MATHEMATICS-IV

Subject Code: MA301BS
Regulations : R16 - JNTUH
Class : II Year B.Tech CSE I Semester

Department of Computer Science and Engineering

BHARAT INSTITUTE OF ENGINEERING AND TECHNOLOGY

Ibrahimpatnam - 501 510, Hyderabad

MATHEMATICS-IV (MA301BS)
COURSE PLANNER

I. COURSE OVERVIEW:

The students will improve their ability to think critically, to analyze a real problem and solve it using a wide array of mathematical tools. They will also be able to apply these ideas to a wide range of problems that include the Engineering applications.

II. PREREQUISITE:

1. Familiarity of complex numbers and complex variables
2. Familiarity of Sequence and Series of Real numbers
3. Differentiation and Integration of Real valued functions
4. Difference between ODE'S and PDE'S
5. Solutions of ODE'S

III. COURSE OBJECTIVE:

1.	This Course provides an introduction to the principles of complex variable and complex function. In particular, the course will consider continuity, differentiability and analyticity of complex function, necessary and sufficient conditions for the complex function to be analytic and Cauchy Reimann equations
2.	This course provides an idea of complex integration. This includes Cauchy integral theorem, Cauchy integral formula, poles, singularities and residues using Laurent series.
3.	This course provides an idea of periodic functions, Fourier series of periodic function, Fourier integral theorem, Fourier sine and cosine integrals, sine and cosine transforms, Finite Fourier transforms.
4.	This course provides an idea of Classification of second order partial differential equations, Solution of one dimensional wave and heat equations.
5.	To know the solution and applications of wave theory

IV.COURSE OUTCOMES:

S No.	Description	Bloom's Taxonomy Level
1.	Analyze the complex functions with reference to their analyticity, integration using and Cauchy's integral theorem	Knowledge, Analyze (Level 1,Level 4)
2.	Find the Taylor's and Laurent's series expansion of complex functions the Bilinear transformation	Knowledge (Level 1)
3.	Formulate any periodic function in term of sine and cosine	Create (Level 6)
4.	Simplify a non-periodic function as integral representation	Analyze(Level 4)
5.	Analyze one dimensional wave an heat equation	Analyze(Level 4)

V. HOW PROGRAM OUTCOMES ARE ASSESSED:

Program Outcomes (PO)		Level	Proficiency assessed by
PO1	**Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.	3	Assignments, Tutorials, Mock Tests
PO2	**Problem analysis**: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.	3	Assignments, Tutorials, Mock Tests
PO3	**Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.	3	Assignments, Tutorials, Mock Tests
PO4	**Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.	-	
PO5	**Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.	-	
PO6	**The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.	3	Assignments, Tutorials, Mock Tests --
PO7	**Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.	2	Assignments, Tutorials,
PO8	**Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.	1	Assignments
PO9	**Individual and team work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.	-	--
PO10	**Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.	-	--

Program Outcomes (PO)		Level	Proficiency assessed by
PO11	**Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.	-	--
PO12	**Life-long learning**: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.	2	Assignments, Tutorials

1: Slight (Low) **2: Moderate (Medium)** **3: Substantial (High)** **- : None**

VI. HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

Program Specific Outcomes (PSO)		Level	Proficiency assessed by
PSO1	**Software Development and Research Ability:** Ability to understand the structure and development methodologies of software systems. Possess professional skills and knowledge of software design process. Familiarity and practical competence with a broad range of programming language and open source platforms. Use knowledge in various domains to identify research gaps and hence to provide solution to new ideas and innovations.	3	Lectures, Assignments, Tutorials, Mock Tests
PSO2	**Foundation of mathematical concepts:** Ability to apply the acquired knowledge of basic skills, principles of computing, mathematical foundations, algorithmic principles, modeling and design of computer- based systems in solving real world engineering Problems.	3	Lectures, Assignments, Tutorials, Mock Tests
PSO3	**Successful Career:** Ability to update knowledge continuously in the tools like Rational Rose, MATLAB, Argo UML, R Language and technologies like Storage, Computing, Communication to meet the industry requirements in creating innovative career paths for immediate employment and for higher studies.	2	Lectures, Assignments

