COIMBATORE INSTITUTE OF TECHNOLOGY

(Government Aided Autonomous Institution Affiliated to Anna University, Chennai)

COIMBATORE - 641 014, TAMILNADU, INDIA

DIAMOND JUBILEE

(1956 - 2016)

Department of Computing

M.Sc. DATA SCIENCE

Curriculum and Syllabi

FIRST TO TENTH SEMESTER

Under Choice Based Credit System

(For the students admitted during the academic year 2016 - 2017 and onwards)

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COIMBATORE INSTITUTE OF TECHNOLOGY

(Government Aided Autonomous Institution Affiliated to Anna University, Chennai)

VISION AND MISSION OF THE INSTITUTE

VISION

The Institute strives to "inculcate a sound knowledge in engineering along with realized social responsibilities to enable its students to combat the current and impending challenges faced by our country and to extend their expertise to the global arena".

MISSION

The mission of CIT is to "impart high quality education and training to its students to make them world - class engineers with a foresight to the changes and problems, and pioneers to offer innovative solutions to benefit the nation and the world at large".

DEPARTMENT OF COMPUTING
COIMBATORE INSTITUTE OF TECHNOLOGY

VISION AND MISSION OF DEPARTMENT OF COMPUTING

VISION

Department of Computing endeavors to make the students, world class software engineers, data scientists and decision makers with prudence of pioneering the solutions to the challenges of the nation and the world.

MISSION

The Mission of Department of Computing is

M1 : To impart sound conceptual knowledge along with intensive practical training and real time industry/ research project exposure to the students.

M2 : To provide a learning ambience to enhance innovations, problem solving skills, leadership qualities, team-spirit and ethical responsibilities.

M3 : To establish Industry Institute Interaction program to provide exposure of latest tools and technologies used in the IT organizations and enhance the entrepreneurship skills.

DEPARTMENT OF COMPUTING

FIVE YEAR INTEGRATED M.Sc. (DATA SCIENCE)

PROGRAMME OUTCOMES (POS)

Students in the M.Sc.(Data Science) should possess the following abilities:

PO1 : Develop mathematical models and their computational solutions to reason and interpret massive amount of data in wide range of domains.

PO2 : Collect and Analyze large quantities of data to discover new knowledge pattern and facilitate decision making.

PO3 : Apply techniques and tools of data science to design and develop the systems for analyzing the rapidly growing data in the fields of medicine, business, geosciences and scientific research.

PO4 : Develop scalable techniques for data analysis and decision making in many areas, including machine learning, algorithms, statistics, operations research, databases, complexity analysis, visualization, and privacy and security.

PO5 : Communicate effectively with decision makers to derive intelligent analytical systems.

PO6 : Work with professional, and ethical values.

PO7 : Understand and solve legal and security issues of analytical applications.

PO8 : Recognize the importance of research to develop leading innovative analytical products.

PO9 : Self learning and adaptation to the emerging technologies to address the challenging issues.

DEPARTMENT OF COMPUTING

FIVE YEAR INTEGRATED M.Sc. (DATA SCIENCE)

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)

Our Graduates will:

PEO 1 : **Expertise in Analytical solution :** Be uniquely positioned to pioneer new developments in the data science field, and to be leaders in industry, the public sector, and academia

PEO 2 : **Research :** Promote research in the development of leading innovative products

PEO 3 : **Leadership :** Inspire and guide the groups they work with in bringing their ideas to fruition, with managerial skills, self-assurance and integrity

PEO 4 : **Social Responsibility :** commit to social ethical and professional responsibilities

PEO 5 : **Life-long Learning :** Participate in life-long learning to enhance knowledge and skills necessary to contribute to the betterment of profession

PEO 6 : **Entrepreneurship :** Become Successful entrepreneurs with the strong business managerial skills

COIMBATORE INSTITUTE OF TECHNOLOGY

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DEPARTMENT OF COMPUTING

M.Sc. DATA SCIENCE

CHOICE BASED CREDIT SYSTEM

Curriculum from the Academic Year 2016 - 2017 and onwards

Semester I

Course Code	Course Name	L	T	P	C	Category
	THEORY					
16MDS11	Technical English	3	0	0	3	HS
16MDS12	Algebra and Applications	3	2	0	4	BS
16MDS13	Basic Statistical Methods	3	2	0	4	BS
16MDS14	Problem Solving and Programming in C	3	0	0	3	PC
16MDS15	Digital Electronics	3	0	0	3	ES
	PRACTICALS					
16MDS16	Programming Laboratory in C	0	0	4	2	PC
16MDS17	Digital Electronics Laboratory	0	0	4	2	ES
16MDS18	Computing Laboratory I	0	0	4	2	BS
16MDS19	English Language Laboratory	0	0	2	1	HS
	TOTAL CREDITS				**24**	

Semester II

Course Code	Course Name	L	T	P	C	Category
	THEORY					
	Language Elective	3	0	0	3	HS
16MDS21	Calculus and Applications	3	2	0	4	BS
16MDS22	Probability and Applications	3	2	0	4	PC
16MDS23	Data Structures and Algorithms	3	0	0	3	PC
16MDS24	Object Oriented Programming	3	0	0	3	PC
	PRACTICALS					
16MDS25	Data Structures and Python Programming Laboratory	0	0	4	2	PC
16MDS26	Object Oriented Programming Laboratory	0	0	4	2	PC
16MDS27	Computing Laboratory II	0	0	4	2	PC
	TOTAL CREDITS				**23**	

Semester III

Course Code	Course Name	L	T	P	C	Category
	THEORY					
16MDS31	Business Statistics	3	0	0	3	BS
16MDS32	Discrete Structures and Automata Theory	3	0	0	3	PC
16MDS33	Computer Architecture	3	0	0	3	PC
16MDS34	Operating Systems	3	0	0	3	PC
16MDS35	Database Management Systems	3	0	0	3	PC
	PRACTICALS					
16MDS36	Computing Laboratory III	0	0	4	2	PC
16MDS37	Database Management Systems Laboratory	0	0	4	2	PC
16MDS38	Operating Systems Laboratory	0	0	4	2	PC
16MDS49*	Communication Skills and Personality Development					EEC
	Total Credits				**21**	

* A pass is required

Semester IV

Course Code	Course Name	L	T	P	C	Category
	THEORY					
16MDS41	Multivariate Data Analysis	3	0	0	3	BS
16MDS42	Modeling and Simulation	3	0	0	3	PC
16MDS43	Advanced Data Structures and Algorithms	3	0	0	3	PC
16MDS44	Computer Networks	3	0	0	3	PC
16MDS45	Software Engineering	3	0	0	3	PC
	PRACTICALS					
16MDS46	Computing Laboratory IV	0	0	4	2	PC
16MDS47	Network Programming Laboratory	0	0	4	2	PC
16MDS48	Algorithms Laboratory in Java	0	0	4	2	PC
16MDS49*	Communication Skills and Personality Development					EEC
	Total Credits				**21**	

* A pass is required

Semester V

Course Code	Course Name	L	T	P	C	Category
	THEORY					
16MDS51	Operations Research	4	0	0	4	PC
16MDS52	Machine Learning	3	0	0	3	PC
16MDS53	Big Data Architecture	3	0	0	3	PC
16MDS54	Artificial Intelligence	3	0	0	3	PC
	Elective - I	3	0	0	3	PE
	PRACTICALS					
16MDS55	Machine Learning Laboratory	0	0	4	2	PC
16MDS56	Big Data Modeling Laboratory	0	0	4	2	PC
	Elective Laboratory - I	0	0	4	2	PE
	Total Credits				**22**	

Semester VI

Course Code	Course Name	L	T	P	C	Category
	THEORY					
16MDS61	Graph Theory	3	0	0	3	PC
16MDS62	Computational Intelligence	3	0	0	3	PC
16MDS63	Data Mining	3	0	0	3	PC
16MDS64	Advanced Databases	3	0	0	3	PC
	Elective- II	3	0	0	3	PE
	PRACTICALS					
16MDS65	Data Mining Laboratory	0	0	4	2	PC
16MDS66	Computational Intelligence Laboratory	0	0	4	2	PC
	Elective Laboratory - II	0	0	4	2	PE
	Total Credits				**21**	

Semester VII

Course Code	Course Name	L	T	P	C	Category
16MDS71	Project Work and Viva Voce-I	0	0	0	18	EEC
	Total Credits				**18**	

Semester VIII

Course Code	Course Name	L	T	P	C	Category
	THEORY					
16MDS81	Advanced Predictive Analytics	3	0	0	3	PC
16MDS82	Data Privacy and Security	3	0	0	3	PC
16MDS83	Data Visualization	3	0	0	3	PC
	Elective - III	3	0	0	3	PE
	Elective - IV	3	0	0	3	PE
	PRACTICALS					
16MDS84	Data Privacy and Security Laboratory	0	0	4	2	PC
16MDS85	Data Visualization Laboratory	0	0	4	2	PC
	Elective Laboratory - III	0	0	4	2	PE
	Total Credits				**21**	

Semester IX

Course Code	Course Name	L	T	P	C	Category
	THEORY					
16MDS91	Information Retrieval	3	0	0	3	PC
16MDS92	Deep Learning	3	0	0	3	PC
	Elective - V	3	0	0	3	PC
	Elective - VI	3	0	0	3	PE
	Elective - VII	3	0	0	3	PE
	PRACTICALS					
16MDS93	Information Retrieval Laboratory	0	0	4	2	PC
16MDS94	Deep Learning Laboratory	0	0	4	2	PC
	Elective Laboratory - IV	0	0	4	2	PE
	Total Credits				**21**	

Semester X

Course Code	Course Name	L	T	P	C	Category
16MDS101	Project Work and Viva Voce- II	0	0	0	18	EEC
	Total Credits				**18**	
	Grand Total of Credits				**210**	

Language Elective

Course Code	Course Name	L	T	P	C	Category
16MDSLE01	Professional English	3	0	0	3	HS
16FY22F	Basic French	3	0	0	3	HS
16FY22G	Basic German	3	0	0	3	HS

Professional Electives

Course Code	Course Name	L	T	P	C	Category
	DATA ANALYTICS APPLICATION STREAM					
16MDSE1	Business Intelligence	3	0	0	3	PE
16MDSE2	Web Mining	3	0	0	3	PE
16MDSE3	Social Network Analysis	3	0	0	3	PE
16MDSE4	Geographical Information Analysis	3	0	0	3	PE
16MDSE5	Health Care Analytics	3	0	0	3	PE
16MDSE6	Information Security Analytics	3	0	0	3	PE
16MDSE7	Image Processing	3	0	0	3	PE
16MDSE8	Bio Informatics	3	0	0	3	PE
16MDSE9	Knowledge Engineering	3	0	0	3	PE
16MDSE10	Natural Language Processing	3	0	0	3	PE
16MDSE11	Econometric Analysis	3	0	0	3	PE
16MDSE12	Business Process Management	3	0	0	3	PE
16MDSE13	Accounting for Decision Making	3	0	0	3	PE
16MDSE14	Business Economics	3	0	0	3	PE
	TECHNOLOGY STREAM					
16MDSE15	Parallel and Distributed Computing	3	0	0	3	PE
16MDSE16	Cloud Computing	3	0	0	3	PE
16MDSE17	Mobile Computing	3	0	0	3	PE
16MDSE18	GPU Computing	3	0	0	3	PE
16MDSE19	Cloud Security and Privacy	3	0	0	3	PE
16MDSE20	Data Centric Computing	3	0	0	3	PE
16MDSE21	Embedded Systems	3	0	0	3	PE
16MDSE22	Internet of Things	3	0	0	3	PE
16MDSE23	Human Computer Interaction	3	0	0	3	PE
16MDSE24	Enterprise Computing	3	0	0	3	PE
16MDSE25	Software Architecture and Design Patterns	3	0	0	3	PE

Professional Electives- Labs

Course Code	Course Name	L	T	P	C	Category
16MDSEL1	Business Intelligence Laboratory	0	0	4	2	PE
16MDSEL2	Web Mining Laboratory	0	0	4	2	PE
16MDSEL3	Image Processing Laboratory	0	0	4	2	PE
16MDSEL4	Cloud Computing Laboratory	0	0	4	2	PE
16MDSEL5	Mobile Application Development Laboratory	0	0	4	2	PE
16MDSEL6	Embedded Systems Laboratory	0	0	4	2	PE
16MDSEL7	Internet of Things Laboratory	0	0	4	2	PE
16MDSEL8	Enterprise Application Development Laboratory	0	0	4	2	PE
16MDSEL9	Parallel and Distributed Computing Laboratory	0	0	4	2	PE

CAT - Category, BS - Basic Sciences, HS - Humanities and Social Sciences,

ES - Engineering Sciences, PC - Professional Core, PE - Professional Elective,

EEC - Employability Enhancement Course, MC - Mandatory Course

16MDS11 - TECHNICAL ENGLISH

L	T	P	C
3	0	0	3

PRE-REQUISITES

Consent of the Instructor

ASSESSMENT : THEORY

COURSE OUTCOME

- *Given a technical paragraph, identify the topic sentence, infer meanings, lexical and contextual items, and find the supporting points and transitional tags.*
- *Given a communication context, specify the barriers to listening and deduce solutions to overcome the barriers. Given short conversations and monologues for listening, specify appropriate responses and construct a summary.*
- *For a given topic, introduce ideas, give opinions and justify your stance. For a given topic, argue for or against the topic for 5 minutes. Plan and prepare a 15 minute presentation using visual aids and deliver a power point presentation for a given technical topic.*
- *For a given topic, write an argumentative, descriptive, biographical or autobiographical essay. Interpret the given technical graphical representation and compose passage. Summarise and paraphrase technical texts in about 200 to 300 words.*
- *Apply the rules of grammar viz, tenses prepositions, subject-verb agreement, adjectives, direct indirect speech and use appropriate patterns in a given sentence.*

FOCUS ON LANGUAGE

Synonyms - Antonyms - Forms of Words - One Word Substitutes - Word Formation - Contextual Meanings - Tenses - Prepositions - Subject-verb Agreement - Adjectives - Sequence Words - Wh-Questions - Direct Indirect Speech- Adverbs - Abbreviations and Acronyms. **(9)**

READING

Predicting the Content - Skimming the Text - Understanding the Gist -Topic Sentence and its Role - Scanning - Inferring Meanings: Lexical and Contextual - Note-Making - Interpreting Graphics in Technical Writing - Sequencing of Sentences - Reading Comprehension - Dictionary Skills - Itinerary. **(9)**

WRITING

Filling Forms - Descriptive Writing - Autobiographical & Biographical Writing - Paragraph Writing - Academic Writing - Tweets - Paraphrasing - Channel Conversion - Essay Writing: Argumentative Writing - Poster Making - Recommendations - Dialogue Writing - Informal Letters. **(9)**

LISTENING

Importance of Listening & Empathy in Communication - Reasons for Poor Listening - Traits of a Good Listener - Listening Mode - Note Taking - Listening to Short Dialogues - Listening to Long Conversations. **(8)**

SPEAKING

Describing Places - Giving Opinions - Narration - Introducing Ideas - Justifying Opinions - Formal Conversations - Telephonic Skill - Debating - Apologizing - Extempore - Effective Presentation Strategies - Planning - Outlining & Structuring - Nuances of Delivery - Controlling Nervousness & Stage Fright - Visual Aids in Presentation - Applications of MS Power Point. **(10)**

