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

SCHOOL OF DATA SCIENCE AND FORECASTING

PROGRAMME: M.TECH. (INTEGRATED) – AI&DS

BATCH: 2021-26>>SEMESTER-IV

Code	Title	Credits (L-T- P)
CORE COURSES		
DS6A-202	Discrete Structures	4 (3-1-0)
DS6A-204	Python Programming	4 (3-0-2)
DS6A-206	Database Management Systems	4 (3-0-2)
DS6A-208	Sampling Theory and Applications	3 (2-1-0)
DS6A-210	Automata Theory	3 (2-0-2)

ELECTIVE COURSES-DISCIPLINE CENTRIC (Any One)		
DS6A-222	Digital Logic Design	3 (2-0-2)
DS6A-224	Optimization Algorithms and Techniques	3 (2-1-0)

DS6A-242	Ethics in AI	3 (3-0-0)

Comprehensive Viva-Voce		
DS6A-252	Comprehensive Viva-Voce	4

DETAILED SYLLABUS

Course Code	DS6A-202	**Course Title**	Discrete Structures
Credits	4 (3-1-0)	**Pre-requisite**	Nil
Objective	To provide knowledge of set theory, relation, function, lattice, combinatorial problems, algebraic structures, proposition logic, and graph theory required for building mathematical foundation of computer science.		

COURSE DESCRIPTION:

Unit	Contents	Contact Hours
1.	**Set theory:** Basic concepts of set theory, operations on sets, Cartesian products, Venn Diagrams, proofs of some general identities on sets **Relation:** Definition, types of relation, composition of relations, Pictorial representation of relation, Equivalence relation, Partial ordering relation. **Function:** type of functions, one to one, into and onto function, Definition of sets, countable and uncountable sets, inverse function, recursive functions.	12
2.	**Lattice:** Introduction to lattice, properties of Lattices, bounded and complemented lattices, Hasse diagram, ordered set, isomorphic ordered set, well ordered set. **Combinatorics**: Introduction, fundamental counting principles, Permutation and combination, Binomial Theorem, Recurrence Relation: Linear recurrence relations with constant coefficients, Homogeneous solutions, Particular solutions, Total solutions; Generating functions, pigeonhole principle, Mathematical Induction.	10
3.	**Propositional and First-order logic:** First order logic, truth tables, tautologies, Contradictions, Algebra of Proposition, logical equivalence, predicates, Normal Forms, Universal and existential quantifiers. finite state machines. **Algebraic Structures:** Definition, Properties, Semi Groups, Monoid, Groups, Abelian group, properties of groups, Subgroup, cyclic groups, Cosets, factor group, Homomorphism and isomorphism of Groups, Rings and Fields.	14
4.	**Graph Theory**: Terminology, isomorphic graphs, Planer graphs, Multigraphs and weighted graphs, directed graphs, Euler's formula (Proof); Warshall's algorithms, Euler path & Hamiltonian circuits, Shortest path & minimal spanning trees, Depth-first Search and Breadth First Search, Tree traversal algorithms. Graph coloring, chromatic number, five color theorem, Isomorphism and Homomorphism of graphs.	10
TOTAL		**46**

BOOKS:

S. No.	Name of Books/Authors/Publisher	Year of Publication/ Reprint
1.	J. P. Tremblay and R. Manohar, Discrete Mathematical Structures with Applications to Computer Science, Tata McGraw-Hill,	1997

	ISBN: 0070651426	
2.	C. L. Liu, Elements of Discrete Mathematics, Tata McGraw-Hill, (ISBN: 9780007043477	2000
3.	Kenneth H. Rosen, Discrete Mathematics and its Applications, Tata McGraw-Hill ISBN**:** 9780070681880	2007
4.	Narsingh Deo, "Graph Theory with Application to Engineering and Computer Science", PHI, ISBN: 9788120301450.	2004

Course Code	DS6A-204	**Course Title**	Python Programming
Credits	4 (3-0-2)	**Pre-requisite**	Nil
Objective	The main objective is to help students to understand the fundamentals of python. Student will learn how to analysis data using Python.		