1: Slight (Low)	**2: Moderate (Medium)**	**3: Substantial (High)**	**- : None**

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) - : None

VII. SYLLABUS:

UNIT – I

Functions of a complex variable: Introduction, Continuity, Differentiability, Analyticity, Properties, Cauchy, Riemann equations in Cartesian and Polar coordinates**.** Harmonic and

Conjugate harmonic functions-Milne-Thompson method.
Applications of Complex variables in flows and fields.
UNIT - II
Complex integration: Line integral, Cauchy's integral theorem, Cauchy's integral formula, and Generalized Cauchy's integral formula, Power series: Taylor's series- Laurent series, Singular points, isolated singular points, pole of order m – essential singularity, Residue, Cauchy Residue theorem (without proof).
Applications of Complex Power Series.
UNIT – III
Evaluation of Integrals: Types of real integrals: a) Improper real integrals $f\ (x)dx$

$$\int_{-\infty}^{\infty} f(x)dx$$

b) $\int_{c}^{c+2\pi} f(\cos\theta\ ,\sin\theta\quad)d\,\theta$

Bilinear transformation- fixed point- cross ratio- properties- invariance of circles.
Conformal Mappings and its applications to computer graphics.
UNIT – IV
Fourier series and Transforms: Introduction, Periodic functions, Fourier series of Periodic Function, Dirichlet's conditions, Even and odd functions, Change of interval, half range sine and cosine series.
Fourier integral theorem (without proof), Fourier sine and cosine integrals, sine and cosine, transforms, properties, inverse transforms, Finite Fourier transforms.
Applications of Fourier series and Fourier transforms in image matching, face recognition,
3D MAP
UNIT – V
Applications of PDE: Classification of second order partial differential equations, Classification of second order partial differential equations, Solution of one dimensional wave and heat equations.
PDE applications in Robotics & Performance of algorithms and their numerical stability
GATE SYLLABUS:
Complex integration: Line integral, Cauchy's integral theorem, Cauchy's integral formula, and Generalized Cauchy's integral formula, Power series: Taylor's series- Laurent series, Singular points, isolated singular points, pole of order m – essential singularity, Residue, Cauchy Residue theorem (without proof).
Fourier series and Transforms: Introduction, Periodic functions, Fourier series of periodic function, Dirichlet's conditions, Even and odd functions, Change of interval, half range sine and cosine series.
Fourier integral theorem (without proof), Fourier sine and cosine integrals, sine and cosine, transforms, properties, inverse transforms, Finite Fourier transforms.
Applications of PDE: Classification of second order partial differential equations, method of separation of variables, Solution of one dimensional wave and heat equations
IES SYLLABUS: NIL
SUGGESTED BOOKS:
TEXT BOOK:
1. A first course in complex analysis with applications by Dennis G. Zill and Patrick Shanahan, Johns and Bartlett Publishers.
2. Higher Engineering Mathematics by Dr. B. S. Grewal, Khanna Publishers.

3. Advanced engineering Mathematics with MATLAB by Dean G. Duffy.

REFERENCES:

1. Fundamentals of Complex Analysis by Saff, E. B. and A. D. Snider, Pearson.
2. Advanced Engineering Mathematics by Louis C. Barrett, McGraw Hill

NPTEL Web Course:

1. https://onlinecourses.nptel.ac.in/noc18_ma10/announcements?force=true

UGC-NET SYLLABUS:

Complex variable, Cauchy's Riemann equations in Cartesian and polar coordinates, Complex Integration, Cauchy's integral, Fourier sine and Cosine Integrals, Fourier Sine and Cosine Transforms, Bilinear Transformations, conformal mapping , Applications of PDE.

