Course Plan for Spring Semester 2019

Tezpur University
Course: MS 105, Mathematics-II
(For the B. Tech. Students of the School of Engineering)
L3-T1-P0-CH4-CR4

Name of the instructors:

1. Dr. Rajat Kanti Nath, Dept. of Mathematical Sciences
2. Ms. Nilufar Mana Begum, Dept. of Mathematical Sciences
3. Mr. Deepak Sarma, Dept. of Mathematical Sciences
4. Mr. Ajay Sharma, Dept. of Mathematical Sciences
5. Mr. Parama Dutta, Dept. of Mathematical Sciences

Abstract: The course introduces basics of linear algebra, complex analysis, numerical analysis and integral transforms. This course gives a thorough understanding of the theory and its applications. Emphasis is given to developing problem solving capability.

Course Objective:
1. To learn the basics of linear algebra, complex analysis, numerical analysis and integral transforms.
2. To enable the students for developing their computational skills.

Prerequisites of the course: None

Course Outline + Suggested readings:

Unit 1: Linear algebra *(12 lectures)*

Rank of a matrix, determinants, Cramer's Rule. Linear systems of equations, Direct methods: Gauss elimination, Gauss-Jordan elimination and LU factorization.
Vector spaces – Linear dependence of vectors, basis, linear transformations, range and kernel of a linear map, rank and nullity, rank-nullity theorem. Matrix associated with a linear map. Eigenvalues and eigenvectors, Cayley-Hamilton Theorem.

Unit 2: Complex analysis *(6 lectures)*

Limit, continuity, differentiability and analyticity of functions Cauchy-Riemann equations, elementary analytic functions (exponential, trigonometric, logarithm) and their properties.

Unit 3: Complex integration *(8 lectures)*

Line integrals, contour integral, Cauchy's integral theorem, Cauchy's integral formula, Cauchy Integral formula (without proof), Liouville's theorem and Maximum-Modulus theorem (without proof). Taylor's series, zeros of analytic functions, singularities, Laurent's series; Residues, Cauchy Residue theorem (without proof).

Unit 4: Numerical methods-I *(7 lectures)*

Finite differences, relation between operators, Interpolation using Newton's forward and backward difference formulae. Interpolation with unequal intervals: Newton's divided difference and Lagrange's formulae.

Solution of polynomial and transcendental equations – Bisection method, Newton-Raphson Method, Secant method and Regula-Falsi method.

Unit 5: Numerical methods-II ***(6 lectures)***

Taylor's series, Numerical Differentiation, Numerical integration: Trapezoidal rule and Simpson's rules. Numerical solution of ordinary differential equations using Euler and modified Euler's methods. Runge-Kutta methods.

Unit 6: Integral transform ***(6 lectures)***

Laplace Transform, Properties of Laplace Transform, Laplace transform of periodic functions. Finding inverse Laplace transform by different methods, convolution theorem. Evaluation of integrals by Laplace transform, solving ODEs and PDEs by Laplace Transform method.
Fourier series, Fourier transforms methods, inverses and their applications.

Textbook(s)

1. Erwin Kreyszig, *Advanced Engineering Mathematics*, (John Wiley & Sons, 9th Edition), 2006.
2. Thomas and Finney, *Calculus and Analytic Geometry*, (Pearson Education, Eleventh (Indian) Edition), 1998.

Reference book(s)

1. Jain, R. K. and Iyengar, S. R. K. *Advanced Engineering Mathematics,* Third Edition, (Narosa publishing house, India), 2009.
2. Veerarajan T., *Engineering Mathematics for first year,* (Tata McGraw-Hill, New Delhi), 2008.
3. Ramana, B. V. *Higher Engineering Mathematics*, (McGraw Hill, India), 2010.
4. Brown J. W. and Churchill R. V., *Complex Variables and Applications,* (Mc-Graw Hill, 7th Edition), 2004.

Pedagogy:
Lecture method, Quiz, Home assignment, Discussion etc.

Lecture Plan for the Course:

Lecture No.	Topics
1	Rank of a matrix
2	Linear system of equations
3	Gauss eliminations and Gauss-Jordan eliminations
4	LU-factorization
5	Vector Spaces and examples
6	Linear dependence of vectors
7	Basis
8	Linear transformation
9	Range and Kernel of a linear map
10	Rank and nullity
11	Matrix associated with a linear map
12	Eigen values and Eigen vectors
13	Finite difference operators and their relations
14	Newton's forward interpolation formula

15	**Newton's backward interpolation formula**
16	**Interpolation with unequal intervals- Newton's divided difference formula**
17	**Interpolation with unequal intervals-** Lagrange's interpolation formula
18	**Bisection and Newton-Raphson method**
19	**Secant and Regula-falsi method**
20	**Taylor's series**
21	**Numerical differentiation**
22	**Numerical differentiation contd.**
23	**Numerical integration**
24	**Numerical solution of ODE**
25	**Numerical solution of ODE contd.**
26	**Functions of complex variables**
27	**,limit & continuity**
28	**Differentiability & analyticity**
29	**Cauchy-Riemann equations**
30	**Exponential, trigonometric & logarithmic functions**
31	**Exponential, trigonometric & logarithmic functions contd.**
32	**Line Integrals and contour integrals**
33	**Cauchy's Integral Theorem & Formula**
34	**Integration continues**
35	**Taylor's series**
36	**Laurent's series**
37	**Zeros and singularities**
38	**Residue theorem**
39	**Residue theorem contd.**
40	**Laplace transform**
41	**Laplace transform contd.**
42	**Evaluation of integrals by Laplace transform**
43	**Solution of ODE and PDE by Laplace transform**
44	**Fourier transform**
45	**Fourier transform contd.**

Evaluation plan:

TEST I	: 25 Marks
MAJOR I	: 40 Marks
TEST III	: 25 Marks
MAJOR II	: 60 Marks
TOTAL	: 150 Marks

Expected outcome of the course: Towards the end of the course the student would be able to apply the concepts taught in various problems in Engineering.