REV-00
MSM/17/22

2016/12

M.Sc. MATHEMATICS
First Semester
COMPLEX ANALYSIS
(MSM - 102)

Duration: 3Hrs. **Full Marks: 70**

Part-A (Objective) =20
Part-B (Descriptive) =50

(PART-B: Descriptive)

Duration: 2 hrs. 40 mins. **Marks: 50**

Answer any *four* from *Question no.* 2 to 8
***Question no.* 1 is compulsory.**

1. State and prove Taylor's Theorem. (10)
2. State and prove Maximum Modulus Theorem. (10)
3. Find the Residue of following problem: (10)

$$\frac{1}{2\pi i}\oint_C \frac{e^{zt}}{z^2(z^2+2z+2)}dz$$

4. State and prove Cauchy-Riemann Equation. (10)
5. Prove that: (10)

$$f^n(a)=\frac{n!}{2\pi i}\oint_C \frac{f(z)}{(z-a)^{n+1}}$$

6. Find the Laurents Series about the indicated Singularities: (10)

(i) $(z-3)Sin\frac{1}{z+2}; z=-2$

(ii) $\frac{1}{z^2(z-3)^2}; z=3$

7. Evaluate: (10)

$\int_{(0,3)}^{(2,4)}(2y+x^2)dx+(3x-y)dy$ along

(a) the Parabola $x=2t, y=t^2+3$

(b) Straight line from (0,3) to (2,3) and then from (2,3) to (2,4)

(c) Straight line from (0,3) to (2,4)

8. State and prove Hadamard's three Circle Theorem. (10)

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Duration: 20 minutes

Marks – 20

(PART A - Objective Type)

I. Choose the correct answer: **1×20=20**

1. Derivative of $f(z)$ is defined if $f(z)$ is
   (a) Continuous function
   (b) Analytic function
   (c) Single Valued function
   (d) Simple function

2. A function $f(z)$ is said to be Analytic at a point z_0 if there exist a neighbourhood $|z-z_0|\langle\delta$ at all points for
   (a) $f'(z)$ exist
   (b) $f'(z)$ does not exist
   (c) $f'(z)=0$
   (d) $f'(z)\rangle 0$

3. Gradient of a real function F (scalar) by
   (a) $F=\nabla F=\frac{\partial F}{\partial Y}+i\frac{\partial F}{\partial x}$
   (b) $F=\nabla F=\frac{\partial F}{\partial Y}+i\frac{\partial F}{\partial x}$
   (c) $F=\nabla F=\frac{\partial F}{\partial Y}+i\frac{\partial F}{\partial x}$
   (d) $F=\nabla F=\frac{\partial F}{\partial Y}+i\frac{\partial F}{\partial x}$

4. For orthogonal families
   (a) $f(z)$ analytic and $f'(z)\neq 0$
   (b) $f(z)$ non Analytic and) $f'(z)\neq 0$
   (c) $f(z)$ Analytic and($f'(z)=0$
   (d) $f(z)$ non Analytic and $f'(z)=0$

5. In Complex line Integral, Curve C is
   (a) Continuous
   (b) Discontinuous
   (c) Rectifiable
   (d) Analytic

6. Relation between Real and Complex line integrals
   (a) $\int_C f(z)dz=\int_C udx-vdy+i\int_C vdx+udy$
   (b) $\int_C f(z)dz=\int_C udy-vdx+i\int_C udx+vdy$
   (c) $\int_C f(z)dz=\int_C vdx-udy+i\int_C udx+vdy$
   (d) $\int_C f(z)dz=\int_C vdx-vdy+i\int_C udx+vdy$

7. A simply connected Region is one which
   (a) Does not have any holes
   (b) Two holes
   (c) Three holes
   (d) One holes

