SCHOOL OF DATA SCIENCE AND FORECASTING

PROGRAMME: M.TECH. (DUAL DEGREE) – AI&DS

BATCH: 2021-26>>SEMESTER-III

DETAILED SYLLABUS

Course Code	Course Title	Credits
Core Courses		
DS6A-201	Mathematics-III	4 (3-1-0)
DS6A-203	Design & Analysis of Algorithms	4 (3-0-2)
DS6A-205	Object Oriented Programming	4 (3-0-2)
DS6A-207	Probability Distributions	4 (3-1-0)
DS6A-209	Computer Architecture	4 (3-0-2)
Elective Courses (Any One) Discipline Centric		
DS6A-221	Engineering Economics	4 (3-1-0)
DS6A-223	Numerical Methods	4 (3-1-0)

Course Code	DS6A-201	**Course Title**	Mathematics-III
Credits	4 (3-1-0)	**Pre-requisite**	Nil
Objective	To import knowledge of Improper Integrals, function of complex variables, conformal mapping.		

COURSE DESCRIPTION:

Unit	Contents	Contact Hours
1.	Improper real integrals of first and second kinds, test for convergence of improper integrals of the first kind, comparison tests, limit comparison test for improper integrals of second kind, absolute convergence of improper integrals, convergence of Beta and Gamma functions.	12
2.	Function of complex variables: differentiability for function of complex variable, Analytic function, Cauchy-Riemann equations, Harmonic functions, Linear rotational and Inverse transformation, Conformal mapping, Bilinear transformation, Schwarz- Christoffel	12

	transformations	
3.	Complex integration: Line integral, Cauchy's integral theorem, Cauchy's integral formula, Cauchy's formula for derivative of analytic functions, Taylor's series, Laurent's series, Singularities, kinds of singularity, zeros, Residues, Cauchy's residue theorem, Evaluation of real integrals.	12
4.	Z-transformations, Inverse z-transforms, Convolution theorem, Introduction to difference equations, application of z-transform for solving difference equations.	10
TOTAL		**46**

BOOKS:

S. No.	Name of Books/Authors/Publisher
1.	E Kreyszig: Advanced Engineering Mathematics, John wiley.
2.	R.K. Jain & S K Iyenger: Advanced Engineerign Mathematics, 3rd edition, Narosa publishing House.
3.	Churchil & Brown: Complex Analysis, 8th edition, Mc Graw –Hill.
4.	Complex Analysis and Applications, Second Edition, Alan Jeffrey, CRC press
5.	Pal Srimant & Bhunia: Engineering mathematics, Oxford University Press.
6.	Complex Analysis by Schaum Series

Course Code	DS6A-203	**Course Title**	Design and Analysis of Algorithms
Credits	4 (3-0-2)	**Pre-requisite**	Data Structures and Algorithms
Objective	To introduce and implement various techniques for designing algorithms and advanced data structures. To learn space and time complexity analysis of algorithms.		

COURSE DESCRIPTION:

Unit	Contents	Contact Hours
1.	***Reasoning About Algorithms:*** P, NP, NP-completeness, Reductions, Complexity analysis. ***Graph Algorithms:*** Strongly-connected components, Kosaraju's	9

	Algorithm 1 and 2, Applications.	
2.	***Greedy Techniques:*** Local versus Global optimality, Interval Scheduling, Exchange arguments. ***Divide-and-Conquer:*** Optimality, Recursive algorithms, Divide-and-Conquer Recurrences, The Master Theorem and applications, Non-uniform Recurrences.	11
3.	***Dynamic Programming:*** Reusing sub-computations (Sequence alignment, Bellman-Ford algorithm), Precomputing (Floyd-Warshall algorithm, Johnson's algorithm), Combinatorial problems. (Knapsack) ***Linear Programming:*** Canonical and standard forms, Feasibility and optimization, Simplex Algorithm.	11
4.	***Approximation Algorithms:*** Relative Approximations, PAS and FPAS Scheduling. ***Randomized Algorithms:*** Random guess (Quick select), Random guess with high confidence (Karger's min- cut algorithm), Storing associative data (Hashing), Error bounds.	12
TOTAL		**43**