TOTAL : 45

TEXT BOOK

1. *Dr. K. Elango, "Resonance", Cambridge University Press, New Delhi, 2013.*

EXTENSIVE READING

2. *Dr. A.P.J. Abdul Kalam "India 2020", Vision for the Millennium - Brooks/Cole Publishing Company, 2002. (Only Essay Questions)*

REFERENCE BOOKS

1. *Meenakshi Raman, Sangeeta Sharma, "Technical Communication - English Skills for Engineers", Oxford University Press, New Delhi, 2012.*
2. *Nagaraj Geetha, "A Course in Grammar and Composition", Cambridge University Press, 2012*
3. *Samson T, "Innovate with English", Cambridge University Press, 2012.*
4. *Mark Ibbotson,"Cambridge English for Engineering", Cambridge University Press, 2012.*
5. *B. Sai Lakshmi, "Poly Skills- A Course in Communication and Life Skills", Cambridge University Press, 2012.*
6. *Simon Sweeney, "English for Business Communication", Cambridge University Press, 2010.*

16MDS12 - ALGEBRA AND APPLICATIONS

L	T	P	C
3	2	0	4

PRE-REQUISITES
Consent of the Instructor

ASSESSMENT : THEORY

COURSE OUTCOME

- *Become familiar in linear algebra concepts to data analysis in economics.*
- *Apply difference equation ideas in data modeling.*
- *Gain knowledge in sequences and series ideas to analyze and study their areas.*
- *Identity and solve the problems related with data science.*

SEQUENCES, SERIES AND ALGEBRAIC EQUATIONS

Convergence and divergence of infinite series-series of positive terms-comparison, ratio, root and raabe's tests-alternating series-Leibnitz test Expansions and summations using Binominal-exponential and logarithmic series. Roots of algebraic and transcendental equations using Graeffe's and Newton-Raphson method. **(9)**

VECTOR SPACES

Definition of vector spaces-linearly dependent and independent-subspaces-basis and dimension-of vector space-rank and nullity of linear transformation.Inner product, properties- Cauchy Schwarz-inequality, norm and its properties, introduction of orthogonal basis and Gram-Schmidt orthogonalization process. **(9)**

MATRICES

Matrix factorization techniques-special matrices-permutation matrix (non negative elements)- Hessenberg matrix-sparse matrix-sparse matrix-band width-Linear system of equations-Gauss elimination-Gauss Jordan-Inverse of a matrix-Gauss-seidal-iteration method. Application of Linear systems: A homogeneous system in economics- non homogenous system by inversion-Applications of Matrices in Input-Output Analysis in Economics. **(9)**

EIGENVALUES AND EIGENVECTORS

Eigenvalues and eigenvectors-Cayley-Hamilton theorem (without proof)-Diagonalization- Quadratic form reduction in three variables-applications. **(9)**

DIFFERNCE EQUATIONS

Finite differences-operators and their interrelations-Interpolations-Newton's and Lagrange's method-Solutions of finite difference equations with constant coefficients-Solution of first order equation (Iterative Method)-General method of solving first order difference equation-simple applications in economics. **(9)**

THEORY : 45

TUTORIAL : 30

TOTAL : 75

TEXT BOOKS

1. *Srimanta pal and Subodh C. Bhunia, "Engineering Mathematics", Oxford University Press India, 1st Edition, 2015. (ParaI, ParaIV)*
2. *Biswa Nath Datta, "Numerical Methods for Linear Control Systems Design and Analysis", Elsevier Academic press, 2004. (ParaIII)*
3. *David. C. Lay, "Linear Algebra and its Applications", Addision Wesley, 2003. (ParaII)*
4. *Curtis F Gerald and Patrick O Wheatly, "Applied Numerical Analysis", Pearson Education, 2002. (ParaV)*
5. *Mehta B.C, and G.M.K. Madani, "Mathematics for Economists", Sultan Chand & Sons, New Delhi, 2006. (ParaIII)*

REFERENCE BOOKS

1. *Erwin Kreyszig, "Advanced Engineering Mathematics", 8th Edition, John Wiley & Sons Asia Private Limited, 2008.*
2. *Grewal, B.S, "Higher Engineering Mathematics", 4th Edition, Khanna Publishers ,2007.*
3. *Piskunov, 'Differential and Integral Calculus", MIR Publishers, Moscow, 1974.*
4. *Wylie C. R, Barret L. C, "Advanced Engineering Mathematics", 6th Edition, Mc Graw Hill, New York, 1995.*

16MDS13 - BASIC STATISTICAL METHODS

L	T	P	C
3	2	0	4

PRE-REQUISITES

Consent of the Instructor

ASSESSMENT : THEORY

COURSE OUTCOME

- *To demonstrate the use statistical tools for diagrammatic and graphical representation of data and also computation of various measures of central tendency and dispersion.*
- *To analyze probability and probability distributions and moments of random variables.*
- *To analyze bivariate data using correlation and simple regression.*

DEFINITION OF STATISTICS

Data -Qualitative and quantitative - Measurement of data -Nominal and Ordinal - Raw data and grouped data - Primary and secondary data - Methods of collection -Classification of data - Tabulation -frequency distribution and various diagrammatic and graphical representations of data. **(7)**

SUMMARY STATISTICS

Measures of Central Tendency: Arithmetic mean, median,mode,geometric mean and harmonic mean Merits and demerits-Relationship between mean, median and mode-Relationship AM, GM and HM, computation of the measures for grouped and ungrouped data-weighted arithmetic Measures of dispersion: Range, mean deviation and standard deviation - coefficient of variation and its use- quartiles and inter quartile range-quintiles deciles and percentiles- moving averages -Skewness and Kurtosis and their uses. **(8)**

PROBABILITY

Deterministic and random experiments -Definition of sample space and events- classical and axiomatic definitions- Properties of probability- addition theorem- conditional probability and multiplication theorem of probability- Definition of independent events - Random variables and their probability distributions-Discrete and continuous random variables Probability mass function and cumulative distribution functions -definition - Mathematical expectation-mean and variance - Mean and variances of linear combination of random variables - Chebyshev's theorem- -Important discrete distributions-Discrete Uniform Distribution, Binomial, Poisson, -Continuous distributions: probability density functions and cumulative probability distributions-Normal distribution and its properties and applications. **(15)**

SAMPLING

Population and sample- sampling and its need -sampling vs complete enumeration -parameter and statistics-Probability sampling and - random sampling- simple random sampling , lottery method and random number table method- stratified random sampling-sampling distribution and standard error of a statistic. **(7)**

CORRELATION AND REGRESSION

Definition of correlation - Scatter plot -Karl Pearson's correlation coefficient its properties- Definition of Regression - Simple regression-Regression of x on y and y on x - Rank correlation - Spearman's Rank correlation coefficient. **(8)**

THEORY : 45

TUTORIAL : 30

TOTAL : 75

TEXT BOOK

1. *S.C. Gupta, " Fundamentals of Statistics", 7th and Enlarged Edition, Himalaya publishing, Delhi, 2014.*

REFERENCE BOOK

1. *D M Levine T C Krehbiel, M L Berensen, "Business Statistics: A First Course", Pearson Education, New Delhi, India, 2003.*
2. *Various e-resources like : http://de.wikibooks.org/wiki/Benutzer:Dirk_Huenniger/wb2pdf.*

16MDS14 - PROBLEM SOLVING AND PROGRAMMING IN C

L	T	P	C
3	0	0	3

PRE-REQUISITES

Consent of the Instructor

ASSESSMENT : THEORY

COURSE OUTCOME

- *Recognize the role of computers and programming languages in solving the real world problems.*
- *Use the suitable data type among Arrays, Pointers Strings, Structure, Union and Files to store and manipulate data in C.*
- *Analyze the given problem statement, divide it into modules and represent them using functions in C.*
- *Analyze the given problem statement and develop an algorithm with the properties of finiteness, completeness, and correctness.*
- *Develop a C program for a given problem statement by using the necessary program structure, data types and constructs to generate the correct output.*

INTRODUCTION

Problem Solving: Overview of Computers and Programming - Program Development Strategy - Software Development Lifecycle - Structured Programming - Types of Programming Languages

Basic Constructs: History of C - Structure of C Program - Introduction to C programming - Operators and Expressions - Data Input and Output - Control Statements. **(10)**

FUNCTIONS, STORAGE CLASSES AND ARRAYS

Top-Down Design and Structure Charts - Defining and Accessing a Function - Prototypes - Passing Arguments - Recursion- Storage classes - Automatic, External and Static Variables - Multifile Programs - Defining and Processing an Array - Passing Arrays to Functions - Multidimensional Arrays. **(10)**

STRINGS AND POINTERS

Defining a String - Null Character - Initialization - Reading and Writing - Processing - Character Arithmetic - Searching and Sorting - Pointer Fundamentals - Declarations - Passing Pointers - Pointers and Arrays -Dynamic Memory Allocation - Operations on Pointers - Arrays of Pointers. **(10)**

STRUCTURES AND UNIONS

Defining and Processing Structures - Typedef - Structures and Pointers - Passing Structures to Functions - Unions. **(8)**

FILE HANDLING AND ADDITIONAL FEATURES OF C

Data File Handling - Binary File Handling - Random Access - Enumerations - Command Line Parameters - Macros - The C Preprocessor **(7)**

TOTAL: 45

TEXT BOOKS

1. *Jeri.R.Hanly, Elliot B.Koffman, "Problem Solving and Program Design in C", Pearson Education, 2012 (Para - I)*
2. *Schaum's outline series, "Programming with C", Tata McGraw Hill Publication, 2nd Edition, 2010 (Para - II to V).*

REFERENCE BOOKS

1. *Herbert Schildt, "C- The Complete Reference", McGraw Hill, 4th edition, 2009.*
2. *Yashavant P. Kanetkar, "Let Us C", BPB Publications, 13th Edition, 2012.*
3. *R.G. Dromey, "How to solve it by Computer", Prentice Hall of India, 8th Edition, 2003.*
4. *Kernighan B.W , Ritchie D.M., "C Programming Language (ANSI C)", Pearson Education, 2004*
5. *Herbert Schildt, Jean Paul Tremblay, Richard B Bunt, "Introduction to Computer Science - An Algorithmic Approach", McGraw Hill, 2nd Edition, 1985.*
6. *Terrence W Pratt, "Programming language - Design and Implementation", Prentice Hall of India, 4th Edition, 2001.*

16MDS15 - DIGITAL ELECTRONICS

L	T	P	C
3	0	0	3

PRE-REQUISITES

Consent of the Instructor

ASSESSMENT : THEORY

COURSE OUTCOME

- *Identification of single bit error detection and correction using hamming code through number systems and parity.*
- *Development of low level to high level programming using arithmetical, relational and logical operations through complement representation.*
- *To produce compact combiational and sequential digital circuits using minimized boolean expression, Karnaugh Map and Quine Mc-Cluskey Method.*
- *To familiarize digital data processing and storage through combinational and sequential logic.*
- *To know serial and parallel data operations using shift registers and counters.*

NUMBER SYSTEM AND CODES

Decimal, Binary, Octal and Hexadecimal Systems - Number base conversions-BCD (8421) code - Gray code and conversion-ASCII code - Error detecting and correcting codes: parity bit, block parity, Hamming code. **(8)**

BINARY ADDITION AND SUBTRACTION

1's, 2's, 9's, 10's, 15's, 16's Complement representation - 1's and 2's Complement subtraction - unsigned and signed numbers - BCD addition - 9's and 10's BCD subtraction - Binary Multiplication and Division. **(8)**

BOOLEAN ALGEBRA AND LOGIC GATES

Laws of Boolean algebra - Basic theorem and properties - Boolean expression and function - Canonical and Standard forms - Minimization of Boolean expression - Karnaugh Map and Quine Mc-Cluskey Method - Basic logic gates and truth tables - universal gates implementation. **(10)**

COMBINATIONAL AND SEQUENTIAL LOGIC CIRCUITS

Combinational logic: Half Adder and Full Adder, Half Subtractor and Full Subtractor -Encoder and Decoder - Multiplexer and Demultiplexer, Sequential logic: Latches and FlipFlops - Clocked RS, JK, T and D Flip-Flops. **(10)**

COUNTERS AND REGISTERS

Asynchronous and Synchronous : Up counter and Down counter - Mod 5, Mod 10 counters - Parallel / Serial In / Out Shift Registers - Ring Counter. **(9)**

TOTAL : 45

TEXT BOOK

1. *A.P.Godse and D.A.Godse, "Digital Electronics", Technical Publications, Pune,1st edition, 2008.*

REFERENCE BOOKS

1. *Malvino PA, Leach BP, "Digital Principles and Applications", McGraw Hill book company, 5th Edition, 1994*
2. *Thomas C Bartee, "Digital Computer Fundamentals", McGraw Hill book company, 6th Edition, 1997.*
3. *Thomas L Floyd, "Digital Fundamentals", UBS, 10th Edition, 2008.*
4. *Morris Mano.M., "Digital Logic and Computer Design", PHI, 2001.*

16MDS16 - PROGRAMMING LABORATORY IN C

L	T	P	C
0	0	4	2

PRE-REQUISITES
Consent of the Instructor

ASSESSMENT : PRACTICAL

COURSE OUTCOME

- *Solve the given problem by devising an algorithm and converting it into C program.*
- *Develop C programs with necessary data types to represent the data and manipulate them using appropriate operators and built-in functions.*
- *Develop C programs with appropriate control structures to implement decision making.*
- *Develop reusable and efficient solutions using functions and/or recursive functions in C.*
- *Develop C programs to create and access the files for handling the persistent data.*
- *Develop a simple project in application or system domain using C.*

CONCEPTS TO BE COVERED

1. Simple programs to understand the concepts of data types.
2. Writing programs to get familiarity on using conditional, control and repetition statements.
3. Defining and creating one and two dimensional arrays- Matrix operations.
4. Solving Systems of Linear Equations.
5. Working with pointers.
6. Functions - call by value and call by reference.
7. String manipulations.
8. Solving Recursive problems.
9. Solving iterative problems - Trigonometric series evaluation.
10. Use dynamic memory allocation functions for storage allocation.
11. Defining and handling structures, array of structures, structure pointers, union and enumeration type.
12. Defining functions with structure.
13. Application Programs using file operations.

16MDS17 - DIGITAL ELECTRONICS LABORATORY

L	T	P	C
0	0	4	2

PRE-REQUISITES
Consent of the Instructor

ASSESSMENT : PRACTICAL

COURSE OUTCOME

- *To emulate and understand the internal working of arithmetical, relational and logical circuits inside computer systems.*
- *To familiarize digital data processing and storage through combinational and sequential logic.*
- *To Demonstrate serial and parallel data operations using shift registers and counters.*
- *To comply data encryption and decryption methods using encoding and decoding.*
- *To implement low level to high level digital computer systems using combinational and sequential logic.*

CONCEPTS TO BE COVERED

1. Study of logic gates.
2. Study of Flip-Flops.
3. Design of binary counter & decade counter.
4. Construction of Half-adder & Full-adder.
5. Implementation of basic Logic gates using Universal gates.
6. Testing Left shift, Right shift and Parallel-In, Parallel-Out operation of the Shift registers.
7. Multiplexing and Demultiplexing.
8. Encoding and decoding.
9. Conversion of binary into gray and gray into binary.

