JNTUH COLLEGE OF ENGINEERING HYDERABAD
(Autonomous)

Department of Mathematics

M.Sc. (Applied Mathematics) – Full Time 2021-22

Course structure

I SEMESTER

S.No.	Code	Subject	L	P	Credits
1	APM05101	Mathematical Analysis	4	0	4
2	APM05102	Algebra	4	0	4
3	APM05103	Theory of Ordinary Differential Equations	4	0	4
4	APM05104	Probability and Statistics	4	0	4
5	APM05105(i) APM05105(ii)	**Departmental Elective-I** (One of the following is to be selected) i) Discrete Mathematics ii) Mechanics	4	0	3
6	APM05106	‘C’ Programming Lab	0	6	2
7	APM05107	Seminar	2	0	1
		Total			**22**

II SEMESTER

S.No.	Code	Subject	L	P	Credits
1	APM05201	Advanced Analysis	4	0	4
2	APM05202	Linear Algebra	4	0	4
3	APM05203	Complex Analysis	4	0	4
4	APM05204	Integral Transforms and Integral Equations	4	0	4
5	APM05205(i) APM05205(ii)	**Departmental Elective-II** (One of the following is to be selected) i) Calculus of variations ii) Advanced Differential Equations	4	0	3
6	APM05206	Data Structures through ‘C’	0	6	2
7	APM05207	Seminar	2	0	1
		Total			**22**

III SEMESTER

S.No	Code	Subject	L	P	Credits
1	APM05301	Topology	4	0	4
2	APM05302	Numerical Analysis	4	0	4
3	APM05303	Partial Differential Equations	4	0	4
4	APM05304	Optimization Techniques	4	0	4
5	 APM05305(i) APM05305(ii)	**Departmental Elective-III** (One of the following is to be selected) i) Discrete Time Control Systems ii) Analytic Number Theory	4	0	3
6	APM05306	MATLAB-I	0	6	2
7	APM05307	Seminar	2	0	1
		Total			**22**

IV SEMESTER

S.No	Code	Subject	L	P	Credits
1	APM05401	Functional Analysis	4	0	4
2	APM05402	Operation research	4	0	4
3	APM05403	Fluid Mechanics	4	0	4
4	APM05404	Differential Equations and Dynamical Systems	4	0	4
5	 APM05405(i) APM05405(ii)	**Departmental Elective-IV** (One of the following is to be selected) i) Theory of Computation ii) Numerical Methods for Partial Differential Equations	4	0	3
6	APM05406	MAT LAB-II	0	6	2
7	APM05407	Project	0	8	3
		Total			**24**

SYLLABUS

FOR

SEMESTER - I

- Mathematical Analysis
- Algebra
- Theory of Ordinary Differential Equations
- Probability and Statistics
- **Departmental Elective- I**
  - Discrete Mathematics
  - Mechanics
- ‘C’ Programming Lab

101- Mathematical Analysis

L: 4, P: 0, Credits: 4

Pre Requisites: Foundation Course.

Objectives:

- To train the students thoroughly in mathematical concepts of Basic analysis.
- To impart firm foundation in analysis which is useful in many other subjects of mathematics

UNIT-I

Basic Topology: Metric Spaces - Compact Sets- Perfect Sets- Connected Sets.
Numerical Sequences and Series: Convergent Sequence- Subsequences- Cauchy Sequences.

UNIT-II

Infinite Series: Series of Non-negative Terms- The Number *e*- The Root and Ratio Tests- Power Series- Summation by parts- Absolute Convergence- Addition and Multiplication of Series.

UNIT-III

Continuity: Limits of Functions- Continuous Functions- Continuity and Compactness- Continuity and Connectedness- Discontinuities- Monotone Functions.

UNIT-IV

Differentiation: The Derivative of a real function- Mean value theorems- The Continuity of Derivatives- L'Hosoital's Rule- Derivatives of Higher Order- Taylor's Theorem.

UNIT-V

The Riemann-Stieltjes Integral-Definition and Existence of the Integral- Properties of Integral- Integration and Differentiation

Scope as in:

1. Principles of Mathematical Analysis- Walter Rudin, Third Edition, Mc Graw Hill.

References:

1. Introduction to Real Analysis- R.G. Bartle and D.R. Sherbert, third Edition, John Wiley.
2. Mathematical Analysis- Tom. M. Apostol, Second Edition, Narosa Publishing House.
3. A First Course in Real Analysis- S.K. Berberian, Springer.
4. Basic Real Analysis– Houshang H. Sohrab, Springer International Edition.
5. Elementary Analysis, The Theory of Calculus- Kenneth A. Ross, Springer.

Outcomes:

- The students become familiar with basic concepts of analysis.
- The students attain the ability to use this knowledge to understand and to solve many problems in other subjects like Differential Equations, Partial Differential equations etc.
- This is a foundation course and students can use this as a pre requisite for many other subjects in their upcoming semesters.

102- Algebra

L: 4, P:0, Credits: 4

Pre Requisites: Foundation Course.

Objectives:

- To train the students thoroughly in mathematical concepts of algebra.
- To impart firm foundation in algebra which is useful in many other subjects of mathematics.

UNIT-I

Group Theory-I: Definition of a Group – Some examples of group – Some preliminary Lemmas – Subgroups – A counting principle – Normal subgroups and Quotient groups.

UNIT-II

Group Theory-II: Homomorphisms – Automorphisms – Cayley's Theorem – Permutation Group

UNIT-III

Another counting principle – Sylow's Theorem – Direct products – Finite abelian groups.

UNIT-IV

Ring Theory-I: Definition and examples of rings – Some special classes of rings – Homomorphisms – Ideals and quotient rings – More ideals and quotient rings – The field of quotients of an integral domain.

UNIT-V

Ring Theory-II: Euclidean rings – A particular Euclidean ring – Polynomial rings –Polynomials over the rational field – Polynomial rings over commutative rings.

Scope as in:

1. Topics in Algebra- I.N. Herestein – Second Edition - John Willey

References:

1. Basic Abstract Algebra- P.B. Bhattacharya, S.K. Jain, S.R. Nagpaul, Second Edition - Cambridge University Press.
2. Algebra- M.Artin, PHI.
3. Algebra Contemporary Abstract- Joseph A. Gallian, Narosa.
4. Abstract Algebra – David S. Dummit, Richard M. Foote – 3rd Edition – Wiley.
5. Basic Algebra- P.B. Cohn, Springer.

Outcomes:

- The students become familiar with basic concepts of algebra.
- The students attain the ability to use this knowledge to understand and to solve many problems on other subjects like galois theory.
- This is a foundation course and students can use this as a pre requisite for many other subjects in their upcoming semesters.

103-Theory of Ordinary Differential Equations

L: 4, P:0, Credits: 4

Pre Requisites: Foundation Course.

Objectives:

- To train the students thoroughly in mathematical concepts of Theory of Ordinary Differential Equations.
- To impart firm foundation in Theory of Ordinary Differential Equations which is useful in many other subjects of mathematics.
- To train the students to use this knowledge in mathematical modeling and some related research areas.

UNIT-I

Linear Equation with Variable Coefficients: Introduction- Initial Value Problem for the Homogeneous Equation- Solutions of the Homogeneous Equation- The Wronskian and linear independence- Reduction of the order of a Homogeneous Equation- The non- homogeneous Equation- Homogeneous Equations with analytic Coefficients- The legendre Equation- Justification of the power series method.

UNIT-II

Linear Equations with Regular Singular points: Introduction- The Euler equation- Second order equations with Regular Singular points- the general case- A convergence proof- The exponential case- The Bessel Equation- Regular Singular points at infinity.

UNIT-III

Existence and Uniqueness of solution to First order Equations: Introduction-Equations with Variables separated- Exact Equations- The Method of Successive Approximations.

UNIT-IV

The Lipschitz condition-Convergence of recursive approximations- Non-local existence of solutions- Approximation and uniqueness of solutions- Equation with complex valued functions.

UNIT-V

Existence and uniqueness of solutions of nth order equations: Introduction- An example- central forces and planetary motion- some special equations- Complex n-dimensional space- Systems as vector equations- **Existence and uniqueness of solutions to systems**- Existence and uniqueness for linear systems- Equations of order n.

Scope as in:

1. An Introduction to Ordinary Differential Equations- Earl A. Coddington, PHI.

References:

1. Differential Equation with Applications and Historical notes. –G.F.Simmons- Tata MC.GrawHill.
2. Text Book of Ordinary Differential Equations- SG.Deo, V.Lakshmikanthan, V.Ragavendra, Tata Mc.GrawHill.
3. A First Course in Differential Equations With Modeling Applications- Dennis G.Zill, 8th Edition, Thomson Books/college.
4. Elementary Differential Equations & Boundary Value Problems- Boyce-Dprima, Seventh Edition, John Willey.

Outcome:

- The students now ready to take higher courses in Differential Equations and Dynamical Systems.

104-Probability and Statistics

L: 4, P:0, Credits: 4

Pre Requisites: Foundation Course.

Objectives: The student will be able to:

- Define experiment, outcome, event, probability and equally likely.
- Restate the formula for finding the probability of an event.
- Determine the outcomes and probabilities for experiments.
- Interact with die rolls and spinners to help predict the outcome of experiments.
- Distinguish between an event and an outcome for an experiment.
- Recognize the difference between outcomes that are equally likely and not equally likely to occur.

UNIT-I

Probability: Sample spaces and events - Basic set theory - Definitions of probability - Axioms of probability - Addition Theorem - Conditional probability -Multiplicative Theorem - Total probability - Baye's Theorem - Independent events – random variables - Introduction - Types of Random variables - Discrete Random variable.