BOOKS:

S. No.	Name of Books/Authors/Publisher
1.	T. H. CORMEN, C. E. LEISERSON, R.L. RIVEST, C. STEIN, Introduction to Algorithms, MIT Press, 3rd Edition.
2.	J. KLEINBERG, E. TARDOS, Algorithm Design, Pearson Education

COURSE OUTCOMES:

No.	Outcome
After completing the course the students will be able to	
1.	Choose and implement appropriate algorithm design techniques for solving problems.
2.	Understand how the choice of data structures and algorithm design methods impact the performance of programs.
3.	Analyze the worst-case and average-case behaviour of algorithms in terms of time

	and memory requirements.

Course Code	DS6A-205	**Course Title**	**Object Oriented Programming**
Credits	4 (3-0-2)	**Pre-requisite**	Nil
Objective	To provide knowledge of Object Oriented programming features.		

COURSE DESCRIPTION:

Unit	Contents	Contact Hours
1.	**Object oriented paradigm & C++ at a glance:** Evolution of programming paradigm, structured versus object-oriented development, elements of object-oriented programming, Objects, classes, methods, popular OOP languages, software reuse. **Classes and objects:** Introduction, Class revisited, constant objects and constructor, static data members with constructors and destructors, constructor overloading, nested classes, objects as arguments, returning objects , friend functions and friend classes, constant parameters and member functions, static data and member functions.	10
2.	**Dynamic objects:** Introduction, pointers to objects, array of objects, pointers to object members, this pointer, self-referential classes **Operator overloading and Inheritance:** overloading of new and delete operators, conversion between objects and basic types, conversion between objects of different classes, overloading with friend functions, abstract classes, inheritance types , virtual base classes, virtual functions, pointer to derived class objects, and base class objects, pure virtual functions, virtual destructors. **Generic programming with templates:** Introduction, function templates, overloaded function templates, class templates, inheritance of class template, class template containership, class template with overloaded operators.	12
3.	Introduction to byte code, security and portability, Data Types, variables, operators, arrays, type conversion and casting, type promotion, Control statements, standard input-output, Designing Classes, constructors, methods, access specifiers : public, private, protected, inheritance, packages and interfaces, Math, String, Vectors, and Array List classes, polymorphism: function and operator overloading, function overriding, abstract classes. **Exception Handling:** exception types, nested try-catch, throw, throws and finally statements, Multithread Programming: thread creation, synchronization and priorities.	12
4.	**Input-output and file operations:** Java.io, stream classes, Byte streams, character streams, serialization. Networking concepts: Client server and socket programming, TCP/IP client and server sockets.	12

	Applets and Java Swing: Applet design, AWT packages, Applet event handling, parameters to applets, AWT controls, layout manager, Frames, container classes, Introduction to Java Beans, Swing and Servlets.	
TOTAL		**46**

BOOKS:

S. No.	Name of Books/Authors/Publisher
1.	Mastering C++ K.R Venugopal Rajkumar, TMH.
2.	C++ Primer, "Lip man and Lajole", Addison Wesley.
3.	Maria litvin, Gary litvin,"Programming in C++", VPH.
4.	D Samantha, "Object oriented Programming in C++ and Java ", PHI.
5.	Patrick Naughton, Herbert Schildt: "The Complete Reference: Java 2", TMH.ISBN-13 9780070495432
6.	C Thomas Wu : "An Introduction to OO programming with Java", TMH,**ISBN**-10: 0073523305
7.	Balaguruswami, "Object oriented with C++", TMH. SBN 0070669074, 9780070669079, 2008
8.	Budd, "Object Oriented Programming", Addison Wesley

Course Code	DS6A-207	**Course Title**	Probability Distributions
Credits	4 (3-1-0)	**Pre-requisite**	Probability
Objective	To apply the concepts of various probability distributions to find out probabilities of the uncertainties. To apply the probability distributions in different fields.		