COURSE DESCRIPTION:

Unit	**Contents**	**Contact Hours**
1.	Introduction to Python: Python versus Java, Python Interpreter and it's Environment, Python installation, Python basics: variables, operators, Strings, Conditional and Control Statements, loops; Data structures: lists and dictionaries; functions: global functions, local functions, lambda functions and methods.	10
2.	**Object Oriented Programming Concepts**: Class, object, constructor, destructor and inheritance; Modules & Packages, File Input and Output, Catching exceptions to deal with bad data, Multithreading, Database Connectivity.	10
3.	**Numpy:** Creating Arrays, Arrays Operations, Multidimensional Arrays. Arrays transformation, Array Concatenation, Array Math Operations, Multidimensional Array and its Operations, Vector and Matrix. **Visualization:** Visualization with matplotlib, Figures and subplots, Labeling and arranging figures, Outputting graphics.	12
4.	**Pandas:** Manipulating data from CSV, Excel, HDF5, and SQL databases, Data analysis and modelling with Pandas, Time-series analysis with Pandas, Using Pandas, the Python data analysis library, Series and Data Frames, Grouping, aggregating and applying, Merging and joining.	12
TOTAL		**44**

BOOKS:

S. No.	Name of Books/Authors/Publisher	Year of Publication/ Reprint
1.	McKinney Wes, "Python for Data Analysis: Data Wrangling with Pandas, NumPy, and IPython", O'Reilly Media	2012
2.	Hauck Trent, "Instant Data Intensive Apps with Pandas How-To", Packt Publishing Ltd.	2013
3.	Beazley David M.,"Advanced Python Programming", Pearson Education	2009
4.	Chun Wesley , Core Python Programming, 3rd Edition,Prentice Hall Professional	2012
5.	Telles Matt "Python Power!: The Comprehensive Guide", Cengage Learning	2008
6.	McKinney Wes & PyData Development Team, "pandas: powerful Python data analysis toolkit", Release 0.13.1, Feb.2014	2014

1. https://docs.python.org/3.4/tutorial/
2. http://www.tutorialspoint.com/python/python_quick_guide.htm

COURSE OUTCOMES:

No.	Outcome
The students will	
1.	learn core data types of python
2.	learn conditional and looping operations in python.
3.	be able to work with Object-oriented concepts and Database connectivity in python.
4.	be able to analyze data using Pandas and Numpy
5.	be able to visualize the data using seaborn and matplotlib

Course Code	DS6A-206	Course Title	Database Management Systems
Credits	4 (3-0-2)	Pre-requisite	Nil
Objective	The purpose of this course is to provide fundamental knowledge of database management system and understanding of how to use and design a DBMS.		

COURSE DESCRIPTION:

Unit	Contents	Contact Hours

1.	DBMS Concepts, Comparison between Database approach and Traditional file accessing approach, Advantages of database systems, Schemas and instances, Data Dependency, Data Dictionary, and Meta Data. Data models, Types of Data models (Object Oriented, Record Based and Physical data models), E-R diagram, Relational Data models: Domains, Tuples, Attributes, Keys, Relational database, Schemas, Integrity constraints, Relational algebra and relational calculus.	12
2.	Database Design: Introduction to normalization, Normal forms (INF, 2NF, 3NF, BCNF), Functional dependency, Decomposition, Dependency preservation and lossless join, multi-valued dependencies. **Structured Query Language**: DDL, DML, DCL, TCL, SQL Functions, integrity constraints, various joins, sub-query, index, View, Sequence, and Clusters. PL/SQL: manipulating data using PL/SQL, Iteration, Exceptions, Cursors, Trigger.	12
3.	Transaction Processing and Concurrency Control: Transaction System, Serializability of schedules, conflict & view serializable schedule, Recovery from transaction failures, Log based recovery. Checkpoints dead lock handling, Concurrency Control, locking Techniques for concurrency control, time stamping protocols for concurrency control, validation based protocol, multiple granularity.	12
4.	Advance Concepts: Introduction to Distributed databases, data mining, data warehousing, Basic Concepts of Object Oriented Database System, Comparative study of OODBMS V/s RDBMS. Introduction to Image and Multimedia databases and data structures, Web and mobile database, Spatial and Geographic Database, Accessing Database from front-end Application. Case Study: Oracle, MySql, DB2.	10
TOTAL		**46**

BOOKS:

S. No.	Name of Books/Authors/Publisher
1.	A Silberschatz, H Korth, S Sudarshan, “Database System and Concepts”, Fifth Edition McGraw-Hill.
2.	Elmasri Ramez and Novathe Shamkant, “Fundamentals of Database Systems”, Benjamin Cummings Publishing. Company.
3.	Rob, Coronel, “Database Systems”, Seventh Edition, Cengage Learning**.**
4.	Ramakrishnan: Database Management System, McGraw-Hill

5.	Fred R.McFadden,Jeffrey A.Hoffer & Marry B.Prescott.?Modern Database Management, Fifth Edition,Pearson Education Asia,2001
6.	Gray Jim and Reuter Address, "Transaction Processing: Concepts and Techniques", Morgan Kauffman Publishers.