LESSON PLAN-COURSE SCHEDULE:

Session	Week No	Unit	TOPIC	Course learning outcomes	Reference
1.	1	1	Introduction of complex variables, Continuity, Differentiability	**Define** Complex Variables	T1,T2,R1
2.			Analyticity, properties, Cauchy, Riemann equations in Cartesian	**Find** C.R.Eqns in Cartesian form	T1,T2,R1
3.			Problems	**Solve** problems	T1,T2,R1
4.			Analyticity, properties, Cauchy, Riemann equations in polar	**Find** C.R.Eqns in polar form	T1,T2,R1
5.	2		Problems	**Solve** problems	T1,T2,R1
6.			Problems	**Solve** problems	T1,T2,R1 T1,T2,R1
7.			Harmonic and conjugate harmonic functions-Milne Thompson method	**Evaluate** Harmonic functions	T1,T2,R1 T1,T2,R1
8.	3		Problems	**Solve** problems	T1,T2,R1
9.			Problems	**Solve** problems	T1,T2,R1
10.			Problems	**Solve** problems	T1,T2,R1
			***Applications of complex variables in flows and fields(content beyond syllabus)**	**Understand** applications	T1,T2,R1
			Mock Test – I		
UNIT – 2					
11.	4		Introduction to complex integrations – line integral	**Define** Line integral	T1,T2,R1
12.			Cauchy's integral theorem, Cauchy's integral formula	**Prove** Cauchy's integral theorem	T1,T2,R1
13.			Problems	**Solve** problems	T1,T2,R1
14.			Generalized Cauchy's integral formula	**Apply** Cauchy's integral	T1,T2,R1

		2		theorem	
15.	5		Power series: Taylor's series	**Apply** Taylor's series	T1,T2,R1
16.			Laurent series	**Apply** Laurent series	T1,T2,R1
17.			Singular points, isolated singular points	**Find** Singular points	T1,T2,R1
18			Problems	**Solve** problems	T1,T2,R1
19			Problems	**Solve** problems	T1,T2,R1
20.			Problems	**Solve** problems	T1,T2,R1
21.	6		Pole of order m – essential singularity	**Evaluate** singularities	T1,T2,R1
22.			Problems	**Solve** problems	T1,T2,R1
23.		2	Residue, Cauchy Residue theorem (Without proof).	**Define** Cauchy Residue theorem	T1,T2,R1
24			Problems	**Solve** problems	T1,T2,R1
			***Applications of Complex power series** (topic beyond syllabus)	**Apply** complex power series	T1,T2,R1
			Tutorial / Bridge Class # 1		T1,T2,R1
UNIT – 3					
25.	7	3	Introduction to evaluations of integrals	**Define** evaluation of integrals	T1,T2,R1
26.			Types of integrals	**Understand** types of integrals	T1,T2,R1
27.			Improper integrals	**Understand** improper integrals	T1,T2,R1
28.			Problems	**Solve** problems	T1,T2,R1
29.	8		$\int_{-\infty}^{\infty} f(x)dx$	**Evaluate** integral	T1,T2,R1
30.			Problems	**Solve** problems	T1,T2,R1
31.			$\int_{c}^{c+2\pi} f(\cos\theta\ ,\sin\theta\ )d\,\theta$	**Evaluate** problems	T1,T2,R1
32.			Problems	**Solve** problems	T1,T2,R1
			Tutorial / Bridge Class # 2		T1,T2,R1
I Mid Examinations					
33.	9	3	Bilinear transformation- fixed point	**Define** bilinear transformation	T1,T2,R14
34.			Problems	**Solve** problems	T1,T2,R1
35.			Cross ratio- properties- invariance of circles	**Solve** problems	T1,T2,R1
36.			Problems	**Solve** problems	T1,T2,R1