16MDS18 - COMPUTING LABORATORY I

L	T	P	C
0	0	4	2

PRE-REQUISITES

Consent of the Instructor

ASSESSMENT : PRACTICAL

COURSE OUTCOME

- *Problems in linear algebra using Scilab scripts and commands.*
- *Measures of central tendency and dispersion using MS-Excel's in built functions.*
- *Graphical and diagrammatic representation of statistical data using MS-Excel's tools.*
- *Bivariate data using MS-Excel's Data Analysis Tools.*
- *Skills in writing script files and analyze data using Scilab and MS-Excel's Data Analysis Pack.*

CONCEPTS TO BE COVERED

1. Scilab Fundamentals.
2. Algebraic operations on matrices, Transpose of a matrix, Determinants, inverse of a matrix.
3. Solving System of linear equations and consistency.
4. Row reduced echelon form and normal form.
5. Eigen values, Eigen vectors, Rank of a matrix.
6. Solving algebraic and system of equations.
7. Estimating numerical values for given data by means of interpolation.
8. Perform data manipulation using excel.
9. Perform graphical and diagrammatic representation of statistical data, like bar diagram, pie, histogram and line diagram.
10. Construct the pivotal tables and apply statistical functions to calculate the descriptive statistics.
11. Practice the theory behind the descriptive statistics, like measures of central tendency, dispersion, skewness and kurtosis.
12. Apply and Implement the theory of probability in various applications.
13. Simple probability and random sampling.
14. Practicing the simple correlation and regression techniques.

16MDS19 - ENGLISH LANGUAGE LABORATORY

L	T	P	C
0	0	2	1

PRE-REQUISITES

Consent of the Instructor

ASSESSMENT : PRACTICAL

COURSE OUTCOME

- *For a given 2 to5 minutes speaking activity like Extempore and Debate, produce language structures accurately and fluently.*
- *Construct dialogues for a given social scenario and interpret the given graphic information and write creative paragraphs.*
- *For a given technical topic, prepare a power point presentation for 15 minutes.*
- *Given short conversations and monologues for listening, specify appropriate responses and construct a summary.*
- *Given a technical paragraph for reading, specify correct responses by identifying the topic sentence, inferring meanings, lexical and contextual items, and finding the supporting points and transitional tags.*

LIST OF EXPERIMENTS

1. Speech Sounds
2. Word Vocabulary
3. Reading Comprehension
4. Listening Practice - I
5. Dialogue Writing
6. Conversational Exercise - I
7. Focus on Language
8. Creative Writing
9. Conversational exercise - II
10. Listening Practice-II

16MDSLE01 - PROFESSIONAL ENGLISH

L	T	P	C
3	0	0	3

PRE-REQUISITES

Consent of the Instructor

ASSESSMENT : THEORY

COURSE OUTCOME

- *Apply the rules of the grammar viz Confusing words, Verbs, Gerunds, Infinitives, Cause and Effect and use appropriate patterns in a given sentence or a passage.*
- *Given a passage or a technical topic, prepare a mind map, make notes and summarize.*
- *Given a Business Communication scenario, prepare Reports, Memos, Instructions, Minutes of the meeting, Emails & Business letters using appropriate format.*
- *Given a communication context, specify the type and barrier to listening, provide solutions and justify. Given short conversations and monologues for listening, specify appropriate responses, and construct a summary.*
- *For a given HR topic, generate valid points for and against the topic and present them with group behavior. For any job requirement plan and prepare for a 20 minute Mock Interview.*

FOCUS ON LANGUAGE

Scientific Terminology - Homonyms - Homophones - Formal Vocabulary - Confusing Words - Idiomatic Expressions - Collocations - Regular and Irregular Verbs - Gerund - Voice - Infinitive - Modal Verbs - Phrasal Verbs - If Conditionals - Cause and Effect - Numerical Adjectival Phrases - Conjunctions - Clauses - Definitions - SMS Language. **(11)**

READING

Summarizing - SQ3R Reading Technique - Note Making: Outline/Linear Method- Sentence Method - Schematic Method - Understanding Discourse Coherence - Non-Verbal Signals - Cloze Comprehension - Mind Mapping. **(7)**

WRITING

Business Letters - Article Writing - Review of a Newspaper Report - Emails - Report Writing - Instructions - Vacancy Advertisements - Resume - Meetings: Agenda and Minutes of the Meeting - Writing Book Reviews - Memorandum - Essay Writing. **(11)**

LISTENING

Types of Listening- Barriers to Effective Listening- Intensive Listening - Listening to Podcast, Negotiation, Job Interviews, Group Discussions and Filling Gaps. **(7)**

SPEAKING

Interviews: Objectives of Interviews - Types of Interviews - Group Discussions - Organizational GD - GD as a Part of Selection Process - Role Play - Negotiation. **(9)**

TOTAL: 45

TEXT BOOK

1. *Dr.K.Elango, "Resonance", Cambridge University Press, New Delhi, 2013.*

REFERENCE BOOKS

1. *Meenakshi Raman, Sangeeta Sharma, "Technical Communication - English Skills for Engineers", Oxford University Press, New Delhi, 2012.*
2. *Nagaraj Geetha, "A Course in Grammar and composition", Cambridge University Press, 2012*
3. *Samson T, "Innovate with English", Cambridge University Press, 2012.*
4. *Mark Ibbotson, "Cambridge English for Engineering" ,Cambridge University Press, 2012.*
5. *B. Sai Lakshmi, "Poly Skills- A Course in Communication and Life Skills" ,Cambridge University Press, 2012.*

16FY22F - BASIC FRENCH

L	T	P	C
3	0	0	3

PRE-REQUISITES
Consent of the Instructor

ASSESSMENT : THEORY

COURSE OUTCOME

- *Comprehend the fundamentals and Grammatical Patterns of French Language.*
- *Acquire the basic Writing and Speaking Skills.*
- *Develop an understanding of French practices and perspectives.*

INTRODUCTION **(2)**

UNITE-1

Faire connaissance - inviter et répondre à une invitation - décrire les personnes- articles définis et indéfinis - genre etnombre des noms et des adjectifs- interrogation et négation - conjugaison du présent. Paris monuments et lieux publics - la vie de quatre parisiens de professions différentes. **(11)**

UNITÉ-2

Exprimer l' ordre et l'obligation demander et commander - evaluer et apprécier- féliciter et remercier - articles partitifs -adjectifs démonstratifs et possessifs prépositions et adverbes de quantité et de l'imperatif verbes pronominaux - une région deFrance la Bourgogne - vie quotidienne à la compagne. **(11)**

UNITÉ-3

Raconter et rapporter - donner son avis - se plaindre et réprimander - expliquer et justifier - pronoms compléments -futur proche - passé composé et imparfait. Plusieurs régions de France - différents univers sociaux. **(11)**

UNITÉ-4

Demander l'autorisation - interdire - formuler des projects - discuter et débattre. Pronoms < en > et < y > - pronoms relatifs et superlatifs - conjugaison du futur - présent continu et passé récent.La vie administrative et régionale - problems economiques et écologiques - traditions et modernité. **(10)**

TOTAL : 45

TEXT BOOK

1. *Nouveau Sans Frontières - Philippe Dominique , Jacky Girardet Michèle Verdelhan , Michel Verdelhan*

REFERENCE BOOKS

1. *Mathurin Dondo, "Dondo Modern French Course"*
2. *Margaret Lang and Isabelle Perez, "Modern French Grammar"*

16FY22G - BASIC GERMAN

L	T	P	C
3	0	0	3

PRE-REQUISITES
Consent of the Instructor

ASSESSMENT : THEORY

COURSE OUTCOME

- *Comprehend the fundamentals and Grammatical Patterns of French Language.*
- *Acquire the basic Writing and Speaking Skills.*
- *Apply the new language actively and creatively in different social contexts.*

EINFUHRUNG

BegrU ung - Name - Vorname - Familienname - Anrede **(7)**

THEMA

Hallo ! Wie geht's?
Begegnungen
Guten Tag, ich suche…,
Im Supermarkt
Arbeit und Freizeit
Familie und Haushalt **(10)**

GRAMMATIK-I

Position des Verbs : Aussage, W - Frage und
Ja/Nein - Frage; Artikel die der das.
W - Frage; Konjugation in Prasens;
Nominativ : bestimmter, unbestimmter und negative Artikel
Akkusativ : unbestimmterundnegativer Artikel
Adjektive : Akkusativ-Erganzung **(18)**

GRAMMATIK-II

Artikel als Pronomen
Dative - Erganzung : Personalpronomen und Ortsangaben;
Imperativ
Modalverben; Ortsangaben; Richtungsangaben;
Zeitangaben; Ordinalzahlen
Possessiv - Artikel; trennbare und nicht trennbareVerben;
Wechselprapositionen **(10)**

TOTAL : 45

TEXT BOOK

Studio d A1: Kurs - und Ubungsbuch (Deutsch alsFremdsprache) CornelsenVerlag.

REFERENCE BOOK

Tangarmaktuell1 :Kursbuch + Arbeitsbuch (Deutsch alsFremdsprache) Max HueberVerlag

16MDS21 - CALCULUS AND APPLICATIONS

L	T	P	C
3	2	0	4

PRE-REQUISITES
Consent of the Instructor

ASSESSMENT : THEORY

COURSE OUTCOME

- *To incorporate the essentials of calculus in modeling and analysis.*
- *To enrich the concepts integral calculus of those are vital for the study of data science subjects.*
- *To study the concepts of differential equations which have got a direct leverage over all data science subjects.*
- *To imbibe the concepts of Fourier series which are invertible for the study of image processing.*

DIFFERENATIAL CALCULUS

Rate of change and limits-rules for finding limits-extensions of the limit concept-continuity-tangent lines-the derivative of function--related rates of change-extreme values of functions-the mean value theorem-first derivative test for local extreme values-Numerical differentiation based on Newton's formula, Lagrange's formula. **(9)**

APPLICATIONS OF DIFFERENTIAL CALCULUS

Curvature-Evolutes-Envelopes-partial differentiation-Jacobians-Functions of several variables--Hessian matrix-Expansions and extreme values- Constrained extrema using Lagrange's multiplier method-applications- Indifference curve-Rate of commodity substitution (RCS)-Maximization of utility. **(9)**

INTEGRAL CALCULUS

Integration-definition and geometrical meaning-double integrals as volumes-changing the order of integration, triple integrals in rectangular co-ordinates-applications to areas and volumes- -compound interest-present value-consumer's surplus-producer's surplus- Numerical integration-Trapezoidal and Simpson's 1/3 rules. **(9)**

FOURIER SERIES

Dirichlet's conditions-Full range series-Half range series-Complex form of series-Parseval's identity -Harmonic analysis. **(9)**

ORDINARY DIFFERENTIAL EQUATIONS

Formation of differential equations-geometrical interpretation of ODE- Higher order differential equations with constant coefficients-Euler Cauchy type-Applications in micro economics. Numerical solution-RK method of order four-Milne Thomson method. **(9)**

THEORY : 45

TUTORIAL : 30

TOTAL : 75

TEXT BOOKS

1. *Srimanta pal and Subodh C. Bhunia, "Engineering Mathematics", Oxford University Press India, 1st Edition, 2015. (ParaIV, ParaV)*
2. *Thomas & Finney, " Calculus", Pearson education, 9th Edition, 2006. (ParaI, ParaII, ParaIII)*
3. *Mehta B.C, and G.M.K. Madani, "Mathematics for Economists, Sultan Chand & Sons, New Delhi,2006. (ParaII, ParaIII, ParaV)*

REFERENCE BOOKS

1. *Erwin Kreyszig, "Advanced Engineering Mathematics", 8th Edition, John Wiley & Sons Asia Private Limited., 2008.*
2. *Grewal, B.S., "Higher Engineering Mathematics", 4th Edition, Khanna Publishers, 2007.*
3. *Piskunov, 'Differential and Integral Calculus, MIR Publishers, Moscow 1974.*
4. *Wylie C. R, Barret L. C, "Advanced Engineering Mathematics", 6th Edition, McGraw Hill, New York, 1995.*

16MDS22 - PROBABILITY AND APPLICATIONS

L	T	P	C
3	2	0	4

PRE-REQUISITES
Consent of the Instructor

ASSESSMENT : THEORY

COURSE OUTCOME

- *To impart knowledge of advanced probability distribution, properties of their moment generating functions and their applications.*
- *To provide a good knowledge on various methods of estimation of parameters and tests of statistical hypothesis.*
- *To provide a basic knowledge in Bayesian statistics.*

DISCRETE PROBABILITY DISTRIBUTIONS

Geometric, negative binomial distributions and hypergeometric distributions. Continuous Probability Distributions: uniform, exponential, gamma, Beta, Chi-square log normal distributions and Weibull distributions and their properties. **(8)**

FUNCTIONS OF RANDOM VARIABLES

Moments and Moment Generating functions of important distributions-Transformations of Variables and finding their distributions -method of direct transformation and method of moment generating functions- - Joint and Marginal Probability mass functions(for discrete) and density functions(for continuous). Conditional probability distributions-conditional mean and variance-Independence of random variables. **(15)**

ESTIMATION

Estimation of parameters using method of moments- Maximum Likelihood Point Estimation(MLE) -Properties of estimators-Unbiasedness,minimum variance, efficience and sufficience-Mean Square Error-Asymptotic properties-consistency-Fisher Information and Cramer-Rao's Inequality - Interval Estimation. **(7)**

SAMPLING AND TESTS OF HYPOTHESIS

Derivation of sampling distribution of mean and S2- t-distribution and F-distribution-Central limit theorems- Test of significance - Basic concepts - null hypothesis - alternative hypothesis - level of significance - Standard error and its importance - steps in testing-One and two tailed tests-The use of p-values for Decision making - Large sample tests and Small sample tests for : Single sample: Testing on a single mean with variance known and variance unknown-Two samples-tests on means -One sample test on a single proportion-two sample tests of two proportions-Goodness of Fit tests, One and two sample tests concerning variances-Tests of independence for categorical data, tests for homogeneity. **(8)**

INTRODUCTION TO BAYESIAN DATA ANALYSIS

Baye's Theorem and its applications -Prior and posterior distributions-Optimal Decisions using loss function--Estimation: Bayesian versus classical - Simple Applications. **(7)**

THEORY : 45

TUTORIAL : 30

TOTAL : 75

TEXT BOOK

1. *Ronald E.Walpole, Raymond H. Myers, Sharon L. Myers and Keying Ye , "Probability and Statistics for Engineers and Scientists", Pearson Education Inc, 7th Edition, New Delhi, India, 2002.*

REFERENCE BOOKS

1. *S.C. Gupta ,"Fundamentals of Statistics",7th and Enlarged Edition, Himalaya publishing, Delhi, 2014.*
2. *S.C.Gupta , V.K.Kappoor, "Fundamentals of Mathematical Statistics", Sultan Chand & Sons, 10th Revised Edition, New Delhi, 2002.*
3. *Anthony O'Hagan,Bryan R. Luce , "A primer on Bayesian Statistics in Health Economics and Outcomes Research", MEDTAP International Inc, 2003.*

16MDS23 - DATA STRUCTURES AND ALGORITHMS

L	T	P	C
3	0	0	3

PRE-REQUISITES
16MDS14

ASSESSMENT : THEORY

COURSE OUTCOME

- *Design and implement abstract data types such as array, linked list, stack, queue, and tree to solve real world problems.*
- *Select and use suitable data structures for problem solving and programming.*
- *Ability to design substantial and complex data structures for a given real-life problem.*
- *Evaluate algorithms and data structures in terms of time and space complexity of basic operations.*
- *Compare and evaluate the searching and sorting techniques based on complexity measures.*