Continuous Random Variables: Probability Distribution Function - Properties of Distribution Function - Probability Density Function (PDF) - Properties of Density Function - Mathematical expectation - Variance - Chebyshev's inequality Probability and distribution: Binomial distribution - Poisson distribution - Uniform distribution - Normal distribution.

UNIT-II

Regression And Correlation: Correlation Analysis- Types of correlation - Positive and negative correlation -Simple - partial and Multiple Correlation - Linear and Non-Linear Correlation - Methods of Studying Correlation - Scatter Diagram correlation - Graphic method - Karl Pearson's Coefficient of correlation - Rank Correlation - Partial correlation - Multiple Correlation - Regression Analysis.

UNIT-III

Tests of statistical hypothesis - large sample tests - Introduction - Statistical Hypothesis -test of a statistical hypothesis- Procedure for Testing of Hypothesis - Set up a Hypothesis - Set up a Suitable significance Level - Setting's test criterion - Doing computations - Making decisions - Type I and Type II errors - Two-tailed and one-tailed test of Hypothesis - Large sample tests: Test of significance of single mean - Test of significance for difference of standard deviation - Test of Significance for single proportion - Test of significance for difference of proportions.

UNIT-IV

Tests of statistical hypothesis small sample tests: Introduction -student's t-distribution- Properties of t-distributing - test of significance of single mean - Test of significance for inference between two mean of independent sample_ Test of significance for difference between Two Means (dependent samples)- Test of Significance of an observed correlation coefficient - F-test for equality of Population Variance - Chi-square distribution : Properties of chi-square distribution - Applications of Test of a statistical χ^2 distributions - Chi-square test for goodness of fit - Conditions for-applying χ^2 test - degree of freedom -Chi-square test for independence of attributes.

UNIT-V

Time series analysis - Introduction - Significance of Time series analysis - Components of time series - Secular Trend: Freehand of Graphic Method - Semi average Method - Method of Moving Averages- Method of Least Square - Straight linear and non-linear trends - Seasonal variations: Method of Simple averages Ratio-to-trends method - Ratio-to-Moving average method – Link relative method.

Scope as in:

1. Fundamentals of Mathematical Statistics- Gupta and Kapoor.

Reference:

1. Probability and Statistics for Engineers and Scientists- Miller& Freund.
2. Probability and Statistics- Anthony J Hayter.
3. Introduction to Probability chartesM.Grinstead- J. Laurie Snell.

Outcomes:

The student will be able to:

- Define certain event, impossible event.
- Describe and list the contents of a standard deck of 52 playing cards.
- Examine the probabilities of experiments with certain outcomes.
- Examine the probabilities of experiments with impossible outcomes
- Evaluate interactive die rolls and spinners in relation to certain and impossible events.
- Explain the difference between certain and impossible events.
- Compute the probability of a certain event.
- Compute the probability of an impossible event.

Departmental Elective- I

105(i).Discrete Mathematics

L: 4, P:0, Credits: 3

Pre Requisites: Algebra.

Objectives:

- To train the students thoroughly in mathematical concepts of discrete mathematics.
- To impart firm foundation in discrete mathematics which is useful in many other subjects of mathematics.
- The student is made to learn the logic and the applications into computer science.

UNIT-I

Recurrence Relations: Generating Functions-Coefficients of Generating Functions-Recurrence Relations-Inhomogeneous recurrence relations.

UNIT-II

Relations and Digraphs: Product Sets and Partitions- Relations and Digraphs- Paths in relation and Digraphs- Properties of Relations- Equivalence Relations -Data structures for Relations and Digraphs- Operations on Relations- Transitive Closure and Warshall's Algorithm- Adjacency Matrices.

UNIT-III

Functions: Functions- Functions for Computer Science- Growth of Functions- Permutation Functions.

UNIT-IV

Order Relations and Structure:-Partially Order Sets- External Elements of Partially Ordered Sets- Lattices- Finite Boolean Algebras- Functions on Boolean Algebras- Circuit Design.

UNIT-V

Graphs: Isomorphism-Trees Spanning Trees-Binary Trees-Planar Graphs-Euler Circuits-Hamiltonian Graphs-Chromatic Numbers.

Scope as in:

1. Discrete Mathematics for Computer Science- L. Mott, A. Kendal and T.P. Baker, 2nd Edition, Kiston(I-IV UNIT) .

1. DiscreteMathematical Structure- Kolman-Busby-Ross, 5th Edition, Pearson Education

References:

1. Discrete Mathematics- Trembly Manohar
2. Discrete and Combinational Mathematics, Ralph. P.Grimaldi, Pearson Education India.
3. Discrete Mathematical Structure, G. Shanker Rao, NewAge International Pub.
4. Discrete Mathematics- Iyenger, Vikas Publications.
5. Discrete Mathematics with Applications, Thomous Koshy, Academic Press Print of Elsevier India.

Outcomes:

- The students become familiar with concepts of discrete mathematics.
- The students attain the ability to use this knowledge to understand and to solve many problems on other subjects like galois theory.

105(ii). Mechanics

L: 4, P:0, Credits: 3

Pre Requisites: Foundation Course.

Objectives:

- To give an overview of some important concepts in applied mathematics like principles of least action, an introduction to the mathematical physics.

UNIT-I

Lagrangian formulation: Mechanics of a particle- Mechanics of a system of particles-Constraints- Generalized coordinates- Generalized velocity- Generalized force and potential- D' Alembert's principle and Lagrange's equation- Simple applications of lagrangian formulation.

UNIT-II

Hamilton's principle- derivation of Lagrange's equations from Hamilton's principle- Extension of Hamilton's principle to non Holonomic systems- Advantages of variational principle formulation- conservation theorems and symmetry properties- **Hamiltonian formulation**: Legendre transformations and the Hamilton equations of motion- cyclic coordinates and conservation theorems- Derivation of Hamilton's equations from a variational principle.

UNIT-III

The principle of least action- the equation of canonical transformation- examples of canonical transformations- Poisson and Lagrange brackets and their invariance under canonical transformation- Jacobi's identity- Poisson's theorem- Equations of motion infinite estimal canonical transformations and conservation theorems in the Poisson bracket formulation.

UNIT-IV

Hamilton Jacobi equations for Hamilton's principal function- The harmonic oscillator problems as an example of the Hamilton- Jacobi method- New concept of space and time- postulates of special theory of relativity.

UNIT-V

Lorentztransformation equation- Lorentz contraction- Time dilation- Simultaneity- Relativistic formulae for composition of velocities and accelerations- Proper time- Lorentz transformations form a group.

Scope as in:

1. Classical Mechanics, 2nd Edition- H. Goldstein, Narosa Publishing House.
2. Introduction to Theory of Relativity- P. G. Bergman.

References:

1. Relevant topics from special relativity- W. Rindler- Oliver & Boyd, 1060.
2. An elementary treatise on the dynamics of a particle and of rigid bodies- S. L. Loney.
3. A first course in mechanics,Grant R. Fowler, PHI.
4. Continuum Mechanics- D. S. Chandrashekaraiah.

Outcome:

- The student can apply mathematical concepts to real world systems.

106- 'C' Programming Lab

L: 2, P:6, Credits: 2

Pre Requisites: Foundation Course.

Objectives:

- To provide students with a comprehensive study of the C programming language. Classroom lectures stress the strengths of C, which provide programmers with the means of writing efficient, maintainable, and portable code. The lectures are supplemented with non-trivial lab exercises.

UNIT-I

Introduction to 'C': Introduction -Basic Structure of C programming- Keywords and Identifiers- constants- variables- data types- declaration of variables- assigning values to variables - Operators and expressions - Decision making and branching – Decision making and looping.

UNIT-II

Arrays: Introduction – One dimensional arrays – Declaration of one dimensional arrays - Initialization of one dimensional arrays – Two dimensional arrays – Initializing two dimensional arrays – Multi dimensional arrays.

Strings: Introduction – Declaring and initializing string variables –Reading strings from terminal – writing strings to screen – Arithmetic operations on characters – putting strings together – Comparison of two strings – String handling functions.

UNIT-III

Functions: Introduction – Need for User defined functions – A multi function program – Elements of user defined functions – Definition of functions – Return values and their types – Function calls – Function declaration – Category of functions – No arguments and no return values – Argument but no return values - Arguments with return values – No arguments but returns a value - Functions that return multiple values – Nesting of functions – Recursion – Passing arrays to functions – Passing string to functions – The scope, visibility and lifetime of variables.

Pointers: Introduction – Accessing the address of variables – Declaring pointer variable – Initialization of pointer variables – Accessing a variable through its pointer – Chain of pointers – Pointer expressions – Pointer increments and scale factors – Pointers and arrays – Pointers and characters strings – Array of pointers – Pointers as function arguments – Functions returning pointers – Pointers to functions – Pointers and structures.

UNIT- IV

Structures and Unions: Introduction – Defining a structure – Declaring structure variable – Accessing structure variables – Structure Initialization – Copying and comparing structure variables – Operations on Individual members – Arrays of structures – Arrays within structures – Structure within structure – Structures and functions – Unions – Size of structures – Bit Fields – Typedef – Enum.

UNIT-V

File management in C: Introduction – Types of files – Defining and opening a file – Closing a file – Input / output operations on files – Error handling during I/O operations – Random Access to files – Command line arguments – Application of command line arguments.

Scope as in:

1. Computer Programming and Data Structures, Third Edition - E. Balagurusamy – Tata McGraw Hill

References:

1. Let Us C-.C. Proramming–YashavantKanitkarSchaum– BPB Publishers

Outcome:

Upon completion of this course, students will be able to:

- Write C programs that are non-trivial.
- Use the variety of data types appropriate to specific programming problems.
- Utilize the modular features of the language.
- Demonstrate efficiency and readability.
- Demonstrate the use of the various control flow constructs.
- Use arrays as part of the software solution.
- Utilize pointers to efficiently solve problems.
- Include the structure data type as part of the solution.
- Create their own data types.
- Use functions from the portable C library.