37.			*** Conformal Mappings and its applications to computer graphics.** (contents beyond the syllabus)	**Understand** application	T1,T2,R1
			UNIT – 4		
38	10	4	Introduction Fourier series	**Define** Fourier series	T1,T2,R1
39			Periodic functions, Fourier series of periodic function	**Define** periodic functions	T1,T2,R1
40			Problems and Dirichlet's conditions	**Solve** Dirichlets functions	T1,T2,R1
41			Even and odd functions, Change of interval	**Understand** even and odd functions	T1,T2,R1
42	11		Half range sine and cosine series.	**Solve** half sine and cosine	T1,T2,R1
43			Problems	**Solve** problems	T1,T2,R1
44			Fourier integral theorem (without proof), Fourier sine and cosine integrals	**Solve** integral theorem	T1,T2,R1
45			***Tutorial / Bridge Class # 3***		T1,T2,R1
46	12		Problems	**Solve** problems	T1,T2,R1
47			Sine and Cosine, transforms and properties	**Solve** sine and cosine	T1,T2,R1
48			Inverse transforms, Finite Fourier transforms	**Solve** inverse transforms	T1,T2,R1
49			Problems	**Solve** problems	T1,T2,R1
50			***Applications of Fourier series and Fourier transforms in image matching, face recognition, 3D MAP** (content beyond the syllabus)	**Know** applications	T1,T2,R1
			Mock Test - II		T1,T2,R1
			UNIT – 5		
51.	13		Classification of second order Partial differential equations	**Define** P.D.E	T1,T2,R1
52.			Problems	**Solve** problems	T1,T2,R1
53.			Problems	**Solve** problems	T1,T2,R1
54.			Method of separation of variables	**Know** method of separation Of variations	T1,T2,R1
55.	14		Problems	**Solve** problems	T1,T2,R1
56.			Problems	**Solve** problems	T1,T2,R1
57.			Solution of one dimensional	**Solve** wave equations	T1,T2,R1

			Wave equations		
58.		5	Problems	**Solve** problems	T1,T2,R1
59.			Problems	**Solve** problems	T1,T2,R1
60.			Solution of one dimensional heat equations	**Know** heat equation	T1,T2,R1
61.			Problems	**Solve** equations	T1,T2,R1
62			Problems	**Solve** equations	T1,T2,R1
	15		**PDE applications in Robotics & Performance of algorithms and their numerical stability** .(content beyond syllabus)	**Know** applications	T1,T2,R1
			Tutorial / Bridge Class # 11		
II Mid Examinations					

SUGGESTED BOOKS:

TEXT BOOK:

1. A first course in complex analysis with applications by Dennis G. Zill and Patrick Shanahan, Johns and Bartlett Publishers.
2. Higher Engineering Mathematics by Dr. B. S. Grewal, Khanna Publishers.
3. Advanced engineering Mathematics with MATLAB by Dean G. Duffy

REFERENCES:

1. Fundamentals of Complex Analysis by Saff, E. B. and A. D. Snider, Pearson.
2. Advanced Engineering Mathematics by Louis C. Barrett, McGraw Hill

IX. MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES:

Course Outcomes	Program Outcomes (PO)													
	P 1	**P 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO10**	**PO11**	**PO12**	**PSO 1**	**PSO 2**
CO 1	1	3	1	-	-	-	-	-	-	-	-	-	1	-
CO 2	2	2	-	-	-	-	-	-	-	-	-	-	1	2
CO 3	2	3	1	-	2	-	-	-	-	-	-	-	2	-
CO 4	2	2	-	2	-	1	-	-	-	-	-	-	-	-
CO 5	1	2	-	-	-	-	-	-	-	-	-	-	1	-
AVG	1.	1.	0.4	0.4	0.4	0.2	-	-	-	-	-	-	1	0.4

1: Slight(Low) **2: Moderate (Medium)** **3: Substantial(High)** **- : None**

QUESTION BANK: (JNTUH)
DESCRIPTIVE QUESTIONS:
UNIT I
Short Answer Questions

S.No	Question	Blooms taxonomy level	Course outcome
1	Find the value of 'a' if cos*ax* sinh*y* is harmonic	Analyze	4
2	Find the points at which f(z) = $\bar{Z}$ is not analytic	Analyze	4
3	Evaluate $\int\int_{z=0}^{z=i+1}[x^2+2xy+i(y^2-x]dz)$	Evaluate	5
4	Write Cauchy Riemann equations	Understand	2
5	Solve$\int_c [(y^2+z^2)dx+(x^2+z^2)dy+(x^2+y^2)dz]$from (0 0 0) to (1 1 1) where c is curve x=t, y=2t, z=t^2t^3 in the parametric form	Apply	3