INTRODUCTION TO DATA STRUCTURES

Primitive data structures - ADT- Arrays: Arrays as ADT, one dimensional array, two dimensional array, multidimensional array, representation-sparse matrix . **(6)**

STACK

Definition - stack as ADT - sequential representation - operations, Applications: Reversing data, conversion & evaluation of expression. Recursion: Definition, properties, examples. QUEUE - Definition - queue as ADT, sequential representation - operations - circular queue - priority queue. Applications : Categorizing data and Queue Simulation. **(11)**

LINKED LISTS

Definition - operations - linked representation of stacks & queue - circular lists - operations - doubly linked list - Application: Operations polynomial. **(9)**

TREES

Terminologies - binary tree : operations, traversals, representation - threaded binary tree - properties. **(6)**

ALGORITHMS

Analysis of Algorithms : Algorithms as a technology, Insertions Sort, Analyzing algorithms, Designing algorithms - Growth of functions. Bubble sort - quick sort - radix sort - Searching: linear search, binary search. **(13)**

TOTAL : 45

TEXT BOOKS

1. *Yedidyah Langsam ,Moshe.J.Augenstein and Aaron.M.Tenenbaum, "Data structures using C & C++", PHI Publications, 2nd Edition, 2006. (Para I - Para IV)*
2. *Thomas H.Cormen, Charles E.Leiserson Ronald L. Rivert and Clifford Stein, "Introduction to Algorithms", PHI Publications, 2nd Edition, 2004.(Para V)*

REFERENCE BOOKS

1. *Ellis Horowitz, Sartaj Sahni, "Fundamentals of Data Structures", Galgotia Publications, 1983.*
2. *Richard F. Gilbery, Behrouz A.Forouzan, "Data structures - A Pseudocode Approach with C", Thomson Asia Pvt Ltd, 2002.*
3. *Krishnamoorthy. R,"Data Structures using C", Mc Graw-Hill Education (India) Pvt.Ltd, 2010.*

16MDS24 - OBJECT ORIENTED PROGRAMMING

L	T	P	C
3	0	0	3

PRE-REQUISITES
Consent of the Instructor

ASSESSMENT : THEORY

COURSE OUTCOME

- *For a given scenario compare and criticize alternate implementations using functional programming and object oriented programming in view of privacy.*
- *Compare and contrast function overloading and default argument function for appropriate usage in an object oriented system.*
- *For a given scenario, construct an object oriented system using appropriate type of inheritance for realizing reusability.*
- *Construct and compare object oriented systems using static binding, dynamic binding and template classes for realizing polymorphism.*
- *Create persistent objects using stream class hierarchy incorporating exceptional handling.*

INTRODUCTION

Introduction to C++ - Programming Paradigms - Procedural Programming - Modularity - Separate compilation - Exception Handling - Data Abstraction- User Defined Types - Concrete Types - Abstract Types - Virtual Function - Object Oriented Programming - Generic Programming. **(3)**

BASIC FACILITIES IN C++

Overview of C++ - Types and Declarations - Arrays, Pointers, Structures, References and Functions - Function Overloading - Name spaces - Source Files and Programs. **(3)**

ABSTRACT DATA TYPE IN C++

Class - Class members and Access control - Constructors- Static members - Default copy constructor - Const member functions - this pointer - Structs - Inline function definition - Concrete classes - Destructors - new and delete - Member objects. **(11)**

OPERATOR OVERLOADING

Operator functions - Binary and unary operators - Member and non member operators - Friend functions - Large objects - Function call -Increment and Decrement - A string class - Dereferencing. **(8)**

INHERITANCE

Derived Classes - Class Hierarchies - A virtual functions - Abstract classes. Templates: Function templates - Derivation and Templates. **(10)**

EXCEPTION HANDLING AND LIBRARY CLASSES

Grouping of exceptions - Catching exceptions - Exceptions that are not errors - Uncaught Exceptions - Standard exceptions - The standard library - I/O streams - File streams. **(10)**

TOTAL : 45

TEXT BOOK

1. *Bjarne Stroustrup, "The C++ Programming Language", Pearson Education, 3rd Edition, 2000.*

RFERENCE BOOKS

1. *Ira Pohl, "Object Oriented Programming Using C++", Pearson Education, 2nd Edition, 2006*
2. *Herbert Schildt, "The Complete Reference C++", Tata McGraw Hill, 4th Edition, 2003.*
3. *Stanley B Lippman, Jove Lajoie, and Barbara Moo "C++ Primer", Addison Wesley, 5th Edition, 2012.*

16MDS25 - DATA STRUCTURES AND PYTHON PROGRAMMING LABORATORY

L	T	P	C
0	0	4	2

PRE-REQUISITES
16MDS23

ASSESSMENT : PRACTICAL

COURSE OUTCOME

- *Choose the appropriate data structure for a specified application.*
- *Demonstrate the abstract properties of various data structures such as stacks, queues, lists and trees in real world application.*
- *Familiar,trace and code recursive methods and compare with iterative methods.*
- *Implement and compare the complexities of various sorting algorithms including bubble sort, heap sort and quick sort.*
- *Demonstrate understanding of linear and binary search algorithms.*

CONCEPTS TO BE COVERED

I. Implement simple programs in Python

II. Implement the following concepts

1. Applications of 2D, 3D arrays.
2. Evaluation of expression using stack.
3. Recursion - Towers of Hanoi, Ackermann's function, Fibonacci series.
4. Implementation of basic queue operations, priority queue, circular queue.
5. Implementation of self referential structures (FIFO, LIFO).
6. Applications of circular linked list.
7. Applications of doubly linked list.
8. Traversals of binary tree.
9. Implementation of sorting and searching techniques.

16MDS26 - OBJECT ORIENTED PROGRAMMING LABORATORY

L	T	P	C
0	0	4	2

PRE-REQUISITES
Consent of the Instructor

ASSESSMENT : PRACTICAL

COURSE OUTCOME

- *Determine the visibility requirements for data members and member functions and communication requirements among objects while constructing classes for a given scenario.*
- *Demonstrate static binding using function overloading and operator overloading for manipulating real-life objects.*
- *For a given scenario, construct an object oriented system using appropriate type of inheritance for realizing reusability.*
- *Design object oriented system for realizing run time polymorphism using dynamic binding.*
- *Create persistent objects using iostream class hierarchy incorporating exceptional handling.*

CONCEPTS TO BE COVERED

1. Identification, construction and destruction of objects
2. Overloading
3. Friend functions
4. Inheritance
5. Polymorphism
6. Exception handling
7. Using I/O Streams
8. File Operations
9. Generic Programming

16MDS27 - COMPUTING LABORATORY II

L	T	P	C
0	0	4	2

PRE-REQUISITES
16MDS21, 16MDS22

ASSESSMENT : PRACTICALS

COURSE OUTCOME

- *Differential Equations of first and second order using Scilab commands.*
- *To understand properties of probability distributions and to perform statistical tests using Scilab programming and Ms-Excel's Tools.*
- *Definite integrals numerically using Trapezoidal and Simpson's methods.*

i) Numerical methods using SCI LAB

- Finding the derivatives of functions using deff and numderivative
- Plotting of a function of single variable using plot command and finding local extreme values using fminsearch
- Constrained optimisation using optim and qpsolve
- Writing Script files in Scilab for Numerical Integration by Trapezoidal rule and Simpson's 1/3 rule and applying them to problems
- Solving first order differential equations using ode
- Solving second order differential equations using ode
- Solving the first order differential equations using Runge Kutta 4th order method and applying them to problems

ii) Probability Distributions using MS-Excel and Scilab

- Using functions in MS-Excel to calculate the **probabilities** and **inverse probabilities** for Binomial, Poisson, Normal, Geometric, Negative Binomial distributions
- Computing and plotting the pmf and cdf of geometric and hypergeometric distributions in Scilab and Ms-Excel
- Computing the pmf and cdf of Binomial, Poison and Negative Binomial distributions using *cdfbin, cdfpoi* and *cdfnbn* in Scilab.
- Using functions in MS-Excel to calculate the **probabilities** and **inverse probabilities** for exponential, gamma, beta and lognormal distributions
- Calculating the cdf of the uniform distribution in the interval (a,b) using *deff* in Scilab
- Computation using *cdfgm* for gamma and exponential distributions in Scilab
- Computation using *cdfbet* for beta distributions in Scilab
- Finding the mean and variance of Weibull distribution using *gamma* function in Scilab
- Using functions in MS-Excel to calculate the probabilities and inverse probabilities for Normal, t, F, Chi-square.

iii) Hypotheis testing Using MS-Excel's Data Analysis Pack

- Testing Single mean, difference between two means large samples- Z test
- Testing Single mean, difference between two means small samples- t- test

iv) Hypotheis testing using Scilab

Writing Script files for testing

- Single proportion
- Difference between two proportions
- Chi- square test for testing i) goodness of fit and ii) independence of attributes
- Equality of two variances

16MDS31- BUSINESS STATISTICS

L	T	P	C
3	0	0	3

PRE-REQUISITES
16MDS13, 16MDS22

ASSESSMENT : THEORY

COURSE OUTCOME

- *Compute various Index Numbers used in Economics and Business.*
- *Apply Statistical methods to analyze time series data from Business.*
- *Prepare Control Charts for variables and attributes using data from economics.*
- *Analyze data from Statistical Experiments using appropriate Statistical Design of Experiment like CRD,RBD,LSDetc.*
- *Analyze data using Non-parametric methods.*

INDEX NUMBERS

Definition, characteristics and uses of Index Numbers-Types of Index Numbers-Price, quantity and value indices- Simple and weighted aggregate index numbers -Laspeyre, Paasche, , Marshell - Edgeworth, Fisher's Ideal Index Numbers-Tests of adequacy of Index Numbers. **(9)**

TIME SERIES FORECASTING

Definition- Time Series Components- Time series decomposition models: multiplicative and additive models -Forecasting error-measurement using Mean Absolute Deviation(MAD) and Mean Squared Error(MSE)- Smoothing Techniques: Naïve forecasting, moving averages and weighted moving averages-Exponential smoothing -Simple Exponential Smoothing- Trend analysis- linear, quadratic and exponential trend-Seasonal Effects-Decomposition methods: method of simple averages, ratio to trend method and ratio to moving average method-Measurement of cyclic and irregular variations. **(9)**

STATISTICAL QUALITY CONTROL

Nature of Control Limits-Purpose of Control Charts-Control Charts for Variables-Control Charts for Attributes-Cusum Control Charts. **(9)**

DESIGN OF EXPERIMENTS

Analysis of Variance (ANOVA) technique-Design of experiments - basic concepts - treatment - experimental unit -experimental error - basic principle - replication, randomization and local control- One way Analysis of Variance:Completely Randomized Design- Randomized blocks design - description - layout - analysis-Latin Square Design-description-layout-analysis. **(9)**

NONPARAMETRIC STATISTICS

Introduction to Nonparametric tests -Sign test - Signed Rank test-Rank-Sum test-Wilcoxon-

Mann-Whitmey test (U test), Kruskal Wallis test-Runs test-Spearman's Rank correlation coefficient. **(9)**

TOTAL : 45

TEXT BOOKS

1. *Ken Black, "Business Statistics for Contemporary Decision Making", 6th Edition, John Wiley &Sons.Inc, 2010 [Para I, II, III and V]*
2. *Ronald E.Walpole , Raymond H. Myers, Sharon L. Myers and Keying Ye ,"Probability and Statistics for Engineers and Scientists", 9th Edition, Prentice Hall,2012 (Para III, IV and V)*

REFERENCE BOOKS

1. *R.P.Hooda, "Statistics for Business and Economics", 5th Edition, Vikas Publishing House Pvt. Ltd., Noida, 2013.*
2. *D M Levine, M L Berensen, T C Krehbiel and P.K.Viswanathan, "Business Statistics: A First Course", 5th Edition, Pearson Education, Delhi, India, 2011.*
3. *Richard I. Levin, David S. Rubin, "Statistics for Management", 7th Edition,Pearson Education, 2011.*

16MDS32 - DISCRETE STRUCTURES AND AUTOMATA THEORY

L	T	P	C
3	0	0	3

PRE-REQUISITES

Consent of the Instructor

ASSESSMENT : THEORY

COURSE OUTCOME

- *Apply logical reasoning in verifying the correctness and validity of simple instances of valid logical arguments.*
- *Identify to devise encoding and decoding procedures for error detection and correction in data transmission problems.*
- *Classify in constructing system models which are the natural extension of automata that are used to devise decision procedures.*
- *Analyze specifiaction of languages using grammars.*
- *Develop problems in pushdown automata and turing machines.*

MATHEMATICAL LOGIC

Connectives - Conditional and Biconditional statements - Statement formulae and Truth tables- Tautologies and tautological Implications - Normal forms - Disjunctive and Conjunctive Normal forms - The Predicate Calculus. **(7)**

ALGEBRAIC STRUCTURES I

Rings, Integral domains and fields - Properties - Construction of finite fields-Irreducible Polynomials-Primitive element of a finite field- Primitive Irreducible Polynomials. **(8)**

ALGEBRAIC STRUCTURES II

Residue arithmetic for Computers- Coding theory - Error Detection - Correction - Distance between Code words - Minimum distance and weight - Group Code , Linear Code and Cyclic code --Problems under Encoding and Decoding Techniques. **(8)**

FINITE AUTOMATA AND GRAMMARS

Finite State Systems - Basic definitions - Transition diagrams- Deterministic & Nondeterministic Finite Automata -Regular Expressions- Equivalence of Finite Automata and Regular Expressions - Moore & Mealy Machine. Grammars: Definition - Types - Leftmost , Rightmost Derivations-Syntaxtrees-Ambiguity. **(10)**

PUSH DOWN AUTOMATA

Definitions - Deterministic & Non deterministic - Acceptance by empty stack and final state. **(5)**

TURING MACHINES

Introduction - Turing machine - Types - Universal TM-Multiple TM - Multilevel TM -Offline TM- Halting problem - - Rice theorem - Linear bounded TM **(7)**

TOTAL : 45

TEXT BOOKS

1. *J.P.Tremblay, R. Manohar, "Discrete Mathematical structures with Applications to computer science", Tata McGraw - Hill, Edition, 1997 , Thirty Eighth reprint , 2010*
2. *Hopcroft J.E., Motwani R., Ullman J.D, " Introduction to Automata Theory, Languages and Computations" , Second Edition, Pearson Education , 2009.*

3. *Ralph P.Grimaidi, "Discrete and Combinatorial Mathematics: An Applied Introduction", Addison Wesley Publishing Company, Fifth Edition, Pearson Education, Second Impression , 2008.*

REFERENCE BOOKS

1. *Kenneth H. Rosen, "Discrete Mathematics and its Applications", Tata McGraw -Hill , Seventh Edition, 2012.*
2. *John C Martin , "Introduction to Languages and the Theory of Computation" , Third Edition , Tata McGraw Hill Publishing Company , New Delhi, Seventh reprint ,2010.*
3. *Mishra K.L.P, Chandrasekaran . N. "Theory of Computer Science: Automata, Languages and Computation", Prentice Hall of India , Third edition , 2008.*

16MDS33 - COMPUTER ARCHITECTURE

L	T	P	C
3	0	0	3

PRE-REQUISITES
16MDS15

ASSESSMENT : THEORY

COURSE OUTCOME

- *Given a computer organization, Demonstrate how the various computer system components work and justify why they perform so.*
- *Given the instruction set of a processor, develop assembly language programs that meets the given requirements.*
- *Given a CPU organization, design a memory module for a given specification.*
- *Given a CPU organization, design an I/O module for a device by choosing appropriate mode of transfer and justify choice.*
- *Given the instruction set, format of the instructions, and cycles needed for execution, can evaluate the execution time of a program.*