Lab Practice:

1. Write a program for addition of two numbers.
2. Write a program for finding area and circumference of a circle.
3. Write a program for finding simple interest.
4. Write a program for finding area and perimeter of a rectangle.
5. Write a program to read 5 subject marks of a student and find average marks of that student.
6. Write a program to convert the given KMPH to Meter per second.
7. Write a program to convert the given number of days into months and days.
8. Write a program to check whether the given number is even or odd.
9. Write a program to check whether the given number is positive or negative.
10. Write a program to calculate the division obtained by a student.
11. Write a program to demonstrate the use of sizeof() operator
12. Write a program to swap two numbers using 3 variables and 2 variables.
13. Write a program to find the biggest of three numbers.
14. Write a program to check whether the given year is leap year or not.
15. Write a program to read a date from the key board, and check whether the given date is in correct format or not. (dd/ mm/ yyyy)
16. Write a program to convert the given temperature from Fahrenheit to centigrade.
17. Write a program to count number of hundred notes, fifty notes and ten notes for the given amount.
18. Write a program to read an integer and check whether the entered value is palindrome or not.
19. Write a program to read an integer value, and print that integer in reverse order
20. Write a program to read an integer and check whether the entered value is Armstrong or not.
21. Write a program to evaluate arithmetic operations using switch case.
22. Write a program to evaluate arithmetic operations on complex numbers using switch case.
23. Write a program to determine whether the given character is vowel or not using switch case.
24. Write a program to calculate sum of all the numbers between 1 and 50 excluding multiples of 3 and 5.
25. Write a program to calculate the sum of digits of an integer.
26. Write a program to check whether the given number is prime or not.
27. Write a program to solve the following series
28. Write a program to calculate the sum of N- Terms of the following series
29. Write a program to calculate the sum of N- Terms of the following series
30. Write a program to print Fibonacci series of N terms.
31. Write a program to calculate the sum of odd numbers between 1 and 50.
32. Write a program to read a character from the keyboard and tell the user whether the character is alphabet, digit or any other special character.(use character test functions)
33. Write a program to read a character from the key board and print that character in reverse case. (use character test functions)
34. Write a program to find a large number in a given array.
35. Write a program to find the average, min and max value for the given array of elements.
36. Write a program to find Fibonacci series using arrays.
37. Write a program to read Two M X N Matrix and perform Addition Operation.
38. Write a program to read Two M X N Matrix and perform Subtraction Operation
39. Write a program to read Two M X N Matrix and perform Multiplication Operation
40. Write a program to read a M X N Matrix and find the Transpose of that matrix.
41. Write a program to read M X N and find the trace of the Matrix.
42. Write a program to read a M X N Matrix and print the diagonal elements.
43. Write a program to read a string and find the number of vowels in the given string.
44. Write a program to read a string and check whether the given string is palindrome or not.
45. Write a program to find the length of the given string including and excluding spaces.

46. S1, S2, S3 are three string variables. Write a program to read two string constants into S1 and S2 and compare whether they are equal or not. If they are not equal join them together. Copy the contents of S1 into the variable S3. At last the program should print the contents of all the three variables and their lengths.
47. Write a program to print a Fibonacci series using functions.
48. Write a program to find the factorial of a given number using recursive function.
49. Write a program to obtain prime factors of given number using functions.
50. Write a program to calculate sum of digits of an integer with and without recursion.
51. Write a program to pass a user defined function as an argument to another function.
52. Write a program to print structure elements.
53. Write a program to display the difference between structure and union.
54. Write a program to use structure within union.
55. Write a program to pass a structure variable as an argument to a user defined function.
56. Write a program to read and display car details using nested structures.
57. Write a program to print the Pascal triangle
58. Write a program to print the Parallelogram.
59. Write a program to swap two numbers using pointers.
60. Write a program to print the values and addresses of variables and pointer variables .
61. Write a program to perform different arithmetic operations using pointers.
62. Write a program to declare void pointer, assign address of integer, float and character to the pointer variable using type casting, and display the contents of the various variables.
63. Writ e a program to declare a pointer variable to a structure and display the contents of the structure.
64. Write a program to show the effect of increment operator on pointer variable. Display the memory location of integer, character and float variables before and after increment operation on pointer variables.
65. Write an example program for call by value concept.
66. Write an example program for call by reference concept.

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SYLLABUSFOR

SEMESTER-II

- Advanced Analysis
- Linear Algebra
- Complex Analysis
- Integral Transforms and Integral Equations
- **Departmental Elective- II**
  - Calculus of Variations
  - Advanced Differential Equations
- Data Structures Through 'C'

201- Advanced Analysis

L: 4, P: 0, Credits: 4

Pre Requisites: Analysis- I.

Objectives:

- To train the students thoroughly in mathematical concepts of advanced Mathematical analysis.
- To impart firm foundation in analysis which is useful in many other subjects of mathematics

UNIT-I

Sequences and Series of Functions: Discussion of main problem – Uniform convergence - Uniform convergence and continuity - Uniform convergence and integration - Uniform convergence and differentiation – Equicontinuous families of functions – The Stone-Weierstrass theorem.

UNIT –II

Functions of several variables: Linear transformations – Differentiation – The contraction principle – The inverse function theorem – The implicit function theorem.

UNIT –III

Algebras of Sets: Algebra of Sets **-** σ Algebra of sets – Open and closed sets – Continuous functions – Borel sets.

UNIT –IV

Lebesgue Measure: Introduction - Outer measure - Measurable sets and Lebesgue measure - A non measurable set- Measurable functions - Littlewood's three principles.

UNIT –V

The Lebesgue Integral: The Riemann Integral - The Lebesgue integral of a bounded function over a set of finite measure - The integral of a non-negative function - The general Lebesgue integral.

Scope as in:

1. Principles of Mathematical Analysis- Walter Rudin, Third Edition, Mc Graw Hill. (Units I & II)
2. Real Analysis- H.L. Royden, 3 rd Edition, PHI. (Units III, IV and V)

References:

1. Introduction to Real Analysis- R.G. Bartle and D.R. Sherbert, third Edition, John Wiley.
2. Basic Multivariable Calculus- Jerrold E. Marsden, Anthony Tromba, Alan Weinstein, Springer.
3. Calculus, Tom M Apostol, Volume- 2, John Wiley.
4. Measure Theory and Integration- G. de Berra, New Age International (P)Ltd.
5. Fundamentals of Real Analysis- Sk. Berberian, Springer.

Outcomes:

- The students become familiar with advanced concepts of analysis.
- The students attain the ability to use this knowledge to understand and to solve many problems on other subjects like Differential Equations, Partial Differential equations etc.

202- Linear Algebra

L: 4, P:0, Credits: 4

Pre Requisites: Algebra

Objectives:

- To train the students thoroughly in mathematical concepts of Linear Algebra.
- To impart firm foundation in linear algebra which is useful in many other subjects of mathematics.

UNIT-I

General Vector spaces: Real vector spaces – Subspaces – Linear Independence – Basis and Dimension – Row space, Column Space and Null space – Rank and Nullity.

UNIT-II

Inner product spaces- Inner products – Angle and orthogonality in inner product spaces – Orthonormal bases: Gram-Schmidt process: Q R-Decomposition – Best Approximation: Least squares – Change of basis – Orthogonal matrices.

UNIT-III

Linear Transformations: General linear transformations – Kernel and Range – Inverse linear transformations – Matrices of general linear transformations – Similarity – Isomorphism.

UNIT-IV

Eigen values and Eigen vectors: Eigen values and Eigen vectors – Orthogonal matrices– Unitary matrices- Normal matrices and Hermitian matrices- similar matrices- Properties of Eigen values and Eigen vectors – diagonalization - Factorization.

UNIT-V

Additional Topics: Application to differential equations – Approximation problems: Fourier series – Quadratic forms.

Scope as in:

1. Elementary Linear Algebra– Howard Anton, 9th Edition, John Wiley and Sons.

Reference:

1. An introduction to Linear Algebra- V. Krishna Murthy, Affiliated East-West press.
2. Introduction to Matrix Analysis- Richard Bellimen, Tata Mc Graw- Hill.
3. Linear Algebra-An Inroductory Approach- William Curtis, 4th edition, springer.
4. Linear Algebra- Kenneth Hoffman and Ray Kunge, PHI.
5. Linear Algebra with Applications- OltoBretscher, Pearson Education.

Outcomes:

- The students become familiar with advanced concepts of algebra.
- The students attain the ability to use this knowledge to understand and to solve many problems on other subjects like Galois Theory.
- This is a foundation course and students can use this as a pre requisite for many other subjects in their upcoming semesters.

203- Complex Analysis

L: 4, P:0, Credits: 4

Pre Requisites: Analysis- I

Objectives:

- To train the students thoroughly in mathematical concepts of complex analysis.
- To impart firm foundation in analysis which is useful in many other subjects of mathematics

UNIT-I

The complex Plane and Elementary Functions: Complex number- Polar representation- Stereographic Projections- The Square and Square Root Functions- The Exponential Function- The Logarithm Function- Power Functions and Phase Factors- Trigonometric and Hyperbolic Functions.

UNIT-II

Analytic Functions: Analytic Functions- The Cauchy-Riemann Equations- Inverse Mappings and the Jacobian- Harmonic Functions- Conformal mappings - Fractional Linear Transformations.

UNIT-III

Line Integrals and Harmonic Functions-Line Integrals and Green's theorem- Independence of path**-** Harmonic Conjugates- The Mean Value Property- The maximum Principle**- Complex Integration and Analyticity:** Complex Line Integrals- Fundamental Theorem of Calculus for Analytic Functions- Cauchy's Theorem- The Cauchy Integral Formula- Liouville's Theorem - Morera's Theorem- Gourasat's Theorem.