Long Answer Questions

S.No	Questions	Blooms taxonomy level	Course outcome
1	Evaluate $\int_C \frac{\log z dz}{(z-1)^3}$ where C: $\lvert z-1\rvert=\frac{1}{2}$ using Cauchy's integral formula.	Evaluate	5
2	Integrate f(z)=x^2 +ixy from point A(1,1) to B(2,8) along the straight line AB	Apply	3
3	State and prove Cauchy's theorem	Evaluate	5
4	Integrate f(z)= x^2 + ixy from A(1,1) to B(2,8) along the curve C: x =t , y =t^3	Apply	3
5	Evaluate $\int(y^2+2xy)dx+(x^2-2xy)dy$ where c is the boundary of the region by y =x^2 and x =y^2	Evaluate	5
6	Evaluate using Cauchy's Theorem $\int_c \frac{z^3e^{-z}}{(z-1)^3}dz$ where C is $\lvert z-1\rvert=\frac{1}{2}$ using Cauchy' integral Formula	Evaluate	5
7	Find analytic function whose real part is $(x\sin y-y\cos y)$	Find	4
8	Evaluate the integral $\int_c \frac{\sin^2 z}{(z-\frac{\pi}{6})3}$ where C=1	Evaluate	5
9	Find the analytic function whose real part is (x^2y-*ysin2y)*	Find	4
10	Evaluate $\int_c \frac{(Z^3-Z)dz}{(Z-2)^3}$where C is $\lvert z\rvert=3$	Evaluate	5

UNIT II

Short Answer Questions

S.No	Question	Blooms taxonomy level	Course outcome
1	Find the residue of z^2 -2 at z=-1.	Analyze	4
2	Expand z cosz	Create	6
3	Find log(1-z) when |z| < 1 using Taylor's series	Analyze	4
4	Define different types of singularities.	Understand	2
5	State Cauchy's Integral theorem	Remember	1

Long Answer Questions-

S.No	Questions	Blooms taxonomy level	Course outcome
1	State and prove Taylor's theorem & expand e^z about z = 1.	Evaluate	5
2	Evaluate $f(z)=\frac{1}{z^2-3z+2}$ in the region (i) $0<\|z-1\|<1$ (ii) $1<\|z\|<2$	Evaluate	5
3	State and prove Laurent's theorem .	Evaluate	5
4	Expand $f(z)=\frac{1}{z^2-3z+2}$ in the region (i) $0<\|z-1\|<1$ (ii) $1<\|z\|<2$	Create	6
5	$\int_0^{\pi}\frac{\cos 2\theta}{1-2a\cos\theta+a^2}d\theta=\frac{\pi a^2}{1-a^2}$,S.T using residue theorem where $a^2<1$.	Evaluate	5
6	Find pole and residues at each pole of $\frac{ze^z}{(z-1)^3}$ &determine the poles of $\frac{z}{\cos z}$	Analyze	4

UNIT III

Short Answer Questions-

S.No	Question	Blooms taxonomy level	Course outcome
1	The fixed points of f(z) are the point a where f(z)=z.	Analyze	4
2	Find the critical points of w=sin *z*.	Create	6
3	Define conformal mapping.	Evaluate	5
4	Find the image of |z|=2 under the transformation of w=3z.	Understand	2
5	Find the bilinear transformation which maps the points (-1,0,1) into the points (0,i,3i).	Analyze	4

Long Answer Questions-

S.No	Questions	Blooms taxonomy level	Course outcome
1	Discus the transformation $w = z + \frac{1}{z}$	Evaluate	5
2	In transformation $w = \frac{z-i}{1-iz}$ find the image of the circle (i) $\lvert w \rvert = 1$ (ii) $\lvert z \rvert = 1$ in the w – plane.	Apply	3
3	Show that the function w=z+i transforms the straight line x=c in the z-plane into a circle in the w-plane.	Evaluate	5
4	Find the image of the strip $0 < y < \frac{1}{2}$ & Show that the image of $x^2 - y^2 = 1$ is the lemniscates under the transformation $w = \frac{1}{z}$	Analyze	4
5	Find the bilinear transformation which maps the points (-1,0,1) into the points (0,i,3i).	Analyze	4
6	Find the image of 1<x<2 under the transformation w=z	Analyze	5
7	Find the bilinear mapping which maps the points Z=(1,I,-1) into (0,1,x)	Analyze	4
8	Find the image of |z| < 1 if w = 1+iz/1-iz	Analyze	5
9	Find the image of |z| < 1 and $\lvert z \rvert > 1$under the transformation w = i,0,-i	Analyze	4
10	Show that the transformation w=z+I transforms the real axis in the z-plane into a circle in the w-plane. find the centre and radius of the circle.	Evaluate	5