BASIC COMPUTER ORGANIZATION

Stored program organization - registers - instructions Timing and control - Instruction cycle - Memory reference instructions - input/output and interrupt - Design of Basic computer - design of accumulator logic - Programming the basic computer **(9)**

MICROPROGRAMMED CONTROL

Control memory - Address sequencing - Microprogram example- Design of control unit. CENTRAL PROCESSING UNIT: General register organization - stack organization - Instruction formats - Addressing modes - Data transfer and manipulation - Program control- Reduced Instruction Set computer **(9)**

COMPUTER ARITHMETIC

Addition - subtraction - multiplication and division algorithms - Floating point Arithmetic operations - Decimal arithmetic unit and operations **(9)**

I/O ORGANIZATION

Peripheral devices - Input/output interface - Asynchronous Data Transfer - Modes of Transfer- Priority interrupt - Direct Memory Access - Input-output processor - Serial communication. **(9)**

MEMORY ORGANIZATION

Memory Hierarchy - Auxiliary memory -Associative memory - Cache memory - Virtual Memory - Memory management hardware **(9)**

TOTAL: 45

TEXT BOOK

1. *M Morris Mano, "Computer system Architecture", Pearson Education, 2007.*

REFERENCE BOOKS

1. *John L Hennessy, David A Patterson, "Computer Architecture - A Quantitative Approach", V Edition, Morgan Kaufmann, 2007.*
2. *Carl Hamacher, Zuonko Uranesic, Safwat Zoky, "Computer Organization", 5th edition, McGraw Hill, 2002.*

16MDS34 - OPERATING SYSTEMS

L	T	P	C
3	0	0	3

PRE-REQUISITES
16MDS14

ASSESSMENT : THEORY

COURSE OUTCOME

- *Demonstrate the batch programming, system calls and virtual machines.*
- *Demonstration of Kernel Management for Inter Process Communication systems.*
- *Estimation of system performance through scheduling algorithms - FIFO, round robin, priority, shortest job first.*
- *Recognizing the memory allocation and deallocation for both static and dynamic storage.*
- *Design and Develop a new simple File System using Disk and File System Management.*

INTRODUCTION

System Software - Macro Processor - Loader - Linker - Operating systems -objectives and functions. Evolution of Operating system - serial processing, simple batch systems, multi- programmed batch system, time sharing systems.

Process Description And Control Process states, Process description, Process control - Processes and threads. **(10)**

CONCURRENCY

Principles of concurrency, mutual exclusion - software support, Dekker's Algorithm - mutual exclusion - hardware support, mutual exclusion - Operating System support - Semaphore - Monitors - Implementation - Message Passing. Deadlock - deadlock prevention, deadlock detection, deadlock avoidance. An integrated deadlock strategy. **(8)**

MEMORY MANAGEMENT

Memory management requirements. Fixed partitioning, placement algorithm. Dynamic partitioning placement algorithm. Replacement algorithm. Relocation. Simple paging - Simple segmentation. Virtual Memory - Paging - address translation in a paging system. Segmentation - organization. Address translation in a segmentation system. Combined paging and segmentation. Virtual memory - Operating System software - fetch policy, placement policy and replacement policy. Page buffering. Resident set management. **(12)**

SCHEDULING

Types of scheduling, scheduling algorithms, scheduling criteria, FIFO, Round Robin, Shortest process next, Shortest remaining time, Highest response ratio and Feedback scheduling. Performance comparison. Fair - share scheduling. **(6)**

I/O MANAGEMENT AND DISK SCHEDULING

Organization of the I/O function - evaluation of the I/O function. Logical structure of the I/O function, I/O buffering. Disk I/O - Disk scheduling algorithms. Disk cache. File Management-Files, File management systems, File system architecture, Functions of File management - File directories - File sharing - secondary storage management. File allocation. **(9)**

TOTAL : 45

TEXT BOOK

1. *William Stallings, "Operating systems Internals and Design Principles", 4th edition, PHI, 2001.*

REFERENCE BOOKS

1. *Silberschatz A, Peterson J.L, Galvin P., "Operating System Concepts", John Wiley Publishing Company, 2002.*
2. *H.M.Deital, " An introduction to Operating System", Pearson Education, 2001*
3. *Charles Crowley, "Operating System a Design Oriented Approach", Tata McGraw Hill, 2000.*
4. *Milankovic M, "Operating System Concepts & Design", McGraw Hill,1999.*
5. *Armass Danesl, "Mastering Linux", Premium Edition, BPB Publications, 1999*
6. *Robert Cowart, Boyd waters, "Windows NT 4 ", BPB Publications, 1997.*

16MDS35 - DATABASE MANAGEMENT SYSTEMS

L	T	P	C
3	0	0	3

PRE-REQUISITES
Consent of the Instructor

ASSESSMENT : THEORY

COURSE OUTCOME

- *Describe the purpose and architecture of database systems from the perspective of persistent storage of real world data.*
- *Analyse the problem statement, construct the Entity Relationship model and map it into relational model by applying normalization.*
- *Generate Relational Algebra, Relational Calculus and SQL statements to perform queries of real world applications.*
- *Evaluate the indexing techniques and choose the suitable technique by analyzing the given application.*
- *Determine the concurrency control and recovery mechanisms based on the criticality of the transaction.*

INTRODUCTION

Database System Applications, Purpose of Database Systems, View of Data, Database Languages, Relational Databases, Database Architecture, Database Users and Administrator. Relational Model : Structure of Relational Databases, Database Schema, Keys, Schema Diagrams, Relational Query Languages, Relational Operations. **(10)**

DATABASE DESIGN

Database Design and the E-R Model, Overview of the Design Process, The Entity-Relationship Model, Constraints, Removing Redundant Attributes in Entity Sets, Entity-Relationship Diagrams, Reduction to Relational Schemas, Extended E-R Features. Relational Database Design : Atomic Domains and First Normal Form, Decomposition Using Functional Dependencies, Functional-Dependency Theory. **(10)**

INTRODUCTION TO SQL

Overview of the SQL Query Language, SQL Data Definition, Basic Structure of SQL Queries, Additional Basic Operations, Set Operations, Null Values, Aggregate Functions, Nested Subqueries, Modification of the Database. Intermediate SQL: Join Expressions, Views, Transactions, Integrity Constraints, SQL Data Types and Schemas, Authorization. Advanced SQL: Accessing SQL from a Programming Language, Functions and Procedures, Triggers Formal Relational Query Languages: The Relational Algebra, Tuple Relational Calculus, Domain Relational Calculus **(10)**

DATA STORAGE AND INDEXING

File Organization, Organization of Records in Files, Data-Dictionary Storage, Database Buffer. Indexing and Hashing: Basic Concepts, Ordered Indices, Overview of B+-Tree Index Files and Hashing, Comparison of Ordered Indexing and Hashing, Bitmap Indices, Index Definition in SQL **(8)**

TRANSACTION, CONCURRENCY CONTROL AND RECOVERY

Concept, Simple Transaction Model, Atomicity and Durability, Isolation, Serializability, Lock based Concurrency Control, Failure Classification, Recovery and Atomicity, Recovery Algorithm. **(7)**

TOTAL : 45

TEXT BOOK

1. *Abraham Silberschatz, Henry F.Korth, S.Sudarshan, "Database System Concepts", Sixth Edition, McGraw Hill, 2010.*

REFERENCE BOOKS

1. *Ramez Elmasri, Shamkant B. Navathe Durvasula, V.L.N. Somayajulu, Shyam K. Gupta, "Fundamentals of Database Systems", Fourth Edition, Pearson Education, 2006.*
2. *Christopher Allen, Simon Chatwin, Catherine A. Creary, "Introduction to Relational Databases and SQL Programming", Tata McGraw-Hill*

16MDS36 - COMPUTING LABORATORY III

L	T	P	C
0	0	4	2

PRE-REQUISITES
Consent of the Instructor

ASSESSMENT : PRACTICAL

COURSE OUTCOME

- *To develop skills in analyzing data using R software package.*
- *To compute various Index Numbers used in Economics using R software.*
- *To analyze time series data using R software.*
- *To develop Shewhart Control charts for variables and attributes using qcc package of R.*
- *To analyze data on Statistical Designs of Experiment like CRD, RBD, LSD using R software.*
- *To analyze data with non-parametric methods using R software.*

CONCEPTS TO BE COVERED

1. Creating Data sets in R: Data Structures-Vectors-Matrices-Arrays-Data frames-factors-Lists.
2. Reading and Writing Data-read.table, read.csv-Subsetting a vector-Subsetting a Matrix.
3. Basic Graphs-Bar, Pie Charts-Histograms-Box Plots.
4. Basic Statistics-Descriptive Statistics-Frequency and Contingency Tables-Correlations and t-tests.
5. Regression Analysis.
6. Computing Simple and weighted aggregate index numbers -Laspeyre and Paasche Index Numbers.
7. Computing Marshell - Edgeworth , Fisher's Ideal Index Numbers.
8. Time-Series Data-Reading and Plotting Time Series Data.
9. Decomposing Time Series Data-Decomposing Non-seasonal and Seasonal Data-Seasonally Adjusting.
10. Forecasts Using Exponential Smoothing.
11. Trend Analysis-Fitting linear trend.
12. Trend Analysis-Fitting quadratic and exponential trends.
13. Control Charts Using qcc package.
14. Shewhart quality control charts for variables: xbar, R and S charts.
15. Control Charts for attributes: p, np and c charts using qcc package.
16. Cusum charts using qcc package.
17. One way ANOVA.
18. Non-parametric tests using R: Sign test,Wilcoxon Signed Rank test.
19. Non-parametric tests: Mann-Whitney-Wilcoxon test.
20. Kruskal Wallis test-Runs test-Spearman's Rank correlation coefficient.

TEXT BOOKS

1. *Robert I.Kabacoff, "R IN ACTION:Data Analysis and Graphics with R", Manning Publications Co.,2011.*
2. *R.D.Peng, "R Programming for Data Science", Leanpub, 2015.*

REFERENCE BOOKS

1. *J.Maindonald, W.John Braun, "Data Analysis and Graphics Using R-an Example Based Approach", 3rd Edition, Cambridge University Press, 2010.*
2. *M.Logan, "Biological Design and Analysis Using R: A Practical Guide", Wiley-Blackwell, 2010.*
3. *A. Coghlan, "A Little Book of R for Time Series Analysis", Release 0.2, 2015.*

Link

http://www.calvin.edu/~stob/courses/m344/S15/a-little-book-of-r-for-time-series.pdf

16MDS37 - DATABASE MANAGEMENT SYSTEMS LABORATORY

L	T	P	C
0	0	4	2

PRE-REQUISITES
16MDS35

ASSESSMENT : PRACTICAL

COURSE OUTCOME

- *Design the conceptual data model as Entity Relationship diagram and create the database using DDL statements for a given application.*
- *Formulate simple DML SQL queries to retrieve the required data for real world applications.*
- *Generate DML queries with Subqueries, Joins, Group By, Order By and Aggregate functions to filter and aggregate the data of the real world applications.*
- *Construct reusable PL/SQL blocks with Functions, Procedures, Packages, Triggers, Exception Handling, and Cursors as required by OLTP applications.*
- *Develop a database project by constructing the ER model, creating Tables and generating SQL and PL/SQL blocks using RDBMS platform.*

CONCEPTS TO BE COVERED

1. Designing a database for an application and representing it through ER diagram
2. Creating and managing tables
3. Basic SQL SELECT statements
4. Restricting and sorting data
5. Single row functions
6. Displaying data from multiple tables
7. Aggregating data using Group function - Group By
8. Subqueries
9. Views, Sequence, Index, Synonym
10. SET operators, Date and Time functions
11. PL / SQL Programs
12. Exception Handling, Cursors, Functions, Procedures, Package, Triggers

16MDS38 - OPERATING SYSTEMS LABORATORY

L	T	P	C
0	0	4	2

PRE-REQUISITES
16MDS34

ASSESSMENT : PRACTICAL

COURSE OUTCOME

- *To Create batch programming, system calls and virtual machines.*
- *To develop Kernel Management programs for Inter Process Communication systems.*
- *To evaluate system performance through scheduling algorithms - FIFO, round robin, priority, shortest job first.*
- *To analyze memory allocation and deallocation for both static and dynamic storage.*
- *To Design and Develop a new simple File System using Disk and File System Management.*

CONCEPTS TO BE COVERED

1. Shell Basics
    a. Types of shells
    b. Shell functionality
    c. Environment
2. Writing first script
    a. Writing script and executing basic script
    b. Debugging script
    c. Making interactive scripts
    d. Variables(default variables)
    e. Mathematical expressions
3. Conditional Statements
    a. if -else-elif
    b. test command
    c. Logical operators - and, or, not
    d. case - esac
4. Loops
    a. while
    b. for
    c. until
    d. break and continue
5. Command Line arguments
    a. Positional parameters
    b. set and shift
    c. IFS
6. Functions and file manipulations
    a. Processing file line by line
    b. Functions
7. Regular Expression & Filters
    a. grep, cut, sort
    b. grep patterns

8. SED & AWK
9. Processes
    a. Concept of process in Unix
    b. Background processes
    c. Scheduling processes - At, batch & cron
10. Misc
    a. Trapping signals
    b. String substitutions / manipulations
11. Advanced Scripting Techniques
    a. Providing command line options to scripts
    b. Shell and Sub shells
    c. Exporting variables
    d. Arrays
12. Implement CPU Scheduling Algorithms
13. Implement Bankers Algorithm to avoid deadlock
14. Implement the Producer - Consumer problem using semaphores
15. Implement Page Replacement algorithms

16MDS41- MULTIVARIATE DATA ANALYSIS

L	T	P	C
3	0	0	3

PRE-REQUISITES
16MDS13, 16MDS22

ASSESSMENT : THEORY

COURSE OUTCOME

- *To analyze various properties like mean vector and variance-covariance matrix of multivariate data.*
- *To formulate and compute multiple linear regression model and understand its properties.*
- *To classify objects into different groups using discriminant function, logistic regression equation and cluster analysis techniques.*
- *To identify underlying factors in multivariate data sets using principal component analysis and factor analysis.*

MULTIVARIATE DATA

Variables in Multivariate Data-Mean Vector, Covariance and Correlation Matrices and their properties-Mean vectors and covariance matrices for subsets of variables -Sample properties of linear combination of variables-Estimation of missing values-Distance between vectors-Multivariate Normal Density-Visualization of multivariate data: The Scatter Plot Matrix and three dimensional plots. **(9)**

MULTIPLE REGRESSION ANALYSIS (MLR)

Multiple Linear Regression Equation and Polynomial Regression Models- Estimation of the coefficients using method of least squares -Linear Regression using Matrices-Properties of Least Squares-Inferences in Multiple Linear Regression: ANOVA and testing the partial regression coefficients- Interpretation of R2-Standardized Regression Coefficient and its interpretation-Inclusion of categorical or indicator variables in MLR -Multi-collinearity problem-Stepwise Regression. **(9)**

DISCRIMINATION AND CLASSIFICATION

Discriminant Function Analysis- Fisher's discriminant function -Fitting discriminant functions using R and interpreting the results. Logistic Regression:Logistic Model-Definitions of Odds and Logit-Estimation of the logistic regression coefficients-Making Predictions-Multiple Logistic Regression-Fitting logistic regression equation using R and interpreting the results. **(9)**

