Mathematics III (MTH213)

Programme: B.Tech. (CSE,ECE,CCE,Mechatronics) Year: 2015 Semester: Third
Course : Core Credits : 4 Hours : 40

Course Context and Overview (100 words):
The main objective of the course is to introduce elements of Complex Analysis and partial differential equations for the undergraduate students. In contrast with Calculus, students are novice in learning Complex Analysis and partial differential equations at the undergraduate level. Realizing this fact, these topics are kept among the main ingredients of Engineering Mathematics.

Prerequisites Courses: Mathematics-I (MTH102) and Mathematics-II (MTH108)

Course outcomes (COs):

On completion of this course, the students will have the ability to:
CO1 Carry out computations with complex numbers and the geometry of the complex plane.
C02 Determine if a function is harmonic and find a harmonic conjugate via the Cauchy-Riemann equations.
C03 Find the images of lines, circles in the complex plane under the exponential, trigonometric and hyperbolic & other elementary mappings.
C04 Evaluate contour integrals using the Cauchy Integral Theorem and the Cauchy Integral Formula in basic and extended form. Find Taylor or Laurent Series for complex valued functions. Identify and classify zeros and singular points of functions. Compute residues. Use residues to evaluate various contour integrals.
C05 Identify & classify PDEs of different types, solve first order PDEs and give their geometric interpretations. Compute canonical form a second order PDE and solve Heat, Wave & Laplace equations on rectangular and spherical domains using Fourier Method.

Course Topics:

Topics	**Lecture Hours**	
UNIT - I **1. Topic**		
1.1 Field of Complex Numbers; Absolute values, Conjugates, Polar form, Argument, Demoivre's Theorem, nth roots, geometrical interpretations.Complex valued functions	2	8
1.2 limits, continuity, differentiability, analyticity; Cauchy-Riemann Equations; harmonic functions; conjugate harmonic functions.	2	
1.3 Principle values of multi-valued functions. Conformal mappings; Mobeus transformations; Mobeus transformation as a composition of translation, dilation, rotation, inversion;	4	

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fixed points; mapping of disk/half plane and applications.		
UNIT - II **2. Topic**		8
2.1 Line integrals; ML-inequality, dependence of integral upon the end points of a path; Cauchy Integral Theorem for simply connected domains and its extension to multiply connected domains.	3	
2.2 Cauchy’s Integral formula; existence of derivatives of all orders of an analytic function; Cauchy’s inequality; Liouville’s Theroem, Morera’s Theorem; Fundamental Theorem of Algebra, Gauss’s Theorem	3	
2.3 Fundamental Theorem of Algebra, Gauss’s Theorem (zeros of the derivative of a polynomial lie within the convex hull of the zeros of the polynomial).	2	
UNIT - III **3. Topic**		8
3.1 Convergence of sequences and series; Power series; radius of convergence; analyticity of power series.	2	
3.2 Taylor Series of an analytic function; Laurent Series; methods of obtaining Laurent Series; Zeroes of an analytic function.	2	
3.3 Cauchy’s inequality; Liouville’s Theroem, Morera’s Theorem; Zeroes of an analytic function; classification of isolated singularities as removable, pole, essential; Residues.	2	
3.4 Cauchy Residue Theoroem; Rouche’s Theorem; Evaluation of some real integrals by using Cauchy’s Residue Theorem.	2	
UNIT - IV **4. Topic**		8
4.1 PDE: introduction, linear, nonlinear (semi-linear, quasilinear), examples,well-posedness (unique solution, no solution, infinite no. of solutions)	2	
4.2 First order linear and quasilinear PDEs, method of characteristics, general solutions	1	
4.3 Classification of 2nd order PDEs	1	
4.4 Reduction to standard form: hyperbolic,parabolic and elliptic	2	
4.5 Wave equations: D’Alemberts formula, Duhamel’s principle	1	
4.6 Wave equations: Solutions for initial boundary value problem	1	
UNIT-V **5. Topic**		8
5.1 Heat equations: Uniqueness and maximum principle, applications	2	
5.2 Laplace and Poisson equations: Uniqueness and maximum principle for Dirichletproblem	2	
5.3 Laplace and Poisson equations: Boundary value	1	

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problems in 2D		
5.4 Fourier Method for IBV problem for wave and heat equation rectangular region	2	
5.5 Fourier Series method for Laplace equation in 3 dimensions	1	

Textbook references (IEEE format):

Text Book:

1. Erwin Kreyszig, Advanced Engineering Mathematics, 8th edition,Wiley publishers.
2. Ian N. Sneddon, Elements of Partial Differential Equations, Dover Publications, 2006.
3. J.W. Brown & R.V. Churchill, *Complex Variables and Applications*, McGraw Hill

Reference books:

1. T. Amarnath, An Elementary Course in Partial Differential Equations.
2. A. Jeffery, Applied Partial Differential Equations: An Introduction.

Additional Resources (NPTEL, MIT Video Lectures, Web resources etc.): NPTEL, MIT Video Lectures.

Evaluation Methods:

Item	Weightage
Quiz1	5%
Quiz2	5%
Quiz3	5%
Quiz4	5%
Midterm	30%
Final Examination	50%

Prepared By: Course Instructor name:

Last Update: _2015_____

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