UNIT IV

Short Answer Questions

S.No	Question	Blooms taxonomy level	Course outcome
1	Expand f(x) = e^{ax} in a Fourier series in 0<x<2π.	Create	6
2	Express f(x) = x as a Fourier series in (-π,π)	Create	6
3	Find the half range sine series of f(x) = 1 in [0,l]	Analyze	4
4	Find the integral equation $\int f(x) \cos \alpha x \, dx = e^{-\alpha}$ in [0,∞]	Analyze	4

5	Find the Finite Fourier sine and cosine transform of f(x)= 1, $0 < x < \pi/2$ -1, $\pi/2 < x < \pi$	Analyze	4

Long Answer Questions

S.No	Questions	Blooms taxonomy level	Course outcome
1	Prove f(x) = x – Π as Fourier series in the interval – Π < X < Π	Evaluate	5
2	Find the Fourier series to represent the function f(x) =|sinx|, $-\pi < x < \pi$.	Analyze	4
3	Find the Fourier series to represent $f(x) = x^2$ in the interval $(0, 2\pi)$.	Analyze	5
4	Find the Fourier series representing f(x) =x, $0 < x < 2\pi$. Sketch the graph of f(X) FROM -4π TO 4π.	Analyze	4
5	Obtain the Fourier series for $f(x) = x - x^2$ in the interval $[-\pi, \pi]$. Hence show that $1/1^2 - 1/2^2 + 1/3^2 - 1/4^2 + \ldots = \pi^2/12$	Analyze	4
6	If f(x) =$\begin{cases} kx: \ if 0 < x < \pi/2 \\ k(\pi - x); if \frac{\pi}{2} < x < \pi \end{cases}$find half range sine series.	Analyze	5
7	Find f(x) = x as a Fourier series in $(-\pi, \pi)$.	Analyze	4
8	Find the Fourier series to represent the function f(x)=|sin x|, $-\pi < x < \pi$.	Analyze	5
9	Expand f(x) = Cos x, $0<x<\pi$ in the half range sine series.	Create	6
10	Find the Fourier series for $f(x) = 2lx - x^2$ in $0 < x < 2l$ and hence deduce $1/1^2 - 1/2^2 + 1/3^2 - 1/4^2 + = \pi^2/12$	Analyze	4

UNIT V

Short Answer Questions

S.No	Question	Blooms taxonomy level	Course outcome
1	Solve $pt - qs = q^3$.	Apply	3
2	Solve $(q + 1)s = (s + 1)t$	Apply	3
3	Solve $y^2r - 2ys + t = p + 6y$	Apply	3
4	Solve the equation by the method of separation of variables $\frac{\partial u}{\partial x} = 2\frac{\partial u}{\partial t} + u$, where $u(x,0) = 6e^{-3x}$	Apply	3
5	Solve the equation by the method of separation of variables $\frac{\partial u}{\partial x} = 4\frac{\partial u}{\partial y}$, where $u(0,y) = 8e^{-3y}$	Apply	3

Long Answer Questions

S.No	Questions	Blooms taxonomy level	Course outcome
1	Form the P.D.E by eliminating the arbitrary constants a and b from log (az -1) = x+ay+b	Apply	3
2	Form the partial differential equation by eliminating the arbitrary function from z = $yf(x^2 + z^2)$.	Apply	3
3	Form the P.D.E by eliminating the arbitrary function f from z = xy + $f(x^2 + y^2)$	Apply	3
4	Solve the partial differential equation log (az -1) =x+ay+b	Apply	3
5	Solve $pqz = p^2(qx + p^2) + q^2(py + q^2)$	Apply	3
6	Solve the partial differential equation z = px + $qy+p^2q^2$	Apply	3
7	Form the partial differential equations by eliminating the arbitrary functions $Z = y^2 + 2f(1/x + \log y)$	Apply	3
8	Form the partial differential equation by eliminating a,b from $(x-a)^2 + (y-b)^2 = z^2 \cot^2\alpha$	Apply	3
9	Solve the partial differential equation $x^2/p + y^2/q = z$	Apply	3
10	Solve the partial differential equation $(x^2 - y^2 - z^2)p + 2xyq = 2xz$.	Apply	3