PRINCIPAL COMPONENT ANALYSIS AND FACTOR ANALYSIS

DataReduction Techniques-Definition of Population Principal Components -Principal Components obtained by Standardized variables -Rules to retain number of Principal Components using Scree Plot-Factor Analysis-Definitions-The Orthogonal Factor Model-Its Covariance Structure- Factor Loadings and Interpretations-Exploratory and Confirmatory Factor Analysis- Estimation of PCA and FA using R. **(9)**

CLUSTER ANALYSIS

Definition-Measures of Similarity or Dissimilarity-Hierarchical Clustering Methods-Single linkage-Complete Linkage-Average Linkage-Centroid-Ward's Hierarchical Clustering Methods-Non-hierarchical Clustering Methods-K-means Method-Cluster Analysis Using R and other Software Packages-Applications. **(9)**

TOTAL : 45

TEXT BOOKS

1. *Alvin C.Rencher Methods of Multivariate Analysis, 2nd Edition, Wiley Inter-science, 2002 [Para 1,Para V]*
2. *R.E.Walpole,R.H.Myers,S.L.Myers and K.Ye, Probability and Statistics for Engineers and Scientists, 9th Edition, Prentice Hal, 2012 [Para II]*
3. *Richard A.Johnsonand Dean W.Wichern. Applied Multivariate Statistical Analysis, 6th Edition, Pearson Prentice Hall, 2007[Para III and Para IV]*

REFERENCE BOOKS

1. *Joseph F. Hair Jr., William C. Black, Barry J.Babin and RolphE.Anderson, Multivariate Data Analysis, 7th Edition, Pearson, 2010.*
2. *G.James,D.Witten, T.Hastie, R.Tibshirani, An Introduction to Statistical Learning with Applications in R, Springer, 2015.*

16MDS42 - MODELING AND SIMULATION

L	T	P	C
3	0	0	3

PRE-REQUISITES

16MDS12, 16MDS21, 16MDS22

ASSESSMENT : THEORY

COURSE OUTCOME

- *Define Systems, models and classifications of mathematical models.*
- *To illustrate changes in the dynamic systems using difference and differential equations.*
- *To predict the behavior of linear and non-linear systems using empirical modelling.*
- *To evaluate the behavior of deterministic and stochastic systems using Simulation techniques.*

DEFINITIONS OF SYSTEMS AND MODELS

Examples-Mathematical models-Definition-Principles of Mathematical Modelling-Deterministic and Stochastic Models-Mechanistic and empirical modelling. **(9)**

MODELLING CHANGE

Modelling Change with Difference Equations-Examples from Economics and other disciplines-Approximate Change with Difference Equations-Examples-Solutions to Dynamical Systems-Systems of Difference Equations-Modelling using Differential Equations-Population Growth Models-Linear, Exponential and Logistic Models. Use of matrices in population growth models-Leslie's age structured population growth model. **(9)**

EMPIRICAL MODEL FITTING

Fitting Models to Data Graphically-Scatter Plot-Analytical Methods of Model Fitting-Applying Least-squares criterion-Fitting linear, quadratic, exponential, power and polynomial models to data -Using Software packages for model fitting-Use of AIC and BIC to select best model to a given data. **(9)**

NON-LINEAR MODEL FITTING

Nonlinear models- Introduction-Examples from real life systems-Meaning of Intrinsically Non-linear models- Linearization by transformation- Fitting Nonlinear models by Numerical Methods-use of Software Packages MS-Excel and R in Nonlinear Model Fitting. **(9)**

SIMULATION

Simulating Deterministic Behavior-Monte Carlo simulation: Area under a curve and Volume under a surface -Generating Random Numbers-Simulating probabilistic behavior using Monte Carlo simulation. Examples from Queuing Models-Techniques for simulating continuous random variables: The Inverse Transform method-Simulation of exponential, normal, gamma, Chi-squared and Beta distributions-Simulation of Discrete random variables: geometric, Binomial and Poisson random variables. **(9)**

TOTAL : 45

TEXT BOOKS

1. *Frank R.Giordano, Maurice D.Weir and William P.Fox. "Mathematical Modeling", Thomson Brooks/Cole, Vikas Publishing House Pvt Ltd., New Delhi.[Para 1, II & III]*
2. *D.G.Zill, "A First Course in Differential Equations with Modeling Applications", 10th Edition, Brooks/Cole, USA, 2013[Para 1 & II]*
3. *Sheldon M.Ross, "Introduction to Probability Models", 10th Edition, Academic Press, 2010.[Para V]*
4. *P.Dalgaard, "Introductory Statistics with R", 2nd Edition, Springer, 2008.(see Chapter 16) [Para IV]*

REFERENCE BOOKS

1. *H.Sayama, "Introduction to the Modeling and Analysis of Complex Systems", Open SUNY Textbooks, Milne Library State University of New York at GeneseoGeneseo, NY 14454, 2015.*
2. *Clive L.Dym."Principles of Mathematical Modeling", 2nd Edition, Elsevier, 2004.*
3. *D.R.Shier, K.T.Wallenius, "Applied Mathematical Modeling-A Multidisciplinary Approach", chapman & hall/crc, 1999.*
4. *C.R.Ranganathan, "A First Course in Mathematical Models of Population Growth (with MATLAB Programs)", Associated Publishing Company, New Delhi, 2005.*

16MDS43 - ADVANCED DATA STRUCTURES AND ALGORITHMS

L	T	P	C
3	0	0	3

PRE-REQUISITES
16MDS23

ASSESSMENT : THEORY

COURSE OUTCOME

- *Design, implement, test and debug programs using a variety of data structures including binary and general tree structures, search trees, B-trees, Tries, graph , heaps,hash tables and buffer pools.*
- *Describe and implement a variety of advanced data structures (AVL Tree, Multiway Tree, B+Tree, Red Black Tree).*
- *For a given data structure, a student will be able to classify best, average, worst and amortized scenario with respect to a problem.*
- *Identify the problem given and design the algorithm using various algorithm design techniques like Divide and Conquer, Greedy method, Dynamic Programming, Backtracking and Branch and Bound Technique.*
- *Recognize and apply design techniques and make judgements about which particular design technique will improve performance of a problem.*

TREES

Binary search tree: Definition, operations - AVL Tree: Balancing trees, node operations. **(6)**

MULTIWAY TREES

Definition - m-way search trees - B-trees - Red Black tree - operations - Trie Structures - B+ trees. **(11)**

GRAPHS AND HEAP

Representation - Breadth first search - Depth first search - Topological Sort. HEAP- Definition - heap data structures - heap algorithms - applications. **(10)**

HASHING

Basic concepts - hashing methods - hashing algorithms - collision resolution methods. **(10)**

ALGORITHM DESIGN TECHNIQUES

Divide and Conquer: General method - Merge sort.

Greedy Method: General method - Knapsack problem -Prim's &Kruskal's algorithm.

Dynamic Programming: General method - Multistage graph- Travelling Salesperson Problem.

Back Tracking: General method - Eight queen's problem. **(13)**

TOTAL : 45

TEXT BOOKS

1. *Richard F. Gilbery, Behrouz A.Forouzan, "Data structures - A Pseudocode Approach with C", Thomson Asia Pvt Ltd., 2002. (Trees, Multiway trees, Heap, Hashing)*
2. *Ellis Horowitz, SartajSahni, SanguthevarRajasekaran, "Fundamental of Computer Algorithms", Galgotia Publications, 1998. (Algorithm Design Techniques)*
3. *Thomas H.Cormen, Charles E.Leiserson, Ronald L. Rivert, Clifford Stein "Introduction to Algorithms", Second Edition, Prentice Hall of India, Publications, New Delhi, 2007. (Graphs, Red Black Trees).*

REFERENCE BOOKS

1. *AnanyLevitin , "Introduction : The Design & Analysis of Algorithm", 2003 Edition, Pearson Education Inc.*
2. *S.K.Basu, "Design Method & Analysis of Algorithm", PHI, 2005.*

16MDS44 - COMPUTER NETWORKS

L	T	P	C
3	0	0	3

PRE-REQUISITES

Consent of the Instructor.

ASSESSMENT : THEORY

COURSE OUTCOME

- *Given an inter-network topology configuration, can demonstrate how a packet reaches the destination.*
- *For a given inter-network specification, can explain the working of inter-networking devices.*
- *For given requirements, can develop simple network applications using Socket API.*
- *For a given inter-network, find the best route to a destination by applying the various routing protocols.*
- *For a given network application, can identify the protocols involved at the various layers and demonstrate the role of the protocols.*

BUILDING A NETWORK

Applications - Requirements - Network architecture - Implementing Network Software - Performance. Connecting to a network: Perspectives on Connecting - Framing - Error Detection - Reliable Transmission - Ethernet and Multiple Access Networks.**(10)**

INTERNETWORKING

Switching and Bridging - Basic Internetworking - Routing - Implementation - IPv6. **(10)**

END -TO - END PROTOCOLS

Simple demultiplexer - Reliable Byte Stream - Remote Procedure call - Transport for Real-Time Applications. **(9)**

CONGESTION CONTROL AND RESOURCE ALLOCATION

Issues in Resource allocation - Queuing Disciplines - congestion control - Congestion Avoidance - Quality of Service. **(8)**

APPLICATIONS

Traditional Applications - Web services - Multimedia applications - Infrastructure services. **(8)**

TOTAL : 45

TEXT BOOK

1. *Larry L. Peterson, Bruce S. Davie, "Computer Networks: A Systems Approach" , Morgan Kaufmann, 5th Edition, 2012.*

REFERENCE BOOKS

1. *Andrew S. Tanenbaum, David J Wetherall, "Computer Networks", 5th Edition, Pearson Edu, 2013.*
2. *Behrouz Forouzan, "Introduction to Data communication and networking", Tata McGraw Hill, 1998.*
3. *William Stallings, "Data communication", Pearson Education Asia, 2004.*

16MDS45 - SOFTWARE ENGINEERING

L	T	P	C
3	0	0	3

PRE-REQUISITES
16MDS24, 16MDS35

ASSESSMENT : THEORY

COURSE OUTCOME

- *Choose and practice the software development process based on the factors such as problem complexity, time and cost to develop the software system.*
- *Create the requirements model by specifying the usecases and actors involved in the scenario or by specifying the classes along with their responsibility and collaboration involved in the given problem to describe the requirements of the software system.*
- *Design the architecture of the system in the various perspectives such as class model, component model and layered model based on the type of the proposed software system.*
- *Design the test plans to conduct unit, integration, system and acceptance testing on the developed system.*
- *Determine the size of the product by applying LOC or Function Point metrics.*

INTRODUCTION

Software Definition - Software Application Domains - Legacy Software - The Software Process - Software Engineering Practice - Software Process Structure - Process Models: Prescriptive Process Models, Specialized Process Models, The Unified Process, Agile Process: Agile Principles, The Extreme Programming Process. **(8)**

MODELING

Understanding Requirements - Requirements Modeling: Scenario-Based Methods, Class Based Methods, Web/Mobile Apps. **(6)**

DESIGN PROCESS

Design Concepts - Design Model: Architectural Design: Software Architecture, Architectural styles, Architectural Design - Component Level Design: Component Definition, Designing Class-Based Components, Component-Level Design for WebApps and Mobile Apps - User Interface Design: Interface Analysis, Interface Design , WebApp and Mobile Interface Design - Pattern-Based Design: Design Patterns, Pattern-Based Software Design, Architectural Patterns - WebApp Design - MobileApp Design. **(15)**

CODING AND TESTING

Code Review - Black Box Testing - White Box Testing - Debugging, Integration and System Testing. **(7)**

SOFTWARE PROJECT MANAGEMENT

Project Management Concepts - Software Project Management Complexities - Responsibilities of a Software Project Manager - Metrics for Project Size Estimation: Lines of Code, Function Point Metric - Project Estimation Technique: Basic COCOMO Model. **(9)**

TOTAL: 45

TEXT BOOKS

1. *Roger S Pressman, "Software Engineering - A Practitioners Approach", Seventh Edition, McGraw Hill Edition, 2010.*
2. *Rajib Mall, "Fundamentals of Software Engineering", Fourth Edition, Prentice Hall India, 2014.*

REFERENCE BOOKS

1. *Ian Somerville, "Software Engineering", 9th edition ,Pearson,2010.*
2. *Pankaj Jalote, "An integrated approach to software Engineering", 3rd edition, Narosa publishing house, Reprint 2013.*

16MDS46 - COMPUTING LABORATORY IV

L	T	P	C
0	0	4	2

PRE-REQUISITES

16MDS36

ASSESSMENT : PRACTICAL

COURSE OUTCOME

- *To solve difference or differential equation models using R software.*
- *To estimate linear and non-linear models to observed data using R software.*
- *To apply simulation techniques to real world problems using R software.*
- *To use R software to analyze multivariate data using multiple linear regression, discriminant function, logistic regression equation models and cluster analysis tools .*
- *To identify underlying factors in multivariate data by applying factor analysis and principal component analysis models and using R software package.*

CONCEPTS TO BE COVERED

1. Modelling with Difference Equations : Solving models
2. Modelling with Differential Equations Solving models using desolve package in R
3. Fitting linear, exponential and logistic population growth models
4. Leslie's age-structured population growth models
5. Fitting non-linear models to data using MS-Excel and R
6. Monte Carlo simulation using MS-Excel and R
7. Simulation of discrete random variables
8. Simulation of continuous random variables
9. Computing the descriptive statistics, variance-covariance and correlation matrix for multivariate data
10. Fitting Multiple Regression equation using MS-Excel and R
11. Step wise regression
12. Fitting logistic regression equation using R
13. Fitting Multiple logistic regression
14. Discriminant function analysis using R
15. Principal component Analysis
16. Factor Analysis
17. Cluster Analysis-Hierarchical Clustering
18. Cluster Analysis- Non-hierarchical Clustering Methods-K-means Method

TEXT BOOKS

1. *G.James,D.Witten, T.Hastie and R.Tibshirani, "An Introduction to Statistical Learning with Applications in R", Springer, 2015.*
2. *John M Chambers, "Software for Data Analysis:Programming with R", Springer, 2008*

REFERENCE BOOKS

1. *K. Soetaert et al., "Solving Differential Equations in R", Springer-Verlag, 2012*
2. *Fernando Miguez, "Introduction to R for Multivariate Data Analysis",*
3. *A. Coghlan," A Little Book of R for Multivariate Analysis", Release 0.1, 2014.*

Links

1. *http://people.stat.sc.edu/hansont/stat730/Coghlan2014.pdf*
2. *http://miguezlab.agron.iastate.edu/OldWebsite/Teaching/MultivariateRGGobi.pdf*

16MDS47 - NETWORK PROGRAMMING LABORATORY

L	T	P	C
0	0	4	2

PRE-REQUISITES
16MDS16

ASSESSMENT : PRACTICAL

COURSE OUTCOME

- *Develop and implement TCP based distributed applications using Socket API for a given set of requirements.*
- *Develop and implement UDP based distributed applications using Socket API for a given set of requirements.*
- *Develop network debug tools such as ping, trace-route etc using SOCK_PACKET and SOCK_RAW options.*
- *Demonstrate the functioning of the various network protocols using ns2 simulation tool.*

THE STUDENTS MUST BE TRAINED TO DEVELOP

1. TCP and UDP applications by exploiting Socket API - concurrent and iterative
2. Applications making use of the various socket options
3. Debugging and maintenance tools with the help of RAW sockets and SOCK_PACKET
4. Programs using SIGALRM, SO_RCVTTIMEO, non-blocking sockets, I/O multiplexing
5. Simple scenarios using NS-2 and study the operation of various Internet work protocols