COURSE DESCRIPTION:

Unit	Contents	Contact Hours
1.	Discrete Probability Distributions: Uniform, Binomial, Poisson, Geometric, Negative Binomial and Hyper-geometric distributions along with their characteristic properties and limiting/approximation cases.	10
2.	Continuous probability distributions: Normal, Exponential, Uniform, Beta, Gamma, Cauchy, lognormal and Laplace distributions along with their characteristic properties and limiting/approximation cases.	8

3.	Exact sampling distribution: Definition and derivation of p.d.f. of $\chi 2$ with n degrees of freedom (d.f.) using m.g.f., nature of p.d.f. curve for different degrees of freedom, mean, variance, m.g.f., cumulant generating function, mode, additive property and limiting form of x^2 distribution, tests of significance and confidence intervals based on x^2 distribution.	12
4.	Exact sampling distributions: Student's and Fishers t-distribution, Derivation of its p.d.f., nature of probability curve with different degrees of freedom, mean, variance, moments and limiting form of t-distribution. Snedecore's F-distribution: Derivation of p.d.f., nature of p.d.f. curve with different degrees of freedom, mean, variance and mode. Test of significance and confidence Intervals based on t and F distributions.	12
TOTAL		**42**

BOOKS:

S. No.	Name of Books/Authors/Publisher
1.	Goon, A.M., Gupta, M.K. and Dasgupta, B. (2003): An Outline of Statistical Theory, Vol. I, 4th Edn. World Press,Kolkata.
2.	Mood, A.M., Graybill, F.A. and Boes, D.C. (2007): Introduction to the Theory of Statistics,3rdEdn.(Reprint).TataMcGraw-HillPub.Co.Ltd.
3.	Myer, P.L. (1970): Introductory Probability and Statistical Applications, Oxford & IBH Publishing, New Delhi
4.	Johnson, R.A. and Bhattacharya, G.K. (2001): Statistics-Principles and Methods, 4th Edn. John Wiley and Sons.
5.	Hogg, R.V. and Tanis, E.A. (2009): A Brief Course in Mathematical Statistics. Pearson Education.
6.	Rohatgi V. K. and Saleh, A.K. Md. E. (2009): An Introduction to Probability and Statistics. 2ndEdn. (Reprint) John Wiley and Sons.

PRACTICALS:

1	Fitting of binomial distributions for n and p=q=½.
2	Fitting of binomial distributions for given n and p.
3	Fitting of binomial distributions after computing mean and variance.
4	Fitting of Poisson distributions for given value of lambda.
5	Fitting of Poisson distributions after computing mean.
6	Fitting of negative binomial.

7	Fitting of suitable distribution.
8	Application problems based on binomial distribution.
9	Application problems based on Poisson distribution.
10	Application problems based on negative binomial distribution.
11	Problems based on area property of normal distribution.
12	To find the ordinate for a given area for normal distribution.
13	Application based problems using normal distribution.
14	Fitting of normal distribution when parameters are given.
15	Fitting of normal distribution when parameters are not given.
16	Exact Sample Tests based on Chi-Square Distribution.
17	Testing of goodness of fit.
18	Testing of independence of attributes.
19	Testing based on 2X2 contingency table without and with Yates'corrections.
20	Testing of significance and confidence intervals of an observed sample correlation coefficient.
21	Testing and confidence intervals of equality of two population variances

COURSE OUTCOMES:

No.	Outcome
By completing this course the students shall learn the following:	
1	Collecting the desired information about the universe in minimum time and high degree of reliability.
2	Understanding the concepts of a random variable and a probability distribution.
3	Understanding the difference between discrete and continuous random variables.
4	Computing probabilities using a binomial and Poisson probability distribution.
5	Understanding the difference between how probabilities are computed for discrete and continuous random variables.
6	How to compute probability values for a continuous uniform probability distribution and be able to compute the expected value and variance for such a distribution.
7	Be able to compute probabilities using a normal probability distribution. Understand the role of the standard normal distribution in this process.
8	Be able to compute probabilities using an exponential probability distribution.