OBJECTIVE QUESTIONS:

UNIT I:

1. If the real part of an analytic function is given by $u(x,y) = x^2-y^2-y$ then find v(x,y).
2. For what values of a, b, c, the function f(z)= (x + ay) + i(bx +cy) is analytic.
3. An analytic function f(z) is such that $Re(f'(z)) = 2y \& f(1+i) = 2$ then the imaginary part of $f(z) is$ _____.
4. The value of $\int_0^{4+2i} zdz$ is_____ .
5. If c is the circle $|z-3i| = 4\ then \oint \frac{dz}{z^2+9}$ = _____.
6. $\int_{|z|=2} \frac{cosz}{z^3} =$ _____.
7. $\int \frac{z^2-4}{z^2+4} dz$evaluated anticlockwise around the circle$|z-i| = 2\ is$ _____.
   A) -4π B) 0 C) $2+\pi$ D) 2+2i
8. Given $f(z) = \frac{1}{z+1} - \frac{2}{z+3}$. If c is a counter clock wise path in the z-plane such that $|z+1| = 1$, then the value of $\frac{1}{2\pi i}\oint f(z)dz is$
   A) -2 B) -1 C) 1 D) 2
9. The fixed points of f(z)=$\frac{2iz+5}{z-2i}$ are _____.
10. Find the radius of convergence of the series of the function $f(z) = \frac{1}{1-z}$ about $z = \frac{1}{4}$ is _____.

UNIT II

1. The residue of the function $f(z) = \frac{2z}{(z+4)(z-1)^2}$ at the point $z = 1$ is _____.
2. The residue of the function $\frac{1+z}{1-cosz} atz = 0\ is$ _____.
3. The residue of $f(z) = \frac{1}{(z+2)^2(z-2)^2} atz = 2\ \ is$ _____.

A)-1/32 B)-1/16 C)1/16 D)1/32

4. The residues of $X(z) = \frac{1-2z}{z(z-1)(z-2)}$ at its poles are _____.

A)1/2,-1/2,1 B)1/2,1/2,-1 C)1/2,1,-3/2 D)1/2,-1,3/2

5. If $f(z) = \frac{z}{8-z^3}$ then residue of $f(z) atz = 2$ is _____.

A) -1/8 B)1/8 C)-1/6 D)1/6

6. Primitive period of exp (z) is _____.

UNIT III

1. A bilinear transformation $w = \frac{az+b}{cz+d}$ having only one fixed point is called _____.
2. An example of a map which is conformal in the whole of its domain of definition is _____
3. Another name of Bilinear Transformation is ----------
4. The transformation affected by an analytic function w=f(z) is conformal at all points of the z plane where $f^1(z)=0$ (True/False)
5. The transformation w=f(z) is isogonal if the angle between the curves in the w-plane is same as the angle between the curves in z-plane (True/False)

UNIT IV

1. The trigonometrically series of f(x) in the interval (-π, π) is ……
2. If x = a is the point of discontinuity then the Fourier series of f(x) at x = a is given by f(x) = …..
3. In the Fourier series expansion of a function, the Fourier coefficient a represents the …….. value of the equation.
4. Conditions for expansion of function in Fourier series are known as …… conditions.
5. The rate of convergence of a Fourier series increases while the series is …….
6. Fourier series expansion of even function in (-c, c) has only ……..terms.
7. If f(x) is an odd function in (-l, l), then the graph of f(x) is symmetrical about the …….
8. If f(x) is an even function in the interval (-l, l) then the value of b =……..