COURSE OUTCOMES:

S. No.	OUTCOME
1.	The student will learn the basics of database management.
2.	The student will be able to design database using ER diagram
3.	The student will able to optimize database using normalization.
4.	The student will able to work on database software MYSQL/Oracle.
5.	The student will learn how to write SQL queries.

Course Code	DS6A-208	**Course Title**	Sampling Theory and Applications
Credits	3 (2-1-0)	**Pre-requisite**	Nil
Objective	The main objective of the sampling theory is to obtain optimum results, i.e., to construct maximum information about the characteristics of the population with the available sources at our disposal in terms of time, money and manpower by studying the sample values only.		

COURSE DESCRIPTION:

Unit	Contents	Contact Hours
1.	**Sample Survey:** Concept of population and sample, need for sampling, steps in a sample survey, principles of sample survey, sampling and non-sampling errors, complete census v/s sample survey, Limitations of sampling.	8
2.	**Simple Random Sampling:** Definition of Simple random sampling, Simple random sampling with & without replacement. Unbiasedness of the sample mean, mean square error of the sample mean; merits, demerits and limitations of simple random sampling, simple random sampling for attributes. **Stratified Random Sampling:** Definition and advantages of stratified random sampling, proportional allocation, optimum allocation, cost function. Comparison of stratified random sampling with simple random	12

	sampling without stratification, proportional allocation versus simple random sampling, Neyman allocation Versus proportional allocation, Neyman allocation versus simple random sampling.	
3.	**Systematic Sampling:** Definition, linear systematic sampling, circular systematic sampling, mean and variance of a systematic sample mean, comparison of systematic sampling to simple random sampling, systematic sampling versus stratified random sampling, stratified random sampling versus simple random sampling for a population with linear trend, merits and demerit of systematic sampling.	10
4.	**Ratio Method of Estimation:** Definition, bias of ratio estimate, expected value of ratio estimate for first order approximation under simple random sampling without replacement, variance of ratio estimate for first order approximation under simple random sampling without replacement. **Regression Method of Estimation:** Definition, simple regression estimate, determination of beta, expected value of regression estimate for first order approximation under simple random sampling without replacement, variance of regression for first order approximation under simple random sampling without replacement.	12
TOTAL		**42**

BOOKS:

S. No.	Name of Books/Authors/Publisher	Year of Publication/ Reprint
1.	Sampling Techniques, Cochran W.G., Wiley Eastern. ISBN: 978-0-471-16240-7	1977
2.	Sampling Theories of Survey with Application, Sukhatme, P.V., Sukhatme, B.V. Sukhatme, S. Asok, C., IOWA State University Press and Indian Society of Agricultural Statistics	1984
4.	Sample Survey Theory, Des Raj and Chandhok P., Narosa Publishing House.	2013
5.	Fundamentals of Applied Statistics, Gupta, S.C. and Kapoor, V.K.: Sultan Chand and Co.	2019
6.	Theory and Methods of Survey Sampling, Mukhopadhyaya, P. PHI Learning. Print Book ISBN : 9788120336766 eBook ISBN : 9789354435430	2008
7.	Goon A.M., Gupta M.K. and Dasgupta B.: Fundamentals of Statistics (Vol.2), World Press.	2001

Course Code	DS6A-210	Course Title	Automata Theory
Credits	3 (2-0-2)	Pre-requisite	Basic Mathematical Fundamentals: Sets, Logic, Relations, Functions.
Objective	This course aims to introduce an idea of Automata, Formal languages and computability.		