UNIT –IV

Power Series - Power Series- Power Series Expansion of an analytic Function- Manipulation of Power Series- The Zeros of an Analytic Function **- Laurent Series and Isolated Singularities:** The Laurent Decomposition- Isolated Singularities of an Analytic Function - Isolated Singularity at Infinity- Partial Fractions Decomposition.

UNIT-V

The Residue calculus- The Residue Theorem- Integrals Featuring Rational Functions- Integrals of Trigonometric Functions- Integrands with Branch Points- Fractional Residues.
The Logarithmic Integral: The Argument Principle- Rouche's Theorem.

Scope as in:

1. Complex Analysis- Theodary W. Gamelin, Springer International Edition.

References:

1.
2. Complex Variables and Applications- J.W .Brown andR.V. Churchill, 6th Edition, Mc Graw-Hill.
3. Functions of One Complex Variable– John B. Conway, Springer.
4. Complex Analysis- L. Ahlfors, McGraw-Hill.
5. Complex Analysis- Serge Lang, springer.

Outcomes:

- The students become familiar with concepts of complex analysis.
- The students attain the ability to use this knowledge to understand and to solve many problems on other subjects like Differential Equations, Partial Differential equations etc.

204.Integral Transforms and Integral Equations

L: 4, P:0, Credits: 4

Pre Requisites: Analysis- I and TODE

Objectives:

- The student is trained to learn various techniques of transforms.
- To train the student in order to learn how to apply the techniques in applications.

UNIT-I

Laplace Transforms: Definition- The Inverse Laplace Transform- Discontinuous Functions, Heaviside's expansion formula- Operational Properties of Laplace Transforms, The convolution theorem- Delta Function, Application of Laplace Transforms.

UNIT-II

The Fourier Integrals and Transforms: The Fourier series and Integrals, Dirichlet conditions for the existence, Fourier Integral representation forms, Fourier Transform- Inverse Fourier Transforms, Properties – Fourier sine and cosine Transforms –Convolution Theorem.

UNIT-III

Z-transforms: Introduction- Sequence- Z-transform- Region of Convergence- Standered Z-transforms- Inverse Z-transforms- Properties of Z-transforms- Convolution- Double Z-transform-modified Z-transform.

UNIT-IV

Volterra Integral Equations: Introduction-Volterra integral equations-Relationship between IVP and Volterra integral equations- Method of iterative kernels- Method of polynomial kernel-Application of Laplace transform to Volterra Integral Equation- Integro Differential equations-Volterra integral equation of first kind- Euler's Integrals –Abel's problem-Abel's Integral Equation and generalizations- Volterra integral equation of convolution type.

UNIT-V

Fredholm Integral Equations- Fredholm Integral Equation of the second kind-fundamentals-The method of fredholm determinants -Iterative kernels method – Integral equation with degenerate kernel- Characteristic members and Eigen functions- solution of homogeneous equations with degenerate kernel – Nonhomogeneous Symmetric Equations. Fredholm Alternative.

Scope as in:

1. Advanced Engineering Mathematics - Alan Jeffrey – Elsevier.
2. Mathematical Methods -Srimantha Pal- OXFORD Publications
3. Problems and Exercises in Integral Equations- M. Kraslov, A.Kiselev, Mir Publishers

Reference:

1. Operational Mathematics- R.V.Churchil, McGraw-Hill.
2. Integral Transforms – Goyal & Guptha, Pragathi Prakashan Publishers.
3. Introduction to Integral equations with applications- Abdul J Jerri, Marcel, Dekker Inc
4. Methods of Applied Mathematics- Francis B.Hildebrand, Second Edition, PHI Ltd, New Delhi
5. Transforms-I. N Sneddon, McGraw-Hill.

Outcome:

The student is able to solve differential equations, boundary value problems and integral equations by using various transform techniques

205- Departmental Electives

205(i).Calculus of Variations

L: 4, P:0, Credits: 3

Pre Requisites: Knowledge of solving ODEs.

Objectives:

- To teach students variational techniques,

UNIT-I

The methods of variations in problems with Fixed Boundaries: Variation and its properties- Euler's equation- Functionals of the form $\int_{x_0}^{x_1} F(x, y_1, y_2, ...y_n, y_1', y_2', ...y_n')dx$ - Functionals dependent on Higher order derivatives.

UNIT-II

Functionals dependent on the functions of several independent variables- Variational problems in parametric form- Some applications.

UNIT-III

Variational problems with moving boundaries and certain other problems: An elementary problem with moving boundaries- The moving boundary problem for a functional of the form $\int_{x_0}^{x_1} F(x, y, z, y', z')dx$ - Extremals with corners- One sided variations.

UNIT-IV

Sufficient conditions for an Extremum: Field of extremals- The function $E(x, y, p, y')$ - Transforming the Euler equations to the canonical form.

UNIT-V

Variational problems involving a conditional extremum: Constraints of the form $\varphi(x, y_1, y_2, ..., y_n) = 0$ - Constraints of the form $\varphi(x, y_1, y_2, ..., y_n, y'_1, y'_{2,} ....., y_n) = 0$ - ISO perimetric problems.

Scope as in:

1. Differential equations and the calculus of variations- George Yankovsky- Mir Publishers.

References:

1. Methods of Applied Mathematics, 2nd Edition - Francis B. Hildebrand, PHI.
2. Calculus of variations- Gelfand, Prentice Hall, Inc.

Outcomes:

- The student can apply variational techniques to different problems in mathematics.

205(ii).Advanced Differential Equations

L: 4, P:0, Credits: 3

Pre Requisites: Analysis- I and TODE.

Objectives:

- To the students concepts of more advanced deferential equations including linear as well as non linear.

UNIT-I

Systems of Linear Differential Equations: Introduction- System of first order equations- Model for arms competition between two nations- Existence and uniqueness theorem- Fundamental Matrix- Non homogeneous linear systems- Linear systems with constant coefficients- Linear systems with periodic coefficients.

UNIT-II

Existence and Uniqueness of Solutions: Introduction- Preliminaries- Successive Approximations- Picard's Theorem- Continuation and dependence on initial conditions- Existence of solutions in the large interval - Existence and uniqueness of solutions of systems- Fixed point method.

UNIT-III

Boundary Value Problems: Introduction- Sturm Liouville problem- Green's Function- Applications of Boundary value problems- Picard's Theorem.

UNIT-IV

Oscillations of Second Order Equations: Fundamental Results- Sturm's comparison theorem and separation theorem - Elementary linear oscillations- Comparison theorem of Hillewintner- Oscillations of $x'' + a(t)x = 0$.

UNIT-V

Stability of Linear and Nonlinear Systems: Introduction- Elementary critical points- System of equations with constant coefficients- Linear equation with constant coefficients- Lyapunov Stability- Stability of Quasi linear systems- Second order linear differential equations.

Scope as in:

1. Text book of ordinary differential equations- V. Lakshmikantam, S.G. Deo and V. Raghavendra, Second Edition, Tata Mc Graw –Hill.

References:

1. Theory of Ordinary Differential Equations- Earl.A. Coddington, PHI.
2. Ordinary Differential equations- with applications in biology and engineering- M .Rama Mohan Rao and ShahiAhamed, Affiliated East-West Press Pvt. Ltd.

3. Theory of Ordinary Differential Equations- Randal H.Cole Appleton, Century-Crafts, New York (1968).

Outcome:

- The student can perform phase plane analysis, analyze systems of equations. For example linearising and non linear equations.

206- Data Structures Through'C'

L: 2, P: 6, Credits: 2

Pre Requisites:No Pre Requisites. Foundation Course

Objectives:

- Assess how the choice of data structures and algorithm design methods impacts the performance of programs.
- Choose the appropriate data structure and algorithm design method for a specified application.
- Solve problems using data structures such as linear lists, stacks, queues, , binary trees, binary search trees, and graphs and writing programs for these solutions.

UNIT-I

Array and Records - Storages structures for arrays strings- sting operations- sparse matrices representation records- Linear data structures- Linear lists- operations on linear lists sequential allocation and linked allocation linked lists- single linked lists- double linked lists- insertion and deletion operations- simple applications of linked lists- multiple linked structures- Circular Linked Lists.

UNIT-II

Stacks - Stack operations- array and pointer implementations of stacks- simple applications of stacks - infix to postfix expression conversions- postfix expression evaluation recursion.

UNIT- III

Queues - Queue operations- array and pointer implementation of queues- circular queues- insertion and deletion operations on circular queues- Simple applications of queues.

UNIT-IV

Non Linear Data Structures - Trees and Graphs - Tree terminology- Binary trees- representations of binary trees- recursive and non recursive traversals of binary trees- Graphs- Terminology- representation of graphs- depth first and breadth first search of graph.

UNIT-V

Searching - Linear search- binary search-**sorting** - Bubble sort- selection sort- insertion sort- merge sort- Quick Sort- heap Sort. Time and Space complexity-definition- time complexity of simple algorithms (Elementary treatment only).

Scope as in:

1. An introduction to data structures with application M.C.M.-Trem Bay Ad Sorenson.

Reference:

1. DataStructure- Kochen
2. Data Structure- Behrouz.A.Forouzan- Richard F.Gilberg.

3. Programming in ANSI E. Balaguruswamy.

Outcome:

- To describe the usage of various data structures
- To explain the operations for maintaining common data structures
- To write programs using linked structures such as List, trees, and graphs
- To analyze algorithms and to determine algorithm correctness and time efficiency class
- To demonstrate various methods of organizing large amounts of data.
- To design and apply appropriate data structures for solving computing problems

Lab Practice:-

1. Implement the following data structures using Arrays.

    i) Stacks

    ii) Linear Queues

    iii) Circular Queues

    iv) Dequeue

2. Implement Polynomial addition and multiplication with linked list sparse matrix.

3. Implement binary search tree using linked list and perform the following operations.

    i) Insertion

    ii) Deletion

    iii) Inorder Traversal

    iv) Preorder Traversal

    v) Preorder Traversal

4. Singly Linked list and doubly lists.

    i) Insertion

    ii) Deletion

    iii) Lockup

5. i) Implement Stack using Linked list.

    ii) Implement Queue using Linked list.