UNIT V

1. The general solution of $p^3 - q^3 = 0$ is -----
2. The general solution of pq +p +q =0 is -------
3. The general solution of $z = px + qy + p^2q^2$ is -------
4. The general solution of z = pq is ------
5. The general solution of $p^2 + q^2 = x + y$ is --------
6. By eliminating a and b from z = ax + by+ a/b , the P.D.E formed is -------

7. By eliminating a and b from z = ax + by $+a^2 +b^2$, the formed P.D.E is ----

8. The P.D.E by eliminating the arbitrary constants a and b is from z = ax + by is –

9. The P.D.E by eliminating the arbitrary function from z = $f(x^2 - y^2)$ is -----

10. The P.D.E by eliminating the arbitrary function from z = yf(y/x) is -------

GATE:

1. For an analytic function, $f(x+iy)=u(x,y)+iv(x,y)$, u is given by $u=3x^2-3y^2$. The expression for v, considering K to be a constant is _____.
   Ans: 6xy + k.
2. $z = \frac{2-3i}{-5+i}$ can be expressed as

a) -0.5-0.5 i b)-0.5+0.5 i c)0.5-0.5 i d)0.5+0.5 iAns: b

3. The real part of an analytic function f(z) where z = x + iy is given by e^{-y}Cosx. Then imaginary part of f(z) is _____. Ans : e^{-y}Sinx
4. The equation sin (z) = 10 has

a) No Solution b) Unique Solution c) Infinite No. of solutions d)Two Solutions Ans: a

5. Consider f(z)= $\frac{9}{(z-1)(z+2)^2}$ .Which of the following is one of the residues:

a)-1 b) 9/16 c) 2 d) 9 Ans: a

6. The analytic function f(z)= $\frac{z-1}{z^2+1}$ has singularities at _____ Ans: i and -i
7. The P.D.E by eliminating the arbitrary constants a and b from $z = ax + by$ is _____ Ans: c)

a) $z = qx + py$ b) $z = px - qy$ c)$z = px + qy$ d) None

8. The P.D.E by eliminating the arbitrary constants a and b from $z = \frac{x}{a} + \frac{y}{b}$ is _____ Ans: a)

a) $z = px + qy$ b) $z = pq$ c)$z = qx + py$ d) None

9. The P.D.E corresponding to the equation $z = f(x^2 + y^2)$ by eliminating the arbitrary function f is _____ Ans: $py = qx$

a)$px = qy$ b) $py = qx$ c)$py + qx = 0$ d) $px + qy = 0$

10. The second order partial differential equation $\frac{\partial^2 u}{\partial t^2} = c^2 \frac{\partial^2 u}{\partial x^2}$ represents the _____ Ans: Wave Equation

a) Heat Equation b) Wave equation c) Both d) None

WEBSITES:

1. www.geocities.com/siliconvalley/2151/matrices.html
2. www.mathforum.org/key/nucalc/fourier.html
3. www.mathworld.wolfram.com
4. www.eduinstitutions.com/rec.htm
5. www.isical.ac.in

NPTEL WEBSITES:

1. http://nptel.ac.in/courses/111108066/
2. http://nptel.ac.in/courses/111106051/
3. http://nptel.ac.in/courses/111102011/
4. http://nptel.ac.in/syllabus/syllabus.php?subjectId=111103019

EXPERT DETAILS:

JOURNALS:

INTERNATIONAL

1. Journal of American Mathematical Society
2. Journal of differential equations - Elsevier
3. Pacific Journal of Mathematics
4. Journal of Australian Society
5. Bulletin of "The American Mathematical Society"
6. Bulletin of "The Australian Mathematical Society"
7. Bulletin of "The London Mathematical Society"

NATIONAL

1. Journal of Interdisciplinary Mathematics
2. Indian Journal of Pure and Applied Mathematics
3. Indian Journal of Mathematics
5. Differential Equations and Dynamical Systems
6. Proceedings of Mathematical Sciences
7. Journal of Mathematical and Physical Sciences.
8. Journal of Indian Academy and Sciences

LIST OF TOPICS FOR STUDENT SEMINARS:

1. Explain Charpit's method
2. Fourier sine and cosine transforms

CASE STUDIES / SMALL PROJECTS:

1. Use partial differential equations in engineering
2. Special functions and their applications.
3. Analytic Functions and their applications