16MDS48 - ALGORITHMS LABORATORY IN JAVA

L	T	P	C
0	0	4	2

PRE-REQUISITES
16MDS43

ASSESSMENT : PRACTICAL

COURSE OUTCOME

- *Discover the programming paradigms of Java.*
- *Practice different data structures implementations using Java.*
- *Devise suitable design techniques for a given scenario.*

CONCEPTS TO BE COVERED

1. Inheritance
2. Polymorphism
3. Runtime Polymorphism using Abstract Class and Interface
4. Packages
5. Exceptions
6. MutiThreading
7. JDBC

IMPLEMENTATION THE FOLLOWING USING JAVA

1. Breadth First Search
2. Depth First Search
3. AVL Trees
4. Multiway Tree
5. Back Tracking
6. Knapsack Problem
7. Graph coloring Problem
8. Travelling Salesperson Problem
9. N-Queens Problem

16MDS49 - COMMUNICATION SKILLS & PERSONALITY DEVELOPMENT

PRE-REQUISITES

Consent of the Instructor

ASSESSMENT : PRACTICAL

Communication Skills - 50 marks

Personality Development - 50 marks

COURSE OUTCOME

- *Conceive appropriate verbal responses from the learners to a given social situation, using the guidelines to effective speaking skills and body language.*
- *Generate trouble shooting solutions to develop team building and interpersonal skills with case studies that focus on body language and empathy.*
- *Develop appropriate responses for business phone calls and formulate effective resolutions to professional conflicts that arise out of cross cultural communication gaps in a given managerial context.*
- *Compose appropriate written responses to professional problems faced by a team at the workplace arising out of ineffective communication skills.*
- *Ascertain the various concepts of Self like the Physical Self - Energy Self - Intellectual Self - Mental Self - Blissful Self with respect to the Western(Occidental) and Eastern(Oriental) theories of the Self and Personality Development.*
- *Outline the significant effects of Self Confidence to build team confidence, given the foundation principles of Self Motivation and Confidence.*
- *Assess the various personalities and Attitudes and choose the best attitude for making bold decisions in personal and professional contexts.*
- *Project appropriate grooming and right etiquette in the corporate context to excel in professional life.*

INTRODUCTION

Introduction - Code and Content - Stimulus and Response: Source - The Encoding Process - The Channel - The Decoding Process - The Receiver - Speaking Skills - Effective Speaking Guidelines - Communicating Soft Skills: A Self-assessment - ClosingTips. **(6)**

SOFT SKILLS

Introduction to Soft Skills - Lessons from the Three Case Studies - Change in Today's Workplace: Soft Skills as a Competitive Weapon - Antiquity of Soft Skills - Classification of Soft Skills: Time Management - Attitude - Responsibility - Ethics, Integrity, Values and Trust - Self-confidence and Courage - Consistency and Predictability - Teamwork and Interpersonal Skills - Communication and Networking - Empathy and Listening Skills - Problem Solving, Troubleshooting and Speed reading - Leadership - Body Language. **(9)**

TELEPHONING SKILLS & NEGOTATIONS

Preparing to make a telephone call - Receiving calls - Taking and leaving messages - Asking for and giving repetition - The secretarial barrier - Cross-cultural communication on the telephone - Setting up appointments - Changing arrangements - Ending a call - Cross-cultural communication on the telephone - Problem-solving on the telephone - Complaints - Negotiations: Types of negotiation - Preparation for a negotiation - Making an opening statement - Bargaining and making concessions - Accepting and confirming - Summarizing and looking ahead - Types of negotiator - Dealing with conflict - Rejecting - Ending the negotiation . **(10)**

WRITING SKILLS TO CREATE AN IMPRESSION

Introduction- Fifteen Principle to Increase Clarity in Communication - Edit-Edit-Edit: The Reader's Perspective - Clarity of Thought - Clarity of Text. **(7)**

PERSONALITY DEVELOPMENT

One's Personality Sends Out a Signal That Others Read - Same Person: Consciously Different Personalities can be Powerful - There isn't One Right Personality; It Differs by Role - Learning about Personality Development from the Three Cases - Personality Analysis - Freudian Analysis of Personality Development - Swami Vivekananda's Concept of Personality - Development: Physical Self - Energy Self - Intellectual Self - Mental Self - Blissful Self - Personality Begets. **(9)**

LEADERSHIP QUALITIES & INTERPERSONAL SKILLS:

Resolving Conflict - A Smiling Face - Appreciative Attitude - Assertive Nature - Communication Skills - Listening Skills - Developing Empathy - The Personality Attribute of Taking Bold Decisions - Personality Types and Leadership Qualities - Mapping the Different Personality Types - Personality Tests: Example of a Personality Test: Jung Typology Test - Personality Assessment. **(9)**

ETIQUETTE

Social Etiquette - Corporate Etiquette - Personal Grooming - Using minimal Body Language - Leadership and Entrepreneurship : Corporate Training - Professionalism - Self awareness - Creativityskills - Cognitive Development - Assertiveness - Positive Thinking and Attitude. **(10)**

TOTAL : 60

REFERENCE BOOKS

1. *Mitra K.Barun, "Personality Development and Soft Skills", Oxford University Press, 2011.*
2. *Krishna Mohan, Meera Banerji. "Developing Communication Skills" Mac Million Publishers, 2012.*
3. *Sai Lakshmi. B, "Poly Skills- A Course in Communication and Life Skills" Cambridge University Press, 2012.*

16MDS51 - OPERATIONS RESEARCH

L	T	P	C
4	0	0	4

PRE-REQUISITES

Consent of the Instructor

ASSESSMENT : THEORY

COURSE OUTCOME

- *Design the optimal model to improve the efficiency and productivity of any organization using the concepts of mathematical modeling of decision problems.*
- *Design of optimization techniques to solve the mathematical models.*
- *Analyze any decision situation and offer solutions for the best utilization of limited resources.*

LINEAR PROGRAMMING

Linear programming problem - canonical and standard forms- formulation - graphical solution - simplex method - Artificial starting solution. **(11)**

DUALITY AND SENSITIVE ANALYSIS

Definition of duality - primal-dual relationships - Economic Interpretation of Duality - Dual simplex method - Generalised simplex algorithm - Applying Sensitive Analysis. **(9)**

ASSIGNMENT AND TRANSPORTATION MODEL

Assignment model - Hungarian Technique-transportation model - Vogels approximation method - degeneracy - unbalanced problems. **(8)**

INTEGER PROGRAMMING

Gomory's fractional cut method - Branch and Bound Method. **(5)**

SEQUENCING AND REPLACEMENT

Sequencing - Basic assumptions - sequencing n jobs on 2 machines (Johnson's procedure)

Replacement - need for replacement of equipments - failure mechanism of items - Replacement policy - Replacement of items that deteriorates gradually - Replacement of items that fail suddenly. **(8)**

INVENTORY

Need for the inventory - Costs involved in inventory - Concepts of average inventory, economic order quantity - Deterministic model: Fixed ordering quantity models - EOQ model with uniform demand, finite / infinite replacement with / without shortages - EOQ with one price break. Inventory control - Buffer stock - Determination of optimum buffer stock - EOQ system of ordering - Multi item order model - ABC analysis. **(7)**

QUEUEING THEORY

Characteristics of queuing systems, steady state M/M/1 model. **(5)**

NETWORK SCHEDULING

Critical path method- network - calculations - floats - critical path - cost analysis-crashing-Least cost schedule algorithm. PERT- Network - critical path. Probability of meeting scheduled date of completion of the project. **(7)**

TOTAL: 60

TEXT BOOKS

1. *Frederick S.Hiller, Gerald J.Leberman, Bodhibrata Nag and Preetam Basu, "Introduction to Operations Research", Ninth Edition, McGraw Hill, 2010.*
2. *Hamdy A.Taha, "Operations Research - An Introduction", Eighth Edition, 2010.*

REFERENCE BOOKS

1. *S. D. Sharma, "Operations Research ", Kedar Nath ram Nath & co publishers, 10th edition, 1995.*
2. *Kanti Swarup, P.K. Gupta, Mani Mohan, "Operations Research", Sultan Chand & Sons, 2001.*
3. *Hillier & Lieberman, "Operations Research - An Introduction", Tata McGrawHill, 2004.*
4. *Billy E. Gillett, "Introduction to Operations Research - A Computer - Oriented Algorithmic Approach", Tata McGrawHill, Edition 1979, 28th Reprint 2006.*

16MDS52 - MACHINE LEARNING

L	T	P	C
3	0	0	3

PRE-REQUISITES
16MDS41

ASSESSMENT : THEORY

COURSE OUTCOME

- *Describe the concepts of learning, and the perspectives and issues in machine learning.*
- *Apply the machine learning techniques like Bayesian, Decision theory, Parametric, Non Parametric methods, Multivariation analysis, reinforcement learning in computing.*
- *Compare the various machine learning techniques inview of design issues in machine learning.*
- *Perform evaluation of learning algorithms, model selection, and to applying a variety of learning algorithms to data.*
- *Development of new machine learning algorithms that learn more accurately, utilize data from dramatically more diverse data sources available over the Internet.*

INTRODUCTION

Machine Learning and Examples of its Applications - Supervised Learning - Bayesian Decision Theory. **(9)**

PARAMETRIC METHODS

Maximum Likelihood Estimation - Bias and Variance - Bayes Estimator - Parametric Classification - Regression - Tuning Model Complexity - Model Selection Procedures - Multivariate Classification - Multivariate Regression. **(8)**

NONPARAMETRIC METHODS

Nonparametric Density Estimation - Generalization to Multivariate Data - Nonparametric Classification - Condensed Nearest Neighbor - Distance-Based Classification - Outlier Detection - Nonparametric Regression - Smoothing Parameter. **(10)**

DECISION TREES

Uni variate Trees - Pruning - Rule Extraction from Trees - Learning Rules from Data - Multivariate Trees- Multilayer Perceptrons. **(9)**

REINFORCEMENT LEARNING

Single State Case:K-Armed Bandit - Elements of Reinforcement Learning- Model-Based Learning Temporal Difference Learning - Generalization - Partially Observable States. **(9)**

TOTAL : 45

TEXT BOOK

1. *Ethem Alpayd, "Introduction to Machine Learning", The MIT Press Cambridge, Massachusetts London, Second Edition, England 2010.*

REFERENCE BOOKS

1. *Tom Mitchell, "Machine Learning", McGraw, 1997.*
2. *Bishop, C. "Pattern Recognition and Machine Learning", Berlin: Springer-Verlag, 2006.*

16MDS53 - BIG DATA ARCHITECTURE

L	T	P	C
3	0	0	3

PRE-REQUISITES

16MDS35

ASSESSMENT : THEORY

COURSE OUTCOME

- *Architectural issues present when building big data systems.*
- *Analyze the analytical techniques on variety of Big data application scenarios.*
- *Apply hadoop clusters and map reduce programs for parallel processing of big data.*
- *Compare :Compare PIG and HIVE with traditional databases.*
- *Generate: Generate dynamic solutions for data analytics problems using map reduce framework.*

INTRODUCTION

Big data characteristics - Volume, Veracity, Velocity, Variety Value - Issues - Case for Big data - Big data options. Team challenge - Big data sources - Acquisition - Features of Big Data - Security, Compliance, auditing and protection.

Understanding the Big Data Project's Ecosystem - Creating the Foundation of a Long-Term Big Data Architecture -Early Big Data with NoSQL - NoSQL Landscape - Introducing Couchbase - Introducing ElasticSearch - Using NoSQL as a Cache in a SQL-based Architecture. **(9)**

STREAMING DATA

Streaming Data - Streaming Architecture - The Anatomy of the Ingested Data - Setting Up the Streaming Architecture

QUERYING AND ANALYZING PATTERNS

Definining an Analytics Strategy - Process and Index Data Using Spark **(9)**

THE HADOOP ECOSYSTEM

Big Data and the HadoopEcosystem- The Hadoop Ecosystem - Hadoop Core Components -

Hadoop Distributions - Developing Enterprise Applications with Hadoop

STORING DATA IN HADOOP - HDFS -HBase -Combining HDFS and HBase for Effective Data Storage -Using Apache Avro - Managing Metadata with HCatalog - Choosing an Appropriate Hadoop Data Organization **(9)**

PROCESSING DATA WITH MAPREDUCE

Getting to Know First MapReduce Application - Designing MapReduce Implementations

CUSTOMIZING MAPREDUCE EXECUTION

Reading Data Way with Custom Record Readers -Organizing Output Data with Custom Output Formats - Writing Data Your Way with Custom Record Writers - Optimizing MapReduce Execution with a Combiner - Controlling Reducer Execution with Partitioners - Using Non-Java Code with Hadoop **(9)**

PIG

Installing and Running Pig - Comparison with Databases - Pig Latin -User-Defined Functions - Data Processing Operators -Pig in Practice

Hive

Installing Hive - Running Hive -Comparison with Traditional Databases -HiveQL -Tables - Querying Data -User-Defined Functions **(9)**

TOTAL : 45

TEXT BOOKS

1 . *Bahaaldine Azarmi. "Scalable Big DataArchitecture -A Practitioner's Guide to ChoosingRelevant Big Data Architecture" A Press, 2016, (Para 1, Para 2, Para 3)*

2. *Kevin T. Smith, Alexey Yakubovich, Boris Lublinsky, "Professional Hadoop® Solutions", John Wiley & Sons Inc, 2013. (Para 4, Para 5, Para 6)*

3. *Tom White - Beijing, "Hadoop: The Definitive Guide", O'reilly, Third Edition, Jan 2012. (Para 7, Para 8)*

16MDS54 - ARTIFICIAL INTELLIGENCE

L	T	P	C
3	0	0	3

PRE-REQUISITES
Consent of the Instructor

ASSESSMENT : THEORY

COURSE OUTCOME

- *To understand the basics of Intelligent Agents and Searching Strategies.*
- *To build Simple Knowledge based systems.*
- *To demonstrate working Knowledge of reasoning in the presence of uncertain Knowledge.*
- *To apply various decision making methods in real world environment.*
- *To analyze and apply the application view of artificial Intelligence.*

ARTIFICIAL INTELLIGENCE

Introduction- Intelligent Agents - Solving Problems by Searching - Adversial Search- Constraint Satisfaction Problems **(10)**

KNOWLEDGE, REASONING AND PLANNING

Logical Agents - First Order Logic - Inference in First order Logic - Knowledge Representation **(8)**

PLANNING AND REASONING

Planning and Acting in real world - Uncertain Knowledge - Quantifying Uncertainty - Probability Reasoning - Reasoning over time **(8)**

DECISION MAKING AND LEARNING

Making Simple Decisions - Making Complex Decisions - Learning From Examples - Knowledge in Learning - Statistical and Reinforcement Learning **(10)**

COMMUNICATING, PERCEVING AND ACTING

Communication - Natural Language Processing - Perception - Robotics **(9)**

TOTAL: 45

TEXT BOOK

1. *Stuart Russell and Peter Norvig, "Artificial Intelligence: A Modern Approach" ,Pearson Eductaion Series, Prentice Hall Publishers, Third Edition*

REFERENCE BOOKS

1. *Thomas Dean, James Allen , Yiannis Aloimonos, "Artificial Intelligence : Theory and Practice", Addison Wesley Pub.,Co*
2. *Nils J Nillsson, "Principles of Artificial Intelligence", Morgan Kauffmann Publishers , 2014*
3. *Patrick Hendry Winson, " Artificial Intelligence", Addition Wesley Publishers, Thrid Edition 1992*

16MDS55 - MACHINE LEARNING LABORATORY

L	T	P	C
0	0	4	2

PRE-REQUISITES
16MDS52

ASSESSMENT : PRACTICAL

COURSE OUTCOME

- *To introduce students to the basic concepts and techniques of machine learning.*
- *To develop skills of using recent machine learning software for solving practical problems.*
- *To gain experience of doing independent study and research in machine learning.*

CONCEPTS TO BE COVERED

1. Supervised Learning : Regression.

Generate a proper 2-D data set of N points. Split the data set into Training Data set and Test Data set.

i) Perform linear regression analysis with Least Squares Method.

ii) Plot the graphs for Training MSE and Test MSE and comment on Curve Fitting and Generalization Error.

iii) Verify the Effect of Data Set Size and Bias-Variance Tradeoff.

iv) Apply Cross Validation and plot the graphs for errors.

v) Apply Subset Selection Method and plot the graphs for errors. vi) Describe your findings in each case.

