

Subject Code: R161110/R16

Set No - 1

I B. Tech I Semester Regular Examinations Dec. - 2016
MATHEMATICS-II
(Numerical Methods and Complex Variables)
(Com. to ECE, EIE, E.Com.E.)
Time: 3 hours
Max. Marks: 70

Question Paper Consists of **Part-A** and **Part-B**
 Answering the question in **Part-A** is Compulsory,
Four Questions should be answered from **Part-B**

PART-A

1. a) What is transcendental equation? Given an example.
 b) What is the difference between interpolation and extrapolation?
 c) Find $y(0.1)$ by Taylor's series method for $y' = y - x$, $y(0) = 1$
 d) Show that the function $e^x(\cos y + i \sin y)$ is holomorphic
 e) State the Cauchy's theorem.
 f) Evaluate $\int_0^{1+i} (x^2 - iy) dz$ along the path $y = x$
 g) Find the Pole and residue of $f(z) = \frac{e^z}{(z-1)^2}$

[2+2+2+2+2+2+2]

PART-B

2. a) Find the Real root of the equation $\tan x = x$ using Bisection method.
 b) Find the Real root of the equation $x + \log_{10} x - 2 = 0$ using false position method. [7+7]
3. a) Estimate the minimum weight of bib taps when bore is 20 mm using the following table

Bore(mm)	8	10	15	25	32	40	50
Weight of bib taps in kg	0.25	0.30	0.40	1.25	1.70	2.15	3.65

- b) Determine the value of $f(x)$ at $x = 25$ for the following data

[7+7]

x	20	24	28	32
y=f(x)	24	32	35	40

4. a) Evaluate $\int_0^{\frac{\pi}{2}} e^{\sin x} dx$ by (i) Trapezoidal rule (ii) Simpson's $1/3^{\text{rd}}$ Rule

[7+7]

- b) Find $y(0.1)$ for the D.E $\frac{dy}{dx} = xy^2$, $y(0) = 1$ using RK method of fourth order

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5. a) Find the Analytic function whose real part is $u(x, y) = \frac{\sin 2x}{\cosh 2y + \cos 2x}$
 b) Show that the function $f(z) = \bar{z}\bar{z}$ is differentiable but not analytic at origin. [7+7]
6. a) Using Cauchy's integral formula, evaluate $\int_c \frac{\cosh \pi z}{z(z^2 + 1)} dz$, where c is $|z| = 2$ [7+7]
 b) Express $f(z) = \frac{z}{(z-1)(z-3)}$ in a series of positive and negative powers of $(z-1)$
7. a) Evaluate $\int_0^\infty \frac{\cos x}{(1+x^2)^2} dx$
 b) Evaluate $\int_c \frac{e^z}{(z^2 + \pi^2)^2} dz$

 Where C is $|z| = 4$ by using residue theorem

[7+7]

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PART-A

1. a) What is Algebraic equation? Given an example.
- b) Prove that $\nabla = 1 - E^{-1}$
- c) Explain single step method with simple example?
- d) Determine whether the function $2xy + i(x^2 - y^2)$ is analytic.
- e) Evaluate $\int_0^{1+i} (x^2 - iy) dz$ along the path $y = x^2$
- f) Obtain Taylor's series for $f(z) = e^z$ about $z = 1$
- g) Find the Pole and residue of $f(z) = \frac{z}{(z^2 - 4)}$

[2+2+2+2+2+2+2]

PART-B

2. a) Find the Real root of the equation $x^2 - x - 4 = 0$ using iteration method [7+7]
- b) Find the Real root of the equation $e^{2x} - e^x - 2 = 0$ using Newton Raphson method

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3. a) The viscosity of an oil is experimentally measured at different temperatures as shown in the following table

Temp in $^{\circ}\text{C}$	110	130	160	190
Viscosity	10.8	8.1	5.5	4.8

Find the Viscosity of the oil at the Temperature of 140°C

- b) Determine the value of $f(x)$ at $x = 10$ for the following data [7+7]

x	2	5	9	11
y=f(x)	94.8	87.9	81.3	75.1

4. a) Evaluate $\int_0^1 \log x \cdot \cos x dx$ by (i) Trapezoidal rule (ii) Simpson's $3/8^{\text{th}}$ Rule [7+7]

- b) Find $y(0.1)$ for the D.E $\frac{dy}{dx} = x^2 y - 1$, $y(0) = 1$ using Taylor's series method

5. a) Define analytic function and Verify the whether $f(z) = \frac{x^3(1+i)-y^3(1-i)}{x^2+y^2}$, ($z \neq 0$) and $f(0) = 0$, is analytic [7+7]

- b) Define Harmonic function and verify whether $u(x, y) = e^{2x}(x \cos 2y - y \sin 2y)$ is harmonic and find its harmonic conjugate.