6. Implement the following sorting Techniques.

    i) Bubble sort

ii) Insertion sort

iii) Quick sort

iv) Heap sort

7. Implementation the following Searching method.

i) Sequential Search

ii) Binary Search

iii) Fibonacci

8. i) Conversion of Infix expression to Postfix notation.

ii) Simple expression evaluation that can handle +--- /and*

SYLLABUSFOR

SEMESTER-III

- Topology
- Numerical Analysis
- Partial Differential Equations
- Optimization Techniques
- **Departmental Elective- III**
    - Discrete Time Control Systems
    - Analytic Number Theory
- MATLAB-I

301- Topology

L: 4, P:0, Credits: 4

Pre Requisites: Analysis- I

Objectives:

- The object of Topology is to stress on the ideas of abstraction, aesthetics and the development of mathematical tools and the use of the language of mathematics.

UNIT-I

Topological Spaces: The definition and some examples – Elementary concepts – Open bases and open sub bases – Weak topologies.

UNIT-II

The function algebras $\mathcal{C}(X,\mathbb{R})$ and $\mathcal{C}(X,C)$.

Compactness: Compact spaces – Product of spaces – Tychonoff's theorem and locally compact spaces.

UNIT-III

Compactness for metric spaces – Ascoli's theorem.
Separation: T_1- spaces and Hausdorff spaces.

UNIT-IV

Completely regular spaces and normal spaces – Urysohn's lemma and the Tietze extension theorem – The Urysohn imbedding theorem- The Stone Cech compactification.

UNIT-V

Connectedness: Connected spaces – The components of a space – Totally disconnected spaces – Locally connected spaces.

Scope as in:

1. Introduction to Topology and Modern Analysis- G.F. Simmons, Tata Mc graw-Hill.

References:

1. Topology -James R. Munkers, PHI.
2. General Topology- Kelley, Springer.
3. Topology- Dugundji, Cambridge University Press.
4. Principles of Topology- Fred.H.Groom, Cengage Learning.

Outcome:

- Students should be familiar with basic concepts of topology.
- Student should gain mathematical maturity.
- Students should become competent in writing proofs.
- Apply special imagination to theory.

302- Numerical Analysis

L: 4, P:0, Credits: 4

Pre Requisites: Foundation Course.

Objectives:

- To provide a firm foundation on numerical techniques involved in the study of higher mathematics

UNIT-I

Transcendental and Polynomial Equations: Bisection Method-Iteration methods based on First Degree Equation- Rate of Convergence –General Iteration methods – Methods for Complex Roots-Polynomial Equations- Choice of an Iterative Method and Implementation - Problems.

UNIT-II

System of Linear Algebraic Equations and Eigenvalue Problems: Introduction – Direct Methods – Error Analysis for Direct Methods – Iteration Methods – Eigenvalues and Eigenvectors – Bounds on Eigenvalues – Jacobi method for symmetric matrices – Givens method for symmetric matrices - Householder's method for symmetric matrices – Power method – Inverse power method – Choice of a method.

UNIT-III

Interpolation: Introduction-Lagrange and Newton Interpolations- Finite Difference Operators-Interpolating Polynomials using finite Differences – Hermit Interpolation – Piecewise and Spline Interpolation. Least Squares Approximation

UNIT-IV

Differentiation and Integration: Introduction- Numerical Differentiation- Optimum Choice of step length- Extrapolation Methods- Partial Differentiation- Numerical Integration- Methods Based on Interpolation- Methods Based on Undetermined Coefficients- Composite Integration Methods- Romberg Integration- Double Integration- Problems.

UNIT-V

Ordinary Differential Equations: Introduction- Numerical Methods- Single step Methods-Multi step Methods- Predictor-corrector Methods- Stability Analysis of multistep Methods - Stiff System- Boundary Value Problems- Initial Value Problems-

Scope as in:

1. Numerical Methods for Scientific and Engineering Computation- M.K. Jain, S.R.K. Iyengar, R.K.Jain, New Age International.

References:

1. Elementary Numerical Analysis-Atkinson and Hahn, John Willey.
2. An Introduction to Numerical Analysis-. Atkinson and Hahn, John Willey.
3. Introductory Methods of Numerical Analysis- S.S. Sastry, PHI.

Outcome:

- The student is able to solve all kinds of equations including algebraic, ODE, PDE, Differentiate, and Integrate using numerical techniques.

303- Partial Differential Equations

L: 4, P:0, Credits: 4

Pre Requisites: Ordinary differential equations and Linear Algebra

Objectives:

- Where and how PDEs arise in applications.
- Fundamental concepts of PDE theory.
- Analytical methods for solving PDEs

UNIT-I

Simultaneous Differential equations of the first order and the first degree in three variables Method of solution of $dx/P = dy/Q = dz/R$ – orthogonal trajectories of a system of curves on a surface – pfaffian differential forms and equations.

UNIT-II

Partial Differential Equations of the First Order: Origins of First Order Partial Differential Equations – Cauchy's problem for first order equations – Linear equations of the first order – Nonlinear Partial Differential equations of the first order – Cauhy's method of Characteristics – Charpit's Method –Jacobi's method.

UNIT-III

Partial Differential Equations of the Second Order: Linear Partial Differential Equations with constants coefficients – Characteristic curves of second order equations – Characteristics of equations in three variables – The solution of linear hyperbolic equations – Separation of variables.

UNIT-IV

Laplace's Equation: The occurrence of Laplace's equation in physics - Elementary solution of Laplace's equation – Boundary Value Problems - Separation of variables – The two dimensional Laplace equation.

UNIT-V

The Wave equation: The occurrence of the Wave equation in Physics – Elementary solutions of the one dimensional wave equation - Green's function for the wave equation.

Scope as in:

1. Elements of Partial Differential Equations- I.N. Sneddon, McGraw-Hill.

Reference:

1. Partial Differential Equations- L.G.Petrovski.
2. Partial Differential Equations An Introduction- Bernard Epstein, Tata Mc Graw -Hill.
3. Partial Differential Equations- Methods and Applications- Robert, C.Mc Owen, Second Edition, Pearson Education.

Outcome:

- Describe real-world systems using PDEs.
- Solve first order PDEs using the method of characteristics.
- Determine the existence, uniqueness, and well-posedness of solution of PDEs.
- Solve linear second order PDEs using canonical variables for initial-value problems, Separation of Variables and Fourier series for boundary value problems

304-Optimization Techniques

L: 4, P:0, Credits: 4

Pre Requisites: Linear Algebra

Objectives:

- To lay a strong foundation in various optimization techniques. So that the student can solve problems that arise in subjects like fluid dynamics.

UNIT-I

Linear Programming problem: Formation of LP Problems –Graphical solution of two variable problems - General formation of Linear Programming problem – Slack and Surplus variables – Standard form of linear programming problem – Some important definitions - convex set - Extreme points of a Convex set- Convex combination of vectors - convex Hull -Linear programming: Simplex method - computational procedure of simplex method -Artificial variables Techniques - Two Phase Method - simple way for two phase simplex method - Big M-Method - Method to resolve degeneracy -Special cases: Alternative solutions, Unbounded solutions and Non-existing feasible solutions.

UNIT-II

Transportations models: Matrix form of transportation problem -Existence of feasible solution – Basic feasible solution of transportation problem - Existence of optimal solution - loops in transportation table and their properties - The initial basic feasible solution to transportation problem - methods for initial Basic feasible solution - Moving towards optimality - To examine the initial basic feasible solution for Non-degeneracy - Determination of Net evaluations - the Optimality test - Degeneracy in Transportation problem - Unbalanced transportation problem.

UNIT-III

Assignment, Problem: Mathematical formulation of Assignment problem - Fundamental theorems - Hungarian Method for Assignment problem - Assignment Algorithm - unbalanced assignment problem - The Maximal Assignment problem - Restrictions on Assignment.

UNIT-IV

Replacement Models: The Replacement problem - Failure Mechanism of items - Replacement policy for items whose maintenance cost increases with time and money value is constant.

UNIT-V

Job Sequencing: Terminology and notations - Principal Assumptions - solution of sequencing problem processing n jobs through two, three and m machines - processing two jobs through m machines (Graphical method).

Scope as in:

1. Operations Research by S.D.Sharma.

Reference:

1. Data Structures in Pascal- Horowitz And Sahni, Galgotia publications.
2. Linear programming by M.K.Venkata Raman.

Outcome:

- The student can apply optimization techniques to solve and understand problems in statistics, fluid dynamics etc.

Departmental Elective- III

305(i)-Discrete Time Control Systems

L: 4, P:0, Credits: 3

Pre Requisites: Differential Equations, Complex analysis

Objectives:

- To train and motivate the students towards mathematical modeling and to understand various real world problems which use applications of mathematics

UNIT-I

Introduction to Discrete Time Control Systems: Introduction - Digital Control Systems - Quantizing and Quantization Error - Data Acquisition, Conversion and Distribution Systems.
The Z Transform: Introduction - Z Transforms of Elementary Functions – Important properties and theorems - The Inverse Z transform- Method for solving difference equations.

UNIT-II

Z-Plane Analysis of Discrete - Time Control Systems: Introduction - Impulse Sampling and data hold - Obtaining the Z Transform by the Convolution integral Method - The pulse transfer function.

