a)f(z)]$
- b. $\lim_{z \rightarrow a} [(z - a)f''(z)]$
- c. $\lim_{z \rightarrow a} \frac{1}{(m-1)!} \frac{d^{m-1}}{dz^{m-1}} [(z - a)^m f(z)]$
- d. $\lim_{z \rightarrow a} \frac{1}{m!} \frac{d^m}{dz^m} [(z - a)^m f(z)]$

Mark only one oval.

- ☐ a
- ☐ b
- ☐ c
- ☐ d

47. *

The residue of $f(z) = \frac{z}{(z-1)^2}$ at $z = 1$ is

a. π

b. 1

c. -1

d. 0

Mark only one oval.

☐ a☐ b☐ c☐ d

48. *

The residue of $f(z) = \frac{z}{z^2+1}$ at $z = i$ is

a. 1

b. -1

c. 0

d. 1/2

Mark only one oval.

☐ a☐ b☐ c☐ d

49. *

If $f(z) = \frac{\sin z}{z}$, then

- a. $z = 0$ is a simple pole
- b. $z = 0$ is a pole of order 2
- c. $z = 0$ is a removable singularity
- d. $z = 0$ is a zero of $f(z)$

Mark only one oval.

- ☐ a
- ☐ b
- ☐ c
- ☐ d

50. *

The value of the integral $\oint_C e^z dz$ where $|z| = 1$ is

a. $2\pi i$

b. $\frac{\pi}{2}i$

c. πi

d. 0

Mark only one oval.

☐ a☐ b☐ c☐ d

51. *

If $f(z) = \frac{-1}{(z-1)} - 2[1 + (z-1) + (z-1)^2 + \dots]$ then the residue of $f(z)$ at $z = 1$ is

a. 1

b. -1

c. 0

d. -2

Mark only one oval.

☐ a☐ b☐ c☐ d

52. *

If the integral $\oint_0^{2\pi} \frac{d\theta}{5+3\cos\theta} = \oint_C f(z)dz$, C is $|z| = 1$, then

(A) $z = -\frac{1}{3}$ lies inside C and

(B) $z = 3$ lies outside C . Which of the following is true.

- a. Both A and B
- b. Only A
- c. Only B
- d. Neither A nor B

Mark only one oval.

- ☐ a
- ☐ b
- ☐ c
- ☐ d

53. *

In Cauchy's Lemma for contour integration, if $f(z)$ be continuous function such that $|zf(z)| \rightarrow 0$ as $|z| \rightarrow \infty$, for C is the circle $|z| = R$, then

a. $\oint_C f(z) dz \rightarrow \infty$ as $R \rightarrow \infty$.

b. $\oint_C f(z) dz \rightarrow 0$ as $R \rightarrow \infty$.

c. $\oint_C f(z) dz \rightarrow 0$ as $R \rightarrow 0$.

d. $\oint_C f(z) dz \rightarrow \infty$ as $R \rightarrow 0$.

Mark only one oval.

☐ a

☐ b

☐ c

☐ d

54. *

If $\oint_C \frac{e^z}{z^2} dz = 0$, then C is

- a. $|z| = 1$
- b. $|z - 1| = 2$
- c. $|z - 2| = 1$
- d. $|z| = 2$

Mark only one oval.

- ☐ a
- ☐ b
- ☐ c
- ☐ d

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