COURSE DESCRIPTION:

Unit	Contents	Contact Hours
1.	Finite Automata: Basic Definition of an automaton, Description of a finite automata Deterministic finite automata (DFA), Non-deterministic finite automata (NFA), transition systems, Acceptability of a string by a finite automation, The equivalence of DFA and NFA, Construction of minimum automaton. Formal Languages: Basic definitions, Chomsky classification of languages, Languages and their relations, Operations on languages, Languages and automata.	10
2.	Regular Grammars: Identities and regular expressions, Finite automata and regular expressions, Conversion of non-deterministic systems to deterministic systems, Algebraic method using Arden's theorem, Construction of finite automata equivalent to regular expression, Pumping lemma for regular sets, Applications of pumping lemma.	8
3.	Context-free Grammer: Context-free grammars, Parse trees, Ambiguity in context-free grammars, Simplification of context-free grammars, Normal forms of context-free grammars, Pumping lemma, Decision algorithms. Pushdown Automata: Basic definitions, Acceptance by pushdown automata, Pushdown automata and context-free languages.	12
4.	Turing Machines and Linear Bounded Automata (LBA): Turing Machines Model, Representation of a Turing machine, Language acceptability by Turing machines, Design of Turing Machines, Universal Turing Machines and other modifications, Model of linear bounded Automaton, Turing machines and type- 0 Grammars, Linear bounded automata and languages, Halting problem of Turing machines, NP Completeness. Computability: Introduction and basic concepts, Primitive recursive functions, Recursive functions, Partial recursive functions and Turing machines.	14
TOTAL		**44**

BOOKS:

S. No.	Name of Books/Authors/Publisher	Year of Publication/ Reprint
1.	J. E. Hopcroft, J. Motwani and J. D. Ull man, Introduction to Automata Theory, Languages and Computation, Pearson Education, Asia	2002
2.	J. H. Martin, Introduction of Languages and the Theory of Computation, McGraw-Hill International Edition, New York	1991
3.	Z. V. I. Kohavi, Switching and Finite Automata Theory, Tata McGraw-Hill, New Delhi.	1972
4.	H. R. Lewis and C. H. Papadimitrou, Elements of the Theory of Computation, Pearson Education.	1998

COURSE OUTCOMES:

No.	Outcome
The students will be able to	
1.	Understand, design, construct, analyze and interpret Regular languages, Expression and Grammars.
2.	Design different types of Finite Automata and Machines as Acceptor, Verifier and Translator.
3.	Understand, design, analyze and interpret Context Free languages, Expression and Grammars
4.	Design different types of Push down Automata as Simple Parser.
5.	Design different types of Turing Machines as Acceptor, Verifier, Translator and Basic computing machine.
6.	Compare, understand and analyze different languages, grammars, Automata and Machines and appreciate their power and convert Automata to Programs and Functions.

Course Code	DS6A-222	**Course Title**	Digital Logic Design
Credits	3 (2-0-2)	**Pre-requisite**	Nil
Objective	To acquaint the students with the fundamental principles of Digital Logic Circuits and their design.		

COURSE DESCRIPTION:

Unit	Contents	Contact Hours

1.	Number systems and Boolean algebra: Introduction to number system and Boolean algebra; Boolean identities, basic logic functions, standard forms of logic expressions, simplification of logic expressions. Logic families: Brief overview of Transistor as a switch; Logic gate characteristics – propagation delay, speed, noise margin, fan-out and power dissipation; Standard TTL and static CMOS gates.	10
2.	Combinational logic: Arithmetic circuits, decoders, encoders, multiplexers, de-multiplexers, and their use in logic synthesis; Hazards in combinational circuits. Introduction to VHDL: Behavioral – data flow, and algorithmic and structural description, lexical elements, data objects types, attributes, operators; VHDL coding examples, combinational circuit design examples in VHDL and simulation.	12
3.	Sequential logic circuits: Latches and Flip Flops (SR,D,J K,T); Timing in sequential circuits; Shift register; Counters–synchronous, asynchronous; Sequential circuit design examples in VHDL and simulation. Finite state machines: Basic concepts and design; Moore and Mealy machines examples; State minimization/reduction, state assignment; Finite state machine design case studies and FSM circuit design examples in VHDL and simulation.	13
4.	ROM and RAM, PLA, PAL and FPGA; RTL based design projects and their implementation in FPGA using VHDL. Astable and monostable multivibrator circuits using basic logic gates; Internal structure of 555 and its applications, clock circuits.	8
TOTAL		**43**

BOOKS:

S. No.	Name of Books/Authors/Publisher	Year of Publication/ Reprint
1.	Mano M.M., Ciletti M.D., “Digital Design”, Pearson India, 4th Edition	2006
2.	Katz R.H., Borriello G., “Contemporary Logic Desing”, Prentice Hall India, 2nd Edition.	2008
3.	Kohavi Z., Jha N.K., “Switching and Finite Automata Theory”, Cambridge University Press, India, 2nd Edition	2011
4.	Wakerly J.F., “Digital Design: Principles and Practices,” Pearson India, 4th Edition.	2008

5.	Harris D., Harris S., “Digital Design and Computer Architecture”, Elsevier Publications, 2nd Edition.	2007
6.	Pedroni V.A., “Digital Circuit Design with VHDL”, Prentice Hall India, 2nd Edition	2001

COURSE OUTCOMES:

No.	Outcome

Course Code	DS6A-224	**Course Title**	Optimization Algorithms and Techniques
Credits	3 (2-1-0)	**Pre-requisite**	
Objective	This course exposes the students in mathematical modelling, solving and analysing business and industrial problems using operations research methods.		

COURSE DESCRIPTION:

Unit	Contents	Contact Hours
1.	Introduction to LPP: Formulation of LP models, Graphical procedure of solution, Convex functions and their properties, Basic feasible solution, Optimal solution.	4
2.	Simplex Algorithm: Simplex method, Big M method, Two phase Method, Degenerate LPP, Revised simplex method, Duality Theorem, Dual Simplex Method, Sensitivity analysis.	14
3.	Transportation Problems: North West Corner Method, Matrix minima Method, VAM Method, Optimality Test, Degeneracy, Unbalanced Transportation problem. Assignment problems. Integer LPP: Branch and Bound Algorithm	12
4.	Network flow: Shortest path problem, Maximal flow problem, CPM, PERT. Introduction to Game Theory: Strategy, Minimax and Maximin Criterion, Existence of saddle point, Game without saddle point, Mixed strategies, Solution of 2x2 games, Rectangular games, Concept and general rules	12

	for dominance, Two person zero sum game. Solution of a game by simplex method.	
TOTAL		**42**

BOOKS:

S. No.	Name of Books/Authors/Publisher	Year of Publication/ Reprint
1.	Hamdy A. Taha: Operations Research: An introduction, Pearson Prentice Hall	
2.	David R. Anderson, Dennis J. Sweeney, Thomas A. Williams: An Introduction to Management Science, South-Western College Publishing.	
3.	William J. Stevenson: Introduction to Management Science, IRWIN.	

COURSE OUTCOMES:

No.	Outcome
1.	Understand the verbal description of the real system and accordingly identify and development of operational research models.
2.	Understand the mathematical tools that are needed to solve optimization problems.
3.	Use of mathematical software to solve the OR models developed.
4.	Develop a technical report that describes the model, solving technique, results analysis and recommendations.

Course Code	DS6A-242	**Course Title**	Ethics in AI
Credits	3 (3-0-0)	**Pre-requisite**	
Objective			

COURSE DESCRIPTION:

Unit	Contents	Contact Hours
1.	AI Ethics: AI ethics vs Ethics of AI. AI ethics theories, Benefits & risks of artificial intelligence, ethical issues in artificial intelligence, artificial intelligence: positive and negative factor, Risks, AI vs Humans, Robust and	4

	beneficial artificial intelligence, Ethics vs Law.	
2.	AI ethics: data control AI control vs ethical control, Superintelligence: Paths, Dangers, The value alignment problem, Principles of Safe AI, Data Collection, Fairness and Bias.	14
3.	Racist AI Algorithmic Accountability, Racist Algorithm, Right to explanation, Fair machine learning, Algorithms Ethics, algorithmic decision making, AI led Inequality and threatens democracy, Transparency and Interpretability, Algorithmic bias, discrimination discovery, Data fairness.	12
4.	Autonomy and Morality Robo ethics, Ariel weapons Morality, Ethical Autonomy, AI automation ethics, Artificial morality, artificial moral advisor, Moral Cognition, Moral Machines, Autonomous vehicles and Ethics, Robo rights.	12
TOTAL		**42**

BOOKS:

S. No.	Name of Books/Authors/Publisher	Year of Publication/ Reprint
1.		
2.		
3.		

COURSE OUTCOMES:

No.	Outcome
1.	
2.	
3.	
4.	