8. Cauchy's Integral Formulae

(a) $f(a)=\frac{1}{2\pi i}\oint_C \frac{f(z)}{z-a}dz$

(b) $f(a)=\frac{1}{2\pi i}\oint_C \frac{f(a)}{z-a}dz$

(c) $f(a)=\frac{1}{2\pi i}\oint_C \frac{f(a)}{a-z}dz$

(d) None of these

9. Converse of Cauchy's Theorem is

(a) Taylor's Theorem

(b) Moreras Theorem

(c) Laurent's Theorem

(d) Cauchy's Integral formulae

10.In Argument Theorem N and P represent

(a) Number of Zeros and number of Poles

(b) Number of Poles and number of Zeros

(c) Both number of Zeros

(d) Both number of Poles

11.The Series of the form $\sum_{n=0}^{n=\alpha} a_n(z-a)^n$ is known as

(a) Power Series

(b) Taylor's Series

(c) Laurent's Series

(d) None of these

12.Taylor's Theorem defined as

(a) $f(a+h)=f(a)+hf'(a)+\frac{h^2}{2!}f''(a)+..........+\frac{h^n}{n!}f^n(a)+..........$

(b) $f(a-h)=f(a)+hf'(a)+\frac{h^2}{2!}f''(a)+..........+\frac{h^n}{n!}f^n(a)+..........$

(c) $f(a+h)=f(a)-hf'(a)+\frac{h^2}{2!}f''(a)-..........+(-1)^n\frac{h^n}{n!}f^n(a)+..........$

(d) $f(a+h)^2=f(a)-hf'(a)+\frac{h^2}{2!}f''(a)-..........+(-1)^n\frac{h^n}{n!}f^n(a)+..........$

13.In Residues Theorem $\int_C f(z)dz=?$

(a) $2\pi i(a+b+c+..........)$

(b) Sum of numbers

(c) $2\pi i(a_{-1}+b_{-1}+c_{-1}+.......)$

(d) Both (i) and (iii)

14.Two example of Entire function

(a) Polynomial function and Exponential function

(b) Polynomial function and Analytic function

(c) Constant function and simple function

(d) None of these

15.If a entire function has no singularity at infinity, then by Liovelli's theorem it is

(a) Analytic

(b) Continuous

(c) Constant

(d) Polynomial

16.In Jensen's Inequality $f(z)$ is

(a) Analytic function (b) Integral function
(c) Continuous function (d) Polynomial function

17.In Hadamard's three Circle Theorem M_i represents

(a) Minimum Value (b) Maximum Value
(c) Greatest value (d) None of these

18.In Cauchy-Riemann equation u and v Satisfies

(a) $\frac{\partial u}{\partial x}=\frac{\partial v}{\partial y}$ (b) $\frac{\partial u}{\partial y}=-\frac{\partial v}{\partial x}$

(c) $\frac{\partial u}{\partial y}=\frac{\partial v}{\partial x} f(z)$ (d) $\frac{\partial u}{\partial x}=-\frac{\partial v}{\partial y}$

19.If $f(z)$, $g(z)$ and $h(z)$ are Analytic function of z ,then

(a) $\frac{d}{dz}\{f(z)\pm g(z)\pm h(z)\}=\frac{d}{dz}f(z)\mp\frac{d}{dz}g(z)\mp\frac{d}{dz}h(z)$

(b) $\frac{d}{dz}\{f(z)\pm g(z)\pm h(z)\}=\frac{d}{dz}f(z)\pm\frac{d}{dz}g(z)\pm\frac{d}{dz}h(z)$

(c) $\frac{d}{dz}\{f(z)\pm g(z)\pm h(z)\}=\frac{d}{dz}f(z)+\frac{d}{dz}g(z)+\frac{d}{dz}h(z)$

(d) None of these

20.In L'Hospital's rule one condition is

(a) $f(z_0)=g(z_0)$ (b) $f(z_0)=g(z_0)=0$
(c) $f(z_0)=g(z_0)\neq 0$ (d) $f(z_0)\neq g(z_0)\neq 0$

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