6. a) Evaluate $\oint \left[\frac{e^z}{z^3} + \frac{z^4}{(z+i)^2} \right] dz$, where $c: |z| = 2$ [7+7]

- b) Expand $f(z) = \frac{z+3}{z(z^2-z-2)}$ in power series where (i) $|z| < 1$ (ii) $1 < |z| < 2$ (iii) $|z| > 2$

7. a) Evaluate $\int_0^{2\pi} \frac{d\theta}{5-4\sin \theta}$ [7+7]

- b) Evaluate $\int_C \frac{z \cos z}{\left(z - \frac{\pi}{2}\right)^3} dz$ where C is the Region bounded by $|z-1|=1$ using Residue theorem

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PART-A

1. a) what is an iterative process , why should we apply iterative technique
 b) Define Newton forward interpolation formula
 c) When do you use numerical integration? Give an example
 d) Find the analytic function whose real part is $\frac{x}{x^2 + y^2}$
 e) Evaluate $\int_0^{1+i} (x^2 + iy) dz$ along the path $y = x$
 f) Obtain Taylor's series for $f(z) = 1/z^2$ about $z = 1$
 g) Find the Singularity of the function $f(z) = e^{1/z}$

[2+2+2+2+2+2+2]

PART-B

2. a) Find the Real root of the equation $2x^3 - 3x - 4 = 0$ using Newton Raphson method
 b) Find the Real root of the equation $4 \sin x = e^x$ using false position method [7+7]
3. a) Determine the value of $f(x)$ at $x = 225$ form the following data [7+7]

x	50	100	150	200	250
y = f(x)	5	5.7	7.7	8.9	10.7

- b) Calculate $f(3)$ from the following table

x	0	1	2	4	5	6
Y=f(x)	1	14	15	5	6	19

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4. a) Evaluate $\int_0^{\frac{\pi}{2}} \frac{\cos x}{1+x} dx$ by (i) Simpson's 3/8th Rule (ii) Simpson's 1/3rd Rule [7+7]
- b) Find $y(0.1)$ for the D.E $\frac{dy}{dx} = x + y + xy$, $y(0) = 1$ using Modified Euler's method
5. a) Show that $\left(\frac{\partial^2}{\partial x^2} + \frac{\partial^2}{\partial y^2} \right) \log |f'(z)| = 0$, where $f(z)$ is analytic function. [7+7]
- b) If $f(z) = u + iv$ is analytic and $v = \frac{2 \sin x \sin y}{\cos 2x + \cosh 2y}$, find u .
6. a) Evaluate $\int_c \frac{ze^{2z}}{(z-2)^3} dz$ where c is the circle with radius 3 by Cauchy integral formula
- b) Obtain Laurent's expansion for $f(z) = \frac{1}{(z+2)(z+1)}$ in $1 < |z| < 2$ [7+7]
7. a) Evaluate $\int_0^{2\pi} \frac{d\theta}{3-2\sin \theta}$ using residue theorem
- b) Find the Residue of $\frac{1+e^z}{z \cos z + \sin z}$ at $z = 0$ [7+7]

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PART-A

1. a) What are possible ways of finding the roots of nonlinear equation
- b) What are the applications of interpolation?
- c) Write the merits and demerits of Euler's method?
- d) Prove that an analytic function with constant imaginary part is constant.
- e) Evaluate $\int_0^{1+i} (x^2 + iy) dz$ along the path $y = x^2$
- f) Obtain Taylor's series for $f(z) = 1/z$ about $z = 1$
- g) Define Removable singularity and give an example

[2+2+2+2+2+2+2]

PART-B

2. a) Find the Real root of the equation $x^2 - x - 2 = 0$ using iteration method [7+7]
- b) Find the Real root of the equation $e^x - 4x^2 = 0$ using Bisection method
3. a) Determine the value of $f(x)$ at $x = 1.6$ from the following data [7+7]

x	1	1.4	1.8	2.2
y=f(x)	3.49	4.82	5.96	6.5

- b) Using Lagrange's Interpolation, find $f(12)$ given that

x	3	7	9	13
y	5	12	13	21

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4. a) Evaluate $\int_0^{\frac{\pi}{2}} \sin x \log(\sin x) dx$ by (i) Trapezoidal rule (ii) Simpson's 1/3rd Rule [7+7]

b) Find $y(0.1)$ for the D.E $\frac{dy}{dx} = \frac{x^2}{y^2 + 1}$, $y(0) = 1$ using Picard's method

5. a) Show that for the function $f(z) = \begin{cases} \frac{z^5}{|z|^4}, & z \neq 0 \\ 0, & z = 0 \end{cases}$ Cauchy- Riemann equation are satisfied

at $z = 0$, but $f(z)$ is not differentiable at 0. [7+7]

b) Show that the function $f(x, y) = x^3y - xy^3 + xy + x + y$ can be the imaginary part of an analytic function of $f(z)$ also find the real part of the complex function

6. a) Evaluate $\int_c \frac{ze^{2z}}{(z - \pi i)^3} dz$ where c is the circle with radius 4 by Cauchy integral formula

b) Obtain Laurent's expansion for $f(z) = \frac{1}{(z+2)^2(z+1)}$ in $|z| > 2$ [7+7]

7. a) Evaluate $\int_0^{\infty} \frac{dx}{(x^4 + 1)}$

b) Find the residue of $f(z) = \frac{z^3}{(z-2)(z-3)(z-1)^4}$ at $z = 1$ [7+7]