UNIT-III

Design of Discrete-Time Control Systems by Conventional Methods: Introduction - Mapping between the S plane and the Z plane - Stability analysis of closed Loop systems in the Z plane.

UNIT-IV

State-Space Analysis: Introduction - State - Space representations of discrete time systems - Solving discrete-time state Space equations - Pulse-transfer-function matrix - Discretization of continuous- time state - space equations - Liapunov stability analysis.

UNIT-V

Pole placement and observer design: Introduction - Controllability - Observability - Useful transformations in state - Space analysis and design - Design via pole placement - State observers.

Scope as in:

1. Discrete - Time Control Systems- Katsuhiko, Ogata Prentice, Hall of India Pvt,2nd edition- New Delhi.

References:

1. Digital Control using Digital Signal Processing- FarzadNekoogar& G Moriarty Prentice Hall PTR- Upper Saddle Rover- New Jersey.

Outcome:

- After the completion of this course the student can apply these techniques to learn and understand mathematical modeling, dynamical systems and mathematical biology.

305 (ii)- Analytic Number Theory

L: 4, P:0, Credits: 4

Pre Requisites: Algebra and Complex Analysis..

Objectives:

- It is to make the students to learn about basic number theory, number theoretic functions and their applications in the proof of prime number theory and in algebra

UNIT-I

Arithmetical Functions and Dirichlet Multiplication: Introduction-The mobius function μ(n)- The eulertotient function ø(n)- A relation connecting ø and μ- A product formula for ø(n)- Dirichlet product of arithmetical functions- Dirichlet inverse and mobius inversion formula- The Mangoldt function $\wedge(n)$.

UNIT-II

Multiplicative functions -Multiplicative functions- Multiplicative functions and Dirichlet Multiplication- The inverse of a completely multiplicative function-Liouville's function λ(n)- The divisor functions $\sigma_\alpha(n)$ - Generalized convolution.

UNIT-III

Averages of Arithmetical functions: Introduction-The big oh notation. Asymptotic equality of functions- Eulars summation formula- Some elementary Asymptotic formulas- The Average order of d(n)- The Average order of the divisor functions $\sigma_\alpha(n)$-The average order of ø(n)-An application to the distribution of lattice points visible from the origin-The average order of μ(n) and $\wedge(n)$ -The partial sums of Dirichlet product.

UNIT-IV

Some Elementary Theorems on the Distribution of Prime Numbers: Introduction-Chebyshev's functions - Relations connecting υ(x) and π(x)- Some equivalent forms of the prime number theorem- Inequalities for π(n) and p_n- Shapiro's Tauberian Theorem- An Asymptotic formula for the partial sums $\sum_{p\le x} (1/\mathrm{p})$ - The partial sums of the Mobius function.

UNIT-V

Finite Abelian Groups and Their Characters: Definition- Examples of groups and subgroups- Elementary properties of groups- Construction of subgroups- Characters of finite abelian groups. The character group- The orthogonality relations for characters- Dirichlet Characters- Sums involving Dirichlet Characters- The non-vanishing of L(1 , x) for real nonprincipal x.

.**Scope as in:**

1. Introduction to Analytic Number Theory– Tom.M.Apostol, Narosa.

References:

1. Analytic Number Theory – Raymond Ayoub, American Math. Society .

2. An Introduction to the Theory of Numbers – G.H Hardy, E. M Wright, Oxford University Press.

Outcome:

- After completion of this course students can learn the applications number theory in advanced subjects like cryptography, cryptology, and coding theory.

306- MAT LAB-I

L: 0, P: 6, Credits: 2

Pre Requisite:. Foundation Course

Objectives:

- The goal of this course is to introduce students to the fundamental concepts of Scientific Programming using MATLAB and we introduce the necessary mathematical concepts as we go.
- The course will cover the syntax and semantics of MATLAB including data types, control structures, comments, variables, functions, and other abstraction mechanisms.

UNIT-I

Introduction to MAT LAB: Starting and ending a MATLAB-MATLAB Environment- Help future- Types of Files- Platform- Search Path.

Constants, Variables and Expression:- Character Set- Data Types- Constants and Variables- Operators- Hierarchy of Operations- Built-in Functions- Assignment Statement- Illustrative Programs.

UNIT-II

Vectors and Matrices:-Scalars and Vectors- Entering Data in Matrices- Line Continuation- Matrix Subscripts/Indices- Multidimensional Matrices and Arrays- Matrix Multiplications- Generation of Special Matrices- Matrix and Array Operations - Functions with Array Inputs- Structure Arrays - Cell Arrays.

Polynomials:-Entering a polynomial- Polynomial Evolution- Roots of a Polynomial- Polynomial Addition and Subtraction- Polynomial Multiplication- Polynomial Division- Formulation of Polynomial Equation - Characteristic Polynomial of a Matrix- Polynomial Differentiation- Polynomial Integration- Polynomial Curve fitting- Evolution of Polynomials with Matrix Arguments.

UNIT-III

Input-output Statements:-Data input- Interactive Inputs- Reading/Storing File Data- Output Commands- Low-level Input-Output Functions.

MATLAB Graphics:-Two Dimensional Plots- Multiple Plots - Style Option -Sub plots- Specialized Two–Dimensional Plots- Three dimensional Plots.

UNIT-IV

Loops: While loop-For loop- Break and Continue Statements- Nesting loops- Branches Control Structures.

Writing Programs and Functions:- MATLAB Editor-MATLAB Programming- Function Subprograms- Types of Functions - Function handles- Errors and Warnings.

UNIT- V

Database Tool Box:-Create a Database and Data Source- Export data from MATLAB Workspace to Database- Import data from Data base to MATLAB workspace - Sub Query from Multiple tables Using VQB (Visual Query Builder) - MATLAB functions with Examples.

Scope as in:

1. MATLAB and Its Application In Eginerring- RajkumarBanasal, Ashok Kumar

Geo, Manoj Kumar Sharma, Pearson Publications.

References: Numerical Methods using MATLAB- John H. Mathews, D.fink, PHI.

Outcome:

Students who successfully complete this course will:

- Become familiar with general concepts in computer science
- Gain an understanding of the general concepts of programming
- Obtain a solid foundation in the use of MATLAB.

Lab Practice:-

1. Let a 4X3 Matrix A= $\begin{bmatrix} 2 & 3 & 4 \\ 3 & 4 & 5 \\ 4 & 5 & 6 \\ 5 & 6 & 7 \end{bmatrix}$, Using matlab Commands

   a) Delete a 1^{st} row of A

   b) Delete the 1^{st}&2^{nd} columns of all rows of matrix.

   c) Replace the elements A(3,4), A(2,3) with 9 and 8.

2. Express the following sets of algebraic equation in the matrix form AY=B.

$$\begin{aligned} x_1 + x_2 - x_3 &= 2 \\ -x_1 + 3x_2 - x_3 &= 2 \\ 3x_1 - 5x_2 - 2x_3 &= 0 \end{aligned} \qquad \& \qquad \begin{aligned} x_1 + x_2 + x_3 &= 4 \\ -x_1 + 3x_2 - x_3 &= 4 \\ 4x_1 - 4x_2 &= 0 \end{aligned}$$

   a) Find the inverse of both matrices.

   b) Obtain the solution for the variables $x_1, x_2 \,\&\, x_3$.

   c) Find the eigen values and eigen vectors of both matrices.

   d) Find rank, trace and transpose of both matrices.

3. Draw multiple plots using hold command and also use legend command.

4. Draw the multiple plots of the following curves $y1 = \sqrt{x^2 + 1}$, $y2 = 5X + 20$, using Line command X varies from 0 to 100 and step size is 10.

5. Draw the graph of the equation Y=3X + 5 for X varies from 0 to 5, add label to it using gtext command.

6. Plot the curve given by the equation y=sin(x) as X varies from 0 to 2*pi also label the X and Y axis produce a suitable title to plot and also show grid lines on the plot.

7. Illustrate the use of pie function to show the concentration of different industries in the regions as per the following data.

Name of the industry	**No. of Industrial Units**
Cement	4
Textile	8
Software	20
Chemical	2
Telecom	7
Banking	10

8. Divide the figure window into 4 sub windows and plot the following functions

i) Plot V v/s I , where V=4*I and I=1,2,3,4

ii) Plot Y v/s X, where $Y=X^2$ and X=1,2,3,4

iii) For t=0 : 2*pi in step t=pi/60, plot sin(t) v/s t.

iv) For t=0 : pi/30 : 2*pi, plot cos(t) v/s t

9. Plot the graph for the equation $y=X^3+2X^2-5$, X varies from -10 to 10, use gtext command to write this equation on the curve plotted.

10. Write a program to plot the curve for equation $A=10e^{-0.2t}$ for t=0 to 50, show the grid lines on the graph.

11. Plot a bar graph to show the comparison of average temperature in city A, B, C for the months from September to February.

	City - A	City - B	City - C
September	31	28	24
October	29	26	22
November	28	25	20
December	27	24	16
January	26	22	17
February	29	25	20

12. Plot the following function on polar plot, the function is $f(\theta)= \sin(4\theta)$ for $-pi/2 \leq \theta \leq pi/2$, where θ is in Radians.

SYLLABUSFOR

SEMESTER-IV

- Functional Analysis
- Operations Research
- Fluid Mechanics
- Differential Equations and Dynamical systems
- **ELECTIVES**
  - Theory of Computation
  - Numerical methods for Partial Differential Equations
- MAT LAB-II

401- Functional Analysis

L: 4, P:0, Credits: 4

Pre Requisites: Analysis- I and Analysis- II.

Objectives:

- The objective of the module is to study linear mappings defined on Banach spaces and Hilbert spaces, especially linear functional and some sequence spaces. In particular, the four big theorems in functional analysis, namely, Hahn-Banach theorem, uniform boundedness theorem, open mapping theorem and Banach-Steinhaus theorem will be covered.