Course Code	DS6A-209	Course Title	Computer Architecture
Credits	4 (3-0-2)	Pre-requisite	Nil
Objective	To familiarize students with the architecture of a processor and machine level programming.		

COURSE DESCRIPTION:

Unit	Contents	Contact Hours
1.	CPU structure and functions, processor organization, A LU, data paths, internal registers, status flags; System bus structure: Data, address and control buses. Processor control, micro-operations, instruction fetch, hardwired control, microprogrammed control, microinstruction sequencing and execution.	12
2.	Instruction set principles, machine instructions, types of operations and operands, encoding an instruction set, assembly language programming, addressing modes and formats.	8
3.	Memory system, internal and external memory, memory hierarchy, cache memory and its working, virtual memory concept. I/O organization; I/O techniques: interrupts, polling, D MA; Synchronous vs. asynchronous I/O.	10
4.	8085 microprocessor architecture; Instruction set, instruction types and formats; Instruction execution, instruction cycles, different types of machine cycles and timing diagram. 16-bit microprocessors, 8086 architecture, registers, memory segmentation and addressing, 32-bit/64-bit microprocessor families.	14
TOTAL		**44**

BOOKS:

S. No.	Name of Books/Authors/Publisher
1.	Mano, M.M., “Computer System Architecture” 3rd Ed., Prentice-Hall of India.
2.	Rajaraman, V. and Radhakrishnan, T., “Computer Organization and Architecture”, Prentice-Hall of India
3.	Govindrajalu, B., “Computer Architecture and Organization”, Tata McGraw-Hill.
4.	Stallings, W , “Computer Organization and Architecture”, 5th Ed., Pearson Education.
5.	Hall, D.V., “Microprocessors and Interfacing”, 2nd Ed., Tata McGraw-Hill.
6.	Brey, B.B., “The Intel Microprocessors”, 6th Ed., Pearson Education

COURSE OUTCOMES:

No.	Outcome

Course Code	DS6A-221	**Course Title**	Engineering Economics
Credits	3 (3-0-0)	**Pre-requisite**	Nil
Objective	To enable students to understand the fundamental economic concepts applicable to engineering and to learn the techniques of incorporating inflation factor in economic decision making.		

COURSE DESCRIPTION:

Unit	Contents	Contact Hours
1.	Introduction to Economics- Flow in an economy, Law of supply and demand, Concept of Engineering Economics – Engineering efficiency, Economic efficiency, Scope of engineering economics – Element of costs, Marginal cost, Marginal Revenue, Sunk cost, Opportunity cost, Break-even analysis. Profit/Volume (P/V) ratio, Elementary economic Analysis – Material selection for product, Design selection for a product, Process planning.	8
2.	Make or buy decision, Value engineering – Function, aims, Value engineering procedure. Interest formulae and their applications –Time value of money, Single payment compound amount factor, Single payment present worth factor, Equal payment series sinking fund factor, Equal payment series payment Present worth factor- equal payment series capital recovery factor – Uniform gradient series annual equivalent factor, Effective interest rate, Examples in all the methods.	10
3.	Methods of comparison of alternatives – present worth method (Revenue dominated cash flow diagram), Future worth method (Revenue dominated cash flow diagram, cost dominated cash flow diagram), Annual equivalent method (Revenue dominated cash flow diagram, cost dominated cash flow diagram), rate of return method, Examples in all the methods.	10

4.	Replacement and Maintenance Analysis: Types of Maintenance, Types of Replacement Problem, Determination of Economic Life of an Asset, Replacement of Existing Asset with a New Asset, Capital Recovery with Return, Concept of Challenger and Defender, Simple Probabilistic Model for Items Which Fail Completely. Depreciation: Methods of Depreciation-Straight Line Method of Depreciation, Declining Balance Method of Depreciation, Sum-of-the-Years-Digits Method of Depreciation, Sinking Fund Method of Depreciation, Service Output Method of Depreciation.	12
TOTAL		**40**

BOOKS:

S. No.	Name of Books/Authors/Publisher
1.	Panneerselvam, R, “Engineering Economics”, Prentice Hall of India Ltd, New Delhi.
2.	Chan S.Park, “Contemporary Engineering Economics”, Prentice Hall of India.
3.	Donald.G. Newman, Jerome.P.Lavelle, “Engineering Economics and analysis” Engg. Press, Texas.
4.	Degarmo, E.P., Sullivan, W.G and Canada, J.R, “Engineering Economy”, Macmillan, New York.
5.	Zahid A khan: Engineering Economy, “Engineering Economy”, Dorling Kindersley.

COURSE OUTCOMES:

No.	Outcome
Upon successful completion of this course, students will acquire the skills to apply the basics of economics and cost analysis to engineering and take economically sound decisions.	

Course Code	DS6A-223	**Course Title**	Numerical Methods
Credits	4 (3-1-0)	**Pre-requisite**	Nil
Objective	This course provides coverage of key numerical methods to solve practical mathematical problems.		

COURSE DESCRIPTION:

Unit	Contents	Contact Hours
1.	Floating point representation and computer arithmetic, Significant digits, Errors: Round-off error, Local truncation error, Global truncation error, Order of a method, Convergence and terminal conditions, Efficient computations.	8
2.	Bisection method, Secant method, Regula−Falsi method. Newton−Raphson method, Newton‘s method for solving nonlinear systems. Gauss elimination method (with row pivoting) and Gauss−Jordan method, Gauss Thomas method for tridiagonal systems. Iterative methods: Jacobi and Gauss-Seidel iterative methods.	10
3.	Interpolation: Lagrange‘s form and Newton‘s form. Finite difference operators, Gregory Newton forward and backward differences Interpolation. Piecewise polynomial interpolation: Linear interpolation, Cubic spline interpolation (only method), Numerical differentiation: First derivatives and second order derivatives, Richardson extrapolation.	12
4.	Numerical integration: Trapezoid rule, Simpson‘s rule (only method), Newton−Cotes open formulas. Extrapolation methods: Romberg integration, Gaussian quadrature, Ordinary differential equation: Euler‘s method. Modified Euler‘s methods: Heun method and Mid-point method, Runge-Kutta second methods: Heun method without iteration, Mid-point method and Ralston‘s method Classical 4th order Runge-Kutta method, Finite difference method for linear ODE.	12
TOTAL		**42**

List of Practicals (using any software)

1	Find the roots of the equation by bisection method.
2	Find the roots of the equation by secant/Regula−Falsi method.
3	Find the roots of the equation by Newton‘s method.
4	Find the solution of a system of nonlinear equation using Newton‘s method.
5	Find the solution of tridiagonal system using Gauss Thomas method.

6	Find the solution of system of equations using Jacobi/Gauss-Seidel method.
7	Find the cubic spline interpolating function.
8	Evaluate the approximate value of finite integrals using Gaussian/Romberg integration.
9	Solve the boundary value problem using finite difference method.

Note: Programming is to be done in any one of Computer Algebra Systems: MATLAB / MATHEMATICA / MAPLE.

BOOKS:

S. No.	Name of Books/Authors/Publisher
1.	Brian Bradie, *A Friendly Introduction to Numerical Analysis*, Pearson Education, India.
2.	M.K. Jain, S.R.K. Iyengar and R.K. Jain, *Numerical Methods for Scientific and Engineering Computation*, 6th Ed., New age International Publisher, India.
3.	C.F. Gerald and P.O. Wheatley, *Applied Numerical Analysis*, Pearson Education, India.
4.	Uri M. Ascher and Chen Greif, *A First Course in Numerical Methods*, 7th Ed., PHI Learning Private Limited.
5.	John H. Mathews and Kurtis D. Fink, *Numerical Methods using Matlab*, 4th Ed., PHI Learning Private Limited.
6.	Laurence V. Fausett, Applied Numerical Analysis, Using MATLAB, Pearson, 2/e

COURSE OUTCOMES:

No.	Outcome