2. Supervised Learning : Classification

i) Implement Naïve Bayes Classifier on a Data set . Test for Accuracy and Precision.

ii) K-Nearest Neighbor Classifier on a Data set . Test for Accuracy and Precision.

3. Unsupervised Learning

i) Implement K-Means Clustering on proper data set.

ii) Implement Hierarchical clustering on proper data set.

4. Dimensionality Reduction

i) Principal Component Analysis-Finding Principal Components, Variance and Standard Deviation calculations of principal components.

5. Supervised Learning and Kernel Methods Design

Implement SVM for classification with proper data set.

16MDS56 - BIG DATA MODELING LABORATORY

L	T	P	C
0	0	4	2

PRE-REQUISITES
16MDS37, 16MDS53

ASSESSMENT : PRACTICAL

COURSE OUTCOME

- *Analyze the analytical techniques on variety of Big data application scenarios.*
- *Apply hadoop clusters and map reduce programs for parallel processing of big data.*
- *Practice structured/unstructured data analysis using PIG and HIVE programs.*
- *Experiment the NOSQL operations for processing of big data.*
- *Generate: Generate dynamic solutions for data analytics problems using map reduce framework.*

CONCEPTS TO BE COVERED

1. Import /Export the data from datacenter(website or unstructed)to HDFS
2. Import /Export the data from SQL to HDFS
3. Parallize Input/output process /compute process using MAPREDUCE
4. Storage /Process the data in NOSQL using MongoDB
5. Perform structured/unstructured data analysis using (Internal MapReduce) PIG
6. Perform structured data process/analysis using HIVE

16MDS61 - GRAPH THEORY

L	T	P	C
3	0	0	3

PRE-REQUISITES
16MDS12, 16MDS21

ASSESSMENT : THEORY

COURSE OUTCOME

- *Various fundamental terminologies of graph theory with examples.*
- *Spanning trees, connectivity, circuits and planarity of graphs Application:Apply:-- Matrices in studying properties of colouring and directed graphs.*
- *Various properties of graphs like connectedness, spanning trees etc using algorithms including shortest path, DFS and planarity testing.*

INTRODUCTION

Graphs - Introduction - Isomorphism - Sub graphs - Walks, Paths, Circuits - Connectedness - Components - Euler Graphs - Hamiltonian Paths and Circuits - Trees - Properties of trees - Distance and Centers in Tree - Rooted and Binary Trees. **(9)**

TREES, CONNECTIVITY, PLANARITY

Spanning trees - Fundamental Circuits - Spanning Trees in a Weighted Graph - Cut Sets - Properties of Cut Set - All Cut Sets - Fundamental Circuits and Cut Sets -Connectivity and Separability - Network flows - 1-Isomorphism - 2-Isomorphism -Combinational and Geometric Graphs - Planer Graphs - Different Representation of a Planer Graph. **(9)**

MATRICES, COLOURING AND DIRECTED GRAPH

Incidence matrix - Submatrices - Circuit Matrix - Path Matrix - Adjacency Matrix -Chromatic Number - Chromatic partitioning - Chromatic polynomial - Matching -Covering - Four Color Problem - Directed Graphs - Types of Directed Graphs -Digraphs and Binary Relations - Directed Paths and Connectedness - Euler Graphs -Adjacency Matrix of a Digraph. **(9)**

ALGORITHMS

Connectedness and Components - Spanning tree - Finding all Spanning Trees of a Graph - Set of Fundamental Circuits - Cut Vertices and Separability - Directed Circuits. **(9)**

ALGORITHMS

Shortest Path Algorithm - DFS - Planarity Testing - Isomorphism. **(9)**

TOTAL: 45

TEXT BOOK

1. *Narsingh Deo, "Graph Theory with Application to Engineering and Computer Science", Prentice Hall of India, 2003.*

REFERENCE BOOKS

1. *R.J. Wilson, "Introduction to Graph Theory", 4th Edition, Pearson Education, 2003.*
2. *J.A.Bondy and U.S.R.Murty, "Graph Theory with Applications", Elsevier Science Publishing, 1982.*

16MDS62 - COMPUTATIONAL INTELLIGENCE

L	T	P	C
3	0	0	3

PRE-REQUISITES

16MDS54

ASSESSMENT : THEORY

COURSE OUTCOME

- *To solve a given application, can apply Evolutionary programming techniques.*
- *To solve a given application, can apply swarm intelligence techniques.*
- *Develop and implement a basic trainable neural network for a computing application.*
- *Develop and implement a basic fuzzy logic system for a typical computing application.*
- *Analyze a given problem, and identify and define the computing requirements appropriate to its solution.*

INTRODUCTION

Introduction to Computational Intelligence - Computational Intelligence Paradigms. **(7)**

ARTIFICIAL NEURAL NEWORKS

Artificial Neuron - Supervised Learning Neural Networks - Unsupervised Learning Neural Networks - Radial Basis Function Networks - Reinforcement Learning. **(10)**

EVOLUTIONARY COMPUTATION

Introduction - Genetic Algorithms - Genetic programming - Evolutionary Programming. **(9)**

COMPUTATIONAL SWARM INTELLIGENCE

Basic Particle swarm optimization - Social Network Structure - Basic variations - Basic PSO parameters - Single solution Particle optimization - Applications. **(10)**

ARTIFICIAL IMMUNE SYSTEM and FUZZY SYSTEMS

AIS: Natural Immune system - Artificial immune models. Fuzzy Systems: Fuzzy sets - Fuzzy logic reasoning - Fuzzy controllers - Fuzzy Sets. **(9)**

TOTAL : 45

TEXT BOOK

1. *Andries P. Engelbrecht, "Computational Intelligence: An Introduction", John Wiley and Sons, Edition 2, 2007.*

REFERENCE BOOKS

1. *Eberhart, E. and Y. Shi., "Computational Intelligence:Concepts and Implementations", Morgan Kaufmann, San Diego, 2007.*
2. *Konar, A., "Computational intelligence : Principles, Techniques, and Applications", Springer, Berlin, Germany, 2005.*

16MDS63 - DATA MINING

L	T	P	C
3	0	0	3

PRE-REQUISITES

16MDS35, 16MDS41, 16MDS52

ASSESSMENT : THEORY

COURSE OUTCOME

- *Demonstrate the need for data preprocessing and suggest appropriate methods to produce proper data sources for mining.*
- *Analyze the suitability of design technique to find mining solution with efficient time, cost and memory requirement.*
- *Interpret optimized decisions by employing the mining concepts in business intelligence problems.*
- *Construct a legitimate mining solution with the help of design technique guidelines and validate the suitability of the techniques applied.*
- *Devise efficient managerial decisions based on mathematical models for real time business intelligence applications.*

INTRODUCTION

Definition and need of data mining, Kinds of data and patterns, Applications and issues. Types of data: Data objects and attribute types, Measuring data similarity and dissimilarity. Data Preprocessing: Overview, data cleaning, data integration, data transformation and data discretization. **(15)**

DATA WAREHOUSE AND OLAP TECHNOLOGY

Data warehouse-basic concepts, data warehouse modeling, data warehouse implementation. **(8)**

DATA MINING TECHNIQUES

Mining Frequent Patterns and Associations: Basic concepts, Frequent itemset mining methods. Pattern mining in Multilevel, Multidimensional Space.

Advanced classification methods : Bayesian Belief networks, Classification by Back probagation. Outlier Detection: Outliers and Outlier analysis, Outlier detection methods. **(16)**

DATA MINING TRENDS

Mining sequence data, Mining other kinds of data, Satistical data mining, Visual and Audio data mining, Web mining. **(6)**

TOTAL : 45

TEXT BOOK

1. *Jiawei Han, Micheline Kamber and Jian Pei, "Data Mining - Concepts and Techniques", 3rd Edition, Elsevier Publications, 2012.*

REFERENCE BOOK

1. *Arun K Pujari, "Data Mining Techniques", Universities Press.*

16MDS64 - ADVANCED DATABASES

L	T	P	C
3	0	0	3

PRE-REQUISITES
16MDS35,16MDS63

ASSESSMENT : THEORY

COURSE OUTCOME

- *Find issues and techniques useful for building effective Multimedia Database Systems.*
- *Integrate past and current data based on temporal database design techniques.*
- *Find the applications of Spatial databases.*

MULTIMEDIA DATABASES

Introduction - Need for MIRS - Overview of Multimedia Indexing and Retrieval- Common Applications of MIRS - Data Types and Formats - Multimedia Database Design Issues. **(5)**

Indexing and Retrieval of Audio - Introduction - Main Audio Properties and Features - Audio Classification - Speech Recognition and Retrieval. Image Indexing and Retrieval - Introduction, Different Approaches to Image Indexing and Retrieval. Video Indexing and Retrieval - Introduction, Overview of Shot-Based Video Indexing and Retrieval, Indexing and Retrieval Based on r Frames of Video Shots and Indexing and Retrieval Based on Motion Information. **(8)**

TEMPORAL DATABASES

Fundamental Concepts, Defining, Querying and Modifying State Tables, Transaction-Time State Tables, Bitemporal Tables, Temporal Database Design. **(11)**

SPATIAL DATABASES

Introduction -Geo-Spatial Data Manipulation-DBMS Support for Geo-Spatial Data- Requirements for Spatial DBMS.

Representation of Spatial Objects - Geographic Space Modeling, Representation Models. Representing the Geometry of a Collection of Objects, Spatial Data Formats and Exchange Standards. **(9)**

CONSTRAINT DATA MODEL AND ACCESS METHODS

Spatial Data Modeling with Constraints, The Linear Constraint Data Model, Modeling Entity-Based Data, Modeling Field-Based Data. Spatial Access Methods. **(12)**

TOTAL : 45

TEXT BOOKS

1. *Guojun Lu, "Multimedia Database Management Systems", Artech House Publishers, 1999*
2. *Richard.T.Snodgrass, "Developing Time-Oriented Database Applications in SQL", Morgan Kaufmann Publisher, 2000*
3. *Philippe Rigaux, Michel O. Scholl, Agnes Voisard, "Spatial Databases: With Application to GIS", Morgan Kaufmann Publisher, 2002*

16MDS65 - DATA MINING LABORATORY

L	T	P	C
0	0	4	2

PRE-REQUISITES
16MDS63

ASSESSMENT : PRACTICAL

COURSE OUTCOME

The student will be able to

- *use tools to implement data preprocessing techniques.*
- *apply data mining techniques on real time data to provide solutions for decision making.*
- *construct data warehouse, using various data models.*

PROBLEMS

1. Perform data cleaning techniques for a given data test.
2. Perform Data Normalization using min-max, z-score and normalization by decimal scaling methods.
3. Extract Frequent Item Sets using candidate generation and without using candidate generation.
4. Extract patterns from multidimensional data.
5. Develop a model to apply Linear Regression for prediction.
6. Implement BBN using Training dataset.
7. Find the outliers using various Outlier Detection method.
8. Evaluation of measures for text retrieval.
9. Classification of Web documents.
10. Perform OLAP operations.
11. Build Datawarehouse using multi dimensional data models.

16MDS66 - COMPUTATIONAL INTELLIGENCE LABORATORY

L	T	P	C
0	0	4	2

PRE-REQUISITES
16MDS62

ASSESSMENT : PRACTICAL

COURSE OUTCOME

- *Apply intelligent systems technologies in a variety of engineering applications.*
- *Employ Evolutionary programming techniques to solve any real world scenarios.*
- *To solve a given application, can apply swarm intelligence techniques.*
- *Develop and implement a basic trainable neural network for a computing application.*
- *Develop and implement a basic fuzzy logic system for a typical computing application.*

CONCEPTS TO BE COVERED

1. Implement Artificial Neural Network Algorithms to simulate logical gates.
2. Implement ANN techniques to solve simple classification problems.
3. Implement Genetic Algorithm to solve optimization problem.
4. Implement PSO to solve optimization problem.
5. Implement Artificial Immune System to solve optimization problem.
6. Implement the different Fuzzy Membership functions, Fuzzy set operations and its properties and composition of Fuzzy and Crisp Relations.

16MDS81 - ADVANCED PREDICTIVE ANALYTICS

L	T	P	C
3	0	0	3

PRE-REQUISITES

16MDS41, 16MDS53, 16MDS63

ASSESSMENT : THEORY

COURSE OUTCOME

- *Comprehend the need, fundamental concepts of supervised learning and regression models.*
- *Introduce the technology, processes, methods and tools used for predictive analytics.*
- *Apply the models and techniques in SVM, random forests and undirected graphs in real time data.*

INTRODUCTION TO SUPERVISED LEARNING

Introduction - Variable types and terminology - Approaches to Prediction - Statistical decision theory - Local methods in High Dimensions - Statistical models - Supervised learning - Function approximation - Structured regression models - Classes of Restricted Estimators. **(8)**

LINEAR METHODS FOR REGRESSION

Introduction - Linear regression models and Least squares - Subset selection - Shrinkage methods - Methods using derived input directions - Multiple outcome shrinkage and selection. **(11)**

TECHNOLOGY, PROCESSES, METHODS AND TOOLS

Evolution of analytic scalability - Convergence - parallel processing systems - Cloud computing - grid computing - enterprise analytic sand box - analytic data sets - Analytic methods - analytic tools - Cognos - Microstrategy - Pentaho. Analysis approaches - Statistical significance - business approaches - Analytic innovation - Traditional approaches - Iterative approaches **(9)**

SUPPORT VECTOR MACHINES AND RANDOM FORESTS

Introduction - Support vector classifier - Support vector machines and Kernels - Generalizing Linear Discriminant analysis - Flexible discriminant analysis - Penalized discriminant analysis - Mixture discriminant analysis - Introduction to Random forests - Definition - Details - Analysis. **(10)**

UNDIRECTED GRAPHICAL MODELS

Introduction - Markov graphs and their properties - Undirected graphical models for continuous variables - Undirected graphical models for discrete variables. **(7)**

TOTAL : 45

TEXT BOOKS

1. *Trevor Hastie, Robert Tibshirani and Jerome Friedman, "The Elements of Statistical Learning- Data mining, Inference and Prediction", Springer Series in Statistics, Second Edition.*
2. *Bill Franks, "Taming the Big Data Tidal Wave: Finding Opportunities in Huge Data Streams with Advanced Analytics", John Wiley & sons, 2012.*

16MDS82 - DATA PRIVACY AND