UNIT- I

Normed Spaces - Banach Spaces: Normed Space- Banach Space –Further Properties of Normed Spaces –Finite Dimensional Normed Spaces and Subspaces –Compactness and Finite Dimension.

UNIT-II

Linear Operators - Bounded and Continuous Linear Operators – Linear Functionals –Linear Operators and Functionals on Finite Dimensional Spaces –Normed Spaces of Operators- Dual Space.

UNIT-III

Inner Product Spaces.Hillbert Spaces: Inner Product Space. Hilbert Space - Further Properties of Inner Product Spaces –Orthogonal Complements and Direct Sums – Orthonormal Sets and Sequences –Series Related to Orthonormal Sequences and Sets –Total Orthonormal Sets and Sequences –Representation of Functionals on Hilbert Spaces.

UNIT-IV

Fundamental Theorems for Normed and Banach Spaces: Zorn's Lemma-Hahn-Banach Theorem-Hahn-Banach Theorem for Complex Vector Spaces and Normed Spaces-Application to Bounded Linear Functional on C[a,b] -Adjoint Operator-Reflexive Spaces-Category Theorem-Uniform Boundedness Theorem.

UNIT-V

Strong and Weak Convergence-Convergence of Sequences of operators and Functionals-Application to Summability of Sequences -Weak Convergence –Open Mapping Theorem – Closed Linear Operators- Closed Graph Theorem.

Scope as in:

1. Introductory Functional Analysis with Applications– Erwin Kreyszig, John Wiley.

References:

1. Introduction to topology and modern Analysis- G.F Simmons – Tata Mc Graw-Hill.
2. Functional Analysis- B.V. Limaye.
3. A First Course in Functional Analysis– Goffman and Pedrick.

4. Operator Theory– S.K. Berberian– Springer.
5. Functional Analysis-A problem oriented approach– V.K. Krishnan, PHI
6. Topics in Functional Analysis and Applications- S. Kesavan, John Wiley.

Outcome:

This is a basic Foundation course in functional analysis with which student gets a better understanding of advanced courses in ODE and PDE.

402- Operations Research

L: 4, P:0, Credits: 4

Pre Requisites: Optimization Techniques

Objectives:

- Model decision making problems using major modeling formalisms of artificial intelligence and operations research, including propositional logic, constraints, linear programs and Markov processes
- Evaluate the computational performance of search, satisfaction, optimization and learning algorithms.
- Apply search, satisfaction, optimization and learning algorithms to real world problems.

UNIT-I

Theory of Games: Characteristics of Games Theory - Basic definitions - Minimax Maximin Criterion and optimal strategy - saddle point optional strategies and the value of game - solution of games with saddle points - Rectangular Games without saddle point – Minimax maximin principle of mixed strategy games - Two by two Games without Saddle point by Arithmetic method - Dominance method - Graphical method for 2xn and mx2 Games.

UNIT-II:

Dynamic Programming: Decision Tree and Bellman's principles of optimality - solution of problem with Finite number of stages - Model 1: Minimum path problem - Model II Single additive constraint, Multiplicatively Separable return - Model III. Single additive constraint, additively separable return -Model IV: Single Multiplicative constraint, additively separable return- Model V: System involving more than one constraint.

UNIT-III

Inventory Production Management: Introduction - Definition - Types of Inventory models - Inventory decisions - How to develop an inventory model - Costs involved in Inventory problems - Variables in inventory problem - classification of characteristics of inventory systems -Concept of average inventory- Concept of economic ordering quantity – Determination of EOQ by trial and Error method-A list of symbols used Graphical method - The EOQ model without shortage.

UNIT-IV:

Project scheduling by PERT - CPM: Introduction– Historical development of CAM / PERT Techniques – Applications of PERT / CPM Techniques - Basic steps in PERT / CPM techniques – Network diagram representation – Rules for drawing Network diagram -Labelling: FULKERS’S 1-J Rule - Time estimates and critical path in network analysis – Project evaluation and review techniques (PERT).

UNIT-V

Queuing theory: Introduction - Queuing system - queuing problem - Transient and steady states - Traffic intensity - Distributions of Arrivals 'Poisson process' (Pure Birth process) - properties of Poisson process of Arrivals - Distribution of inter - Arrival time (exponential process) - Markovian property of inter-arrival times - Distribution of Departure (Pure Death process) - Classification of Queuing Models - Solution of Queuing models and limitations for its applications - Model I. (M/M/1):(∞ /FCFS): Birth and death model.

Scope as in:

1. Operations Research by S.D.Sharma.

References:

1. Operations Research by TahaHandi, Prentice –Hall.
2. Operations Research by Prem Kumar Gupta S.Chand.

Outcome:

Upon successful completion of this course, students will be able to:

- Describe at an initiative level the process of artificial intelligence and operations research: a real-time cycle of problem understanding, formulation, solution and implementation.
- Formulate simple reasoning, learning and optimization problems, in terms of the representations and methods presented.
- Manipulate the basic mathematical structures underlying these methods, such as system state, search trees, plan spaces, model theory, propositional logic, constraint systems, Markov decision processes, decision trees, linear programs and integer programs.
- Demonstrate the hand execution of basic reasoning and optimization algorithms on simple problems.
- Formulate more complex, but still relatively simple problems, and apply implementations of selected algorithms to solve these problem.
- Evaluate analytically the limitations of these algorithms, and assess tradeoffs between these algorithms.

403 - Fluid Dynamics

L: 4, P:0, Credits: 4

Pre Requisites: Mechanics.

Objectives:

- Develop an understanding of fluid dynamics in aerospace engineering as well as a variety of other fields.
- Learn to use control volume analysis to develop basic equations and to solve problems.
- Understand and use differential equations to determine pressure and velocity variations in internal and external flows.

UNIT-I

General Orthogonal Curvilinear Coordinates: Arc length in Orthogonal coordinates – Gradient in orthogonal coordinates – Divergence in orthogonal coordinates – Laplacian in orthogonal coordinates – Curl of a vector function in orthogonal coordinates – **Kinetics of fluids in motion:** Real fluids and ideal fluids – Velocity of a fluid at a point – Streamlines and Pathlines: Steady and unsteady flows – The velocity potential – The vorticity vector – Local and particle rates of change – Conditions at a rigid boundary – General analysis of fluid motion.

UNIT-II

Equations of Motion of a Fluid: Pressure at a point in a fluid at rest- Pressure at a point in a moving fluid -Conditions at boundary of two inviscid immiscible fluids - Euler's equation of motion- Bernoulli's equation – Discussion of the case of steady motion under conservative body forces – Some potential theorems – Some flows involving axial symmetry – Some special two dimensional flows – Impulsive motion – Some further aspects of vortex motion.

UNIT-III

Some Three Dimensional Flows: Sources, Sinks, Doublets - Images in a rigid infinite plane- Images in solid spheres - Axi-symmetric flows; Stoke's stream function – Some special forms of the stream function for Axi Symmetric irrotational motions.

UNIT-IV

Some Two-Dimensional Flows: Meaning of two dimensional flows- Use of cylindrical polar coordinates –The stream function- The complex potential for two dimensional irrotational incompressible flow.

UNIT-V

Complex velocity potentials for standard two dimensional flows - Uniform stream - line sources and line sinks- Line doublets - Two dimensional image Systems –The Milne Thomson circle theorem –Some Applications of the circle theorem - Extension of the circle theorem- Theorem of Blassius- Use of conformal transformation –Some Hydrodynamical aspects of a conformal transformation

Scope as in:

1. Text book of Fluid Dynamics- F. Chorlton.

References:

1. Hydrodynamics- Milne Thomson.
2. Fluid Mechanics- Raisinghania, S. Chand.
3. An Introduction to Fluid Dynamics- G.K. Batchets, Cambridge University Press.
4. Elementary Fluid Dynamics- D.J. Acheson, Oxford University Press.
5. A First Course in Fluid Dynamics, Cambridge University press.

404- Differential Equations and Dynamical Systems

L: 4, P:0, Credits: 3

Pre Requisites: Theory of Ordinary differential equations

Objectives:

By the end of the course, you would/should have:

- Learned and used various tools for the analysis and control of nonlinear systems.
- Got a feeling and gained insight into the complexity of nonlinear systems.
- Known and played around with a wide variety of interesting, inherently nonlinear examples.

UNIT –I

Linear Systems: Uncoupled Linear Systems- Diagonalization- Exponentials of Operators- The Fundamental Theorem for Linear Systems- Linear Systems in R^2- Complex Eigen Values- Multiple Eigen Values- Jordan Forms- Stability Theorem- Non homogeneous Linear Systems.

UNIT-II

Nonlinear Systems: Local Theory- Some Preliminary Concepts and Definitions- The Fundamental Existence- Uniqueness Theorem- Dependence on Initial Conditions and Parameters- The Maximal Interval of Existence- The Flow Defined by a Differential Equation- Linearization- The Stable Manifold Theorem- The Hartman- Grobman Theorem- Stability and Liapunov Functions- Saddle- Nodes- Foci and Centers- NonHyperbolic Critical Points in R^2- Gradient and Hamiltonian Systems.

UNIT-III

Nonlinear Systems: Global Theory- Dynamical Systems and Global Existence Theorems- Limit Sets and Attractors- Periodic Orbits- Limit Cycles and Separatrix Cycles- The Poincare Map- The Stable Manifold Theorem for Periodic Orbits- Hamiltonian Systems with Two Degrees of Freedom- The Poincare Bendixson Theory in R^2- Lienard Systems – Bendixon's Criteria- The Poincare Sphere and separatrix Configurations- Index Theory.

UNIT-IV

Nonlinear Systems: Bifurcation Theory- Structural Stability and Piexoto's Theorem- Bifurcations at Non Hyperbolic Equilibrium Points- Hopf Bifurcation and Bifurcation of Limit Cycles from a Multiple Focus.

UNIT-V

Bifurcations at Non Hyperbolic Periodic Orbits- One Parameter Families of Rotated Vector Fields- The Global Behavior of One Parameter Families of Periodic Orbits- Homoclinic Bifurcations- Melnikov's Method.

Scope as in:

1. Differential Equations, Dynamical Systems and an Introduction to Chaos- M.W.Hirsch, Stephens Snale, Rldevaney, ELSE WEAR Press.

References:

1. Differential Equations and Dynamical Systems- Lawrence Perko, Springer.

Outcome:

- Knowledge. The student has knowledge of basic concepts and methods from the theory of differential equations and dynamical systems, including analytical and geometrical techniques for the study of qualitative properties of solutions. In particular, the student is familiar with linear and nonlinear systems, existence and uniqueness, continuous dependence, phase plane analysis, equilibria, limit cycles, stability, Lyapunov's Direct Method, index theory, the Poincaré-Bendixson theorem, the additional topics and examples of applications.
- Skills. The student is able to apply his or her knowledge to the study of concrete examples. The student masters central techniques of proof and is able to apply these to related problems.

Departmental Elective - IV

405(i)- Theory of Computation

L: 4, P:0, Credits: 3

Pre Requisites: DMS

Objectives:

- The primary objective of a Theory of Computation (TOC) course is to introduce the fundamental mathematical and computational principles that are the foundation of computer science. These include topics such as Turing machines, Automata, grammars and formal languages, decidability, halting problem, the P = NP question and NP-Completeness reductions.

UNIT-I

The Theory of Automata: Definition of an automata- Description of a Finite Automation- Transition Systems- Properties of Transition Functions- Acceptability of a string by a finite Automation- Non Deterministic finite State Machines- The Equivalence of DFA and NDFA- Mealy and Moore models- Minimization of Finite Automaton.

UNIT-II

Formal Languages: Basic definitions and examples- Chomsky classification of Languages- Languages and their relation- Recursive and recursively enumerable sets- operations of languages- Languages and Automaton.

UNIT-III

Regular sets and Regular Grammars: regular expressions- Finite Automata and regular expressions- Pumping lemma for Regular sets- Application of Pumping lemma- Closure properties of regular sets- Regular sets and Regular grammars.

UNIT-IV

Context-free Languages: Context-free languages and derivation trees- Ambiguity in Context-free Grammars- Simplification of Context-free Grammars- Normal forms for Context-free Grammars.

UNIT-V

Turing Machines: Turing Machine model- Representation of Turing Machines- Languages Acceptability by Turing Machines- Design of Turing Machines- Universal Turing Machines and other modifications.

Scope as in:

1. Theory of Computer Science (Automata- Languages and Computation).

Chapters: 2-3-4-5.1 to 5.4 and 7.1 to7.5 By K.L.P. Mishra- N. Chandrasekharan, Second

Edition, PHI.

References:

1. Introduction to Automata theory-languages and computation- Hopcroft H E and Ullman J D.
2. Introduction to theory of computer science - Krishna Murthy ,E.V, Affiliate East west press.
3. Elements of theory of computation- Lewis H.P&Papadimition C H. Printice Hall.
4. Theory of computation- T.Nagamallika& Raju, Sure publications Pvt Ltd.

Outcome:

- The foundation of the theory of computer science is learnt. Student is able to write programs on theory of automata after the completion of this course.

405(ii)- Numerical Methods for Partial Differential Equations

L: 4, P: 0, Credits: 3

Pre Requisites: B. Sc Mathematics

Objectives:

- Gain a fundamental understanding of finite difference method for solving partial differential equation.
- To equip the students with the finite element analysis fundamentals.
- To train the students to use this knowledge in related research area.

UNIT-I

Introduction to finite difference formula – Parabolic equation – Explicit finite difference approximation to one dimensional equation Crank – Nicholson implicit method – Derivation boundary conditions.

UNIT-II

Alternate direction implicit (ADI) method finite difference in cylindrical and spherical polar co-ordinates.

Convergence Stability and consistency: Definitions of local truncation error and consistency convergence analysis – stability analysis by matrix method eigenvalue von Newmann stability methods, global rounding error – local truncation error – Iax's equation theorem.

UNIT-III

Hyperbolic Equations: Analytical solution of 1st order quasi linear equation – Numerical Integration along a characteristic Iax wenderoff explicit method. CFL condition wenderoff implicit approximation – Propagation of discontinues – Numerical solution by the method of characteristics.

UNIT-IV

Elliptic Equations: Introduction – Finite differences in polar co-ordinates – formulas for derivative near a curved boundary analysis of the discretization error of the five point approximation to polman's equation over a rectangle.

UNIT-V

Systematic iterative methods for large linear systems – necessary and sufficient condition for convergence of iterative methods – stones implicit methods.

Finite Element Method: weighted residual method – variations methods – division of the region into elements linear element – Galerkin formulation.

Scope as in:

1. Numerical Solution of Partial Differential Equations, Finite Differences methods - G.D. Smith, Brunel University, Clarandon Press Oxford.

References:

1. The Finite Finite Differences Methods in Partial Differential Equations – A. R. Mitchel and D.F. Grnra, John Wiley.

2. Numerical Methods for Engineers and Scientists – Joe D.Hoffman, Mc Graw Hill.
3. Applied Finite Element Analysis – Larry J. Segerlind, John Wiley.

Outcome:

At the end of the course, the student will be able to

- Apply the FOM and FEM to partial differential equations.
- Solve the simple ID equations using different numerical techniques.

406-MAT LAB-II

L: 2, P: 6, Credits: 2

Pre Requisites: MATLAB- I.

Objectives:

- The goal of this course is to introduce students to the fundamental concepts of Scientific Programming using MATLAB and we introduce the necessary mathematical concepts as we go.
- The course will cover the syntax and semantics of Matlab including data types, control structures, comments, variables, functions, and other abstraction mechanisms.
- Once the foundations of the language have been established students will explore different types of scientific programming problems including curve fitting, optimization, integration, differentiation, statistical analysis, ODE solving, image processing, clustering, and simulation.

UNIT-I

Curve Fitting Tool Box:- Introduction to TOOL Box- Importing the Data Sets -Viewing the Data sets - Smoothing Data- Moving Average Filtering- Low less and Less: Local Regression Smoothing- **Fitting Data: -** The Fitting Process- Parametric Fitting- Basic Assumptions about the Error.

UNIT-II

Solutions of Algebraic and Transcendental Equations Programs by Using MATLAB: Bisection Method-the Method of False Position Method- Iterative Method Newton –Raphson Method-**Solutions to System of Nonlinear Equations: -** Iterative method -Picards Method.

UNIT-III

Numerical Integration programs by Using MATLAB:-Trapezoidal Rule- Simpson's 1/3-rule-Simpson's 3/8-rule-**Interpolation:-**Newton's Forward and Backward Interpolation Formulas.

UNIT-IV

Ordinary Differential Equations and Symbolic Mathematics: Ordinary Differential Equation solvers- Syntax of ODE solvers and steps to use ODE solvers, **Symbolic Mathematics-** Use of Symbolic Mathematics- calculus using symbolic Mathematics – simplification functions.

UNIT- V

MATLAB Applications in Control Systems: Laplace transforms – Inverse Laplace transforms-Partial fraction expansion using MATLAB- Transfer function representation- State space representation of dynamic systems- Transfer function to state space conversion and vice versa-Series/ cascade, parallel and feedback connections- time response of control systems- Standard input test signals- Step response of linear dynamic systems- Performance indices- Impulse and ramp response of control systems- Response to arbitrary input- Steady state errors- - Steady state errors for different types of inputs and systems- Stability of control systems- Routh Hurwitz criterion.

<u>Scope as in:</u>

1. MATLAB and Its Application In Engineering- Rajkumar Banasal, Ashok Kumar Geol-Manoj Kumar Sharma -Pearson Publications.

<u>References:</u>

1. Numerical Methods using MATLAB- JohnH.Mathews, D.fink, PHI publication.

<u>Outcome:</u>

Students who successfully complete this course will:

- Become familiar with general concepts in computer science
- Gain an understanding of the general concepts of programming
- Obtain a solid foundation in the use of MATLAB

<u>Lab Practice:-</u>

1. Write a program for Bisection method.
2. Write a program for Newton Raphson method
3. Write a program for Regula Falsi method
4. Write a program for Rungekutta method.
5. Write a program for Simpson's 1/3 rule
6. Write a program for Simpson's 3/8 rule
7. Write a program for Trapezoidal Method.
8. Write a program for Legranges Interpolation.
9. Write a program for Newton forward Interpolation.
10. Write a program for Newton backward Interpolation.
11. Write a program to implement logic gates.
12. Write a program to solve explicit ODE.
13. Write a program to solve implicit ODE.
14. Write a program to solve Boundary Value Problem (BVP).
15. Write a program to solve Delay Differential Equation (DDE).
16. Write a program to solve Partial Differential Equation (PDE).
17. Write a program to implement Unit Step Response and Unit Ramp Response.

    Eg: $\frac{0.5151z^{-1}-0.1452z^{-2}-0.2963z^{-3}+0.5528z^{-4}}{1-1.8528z^{-1}+1.5906z^{-2}-0.6642z^{-3}+0.0528z^{-4}}$
18. Write a program to find inverse Z Transform of the given function.

Eg: $\frac{0.4637z^{-1}-0.3393z^{-2}}{1-1.5927z^{-1}+0.6607z^{-2}}$

19. Write a program to generate Fibonacci Series.
20. Write a program to implement Unit Step response in Laplace Transform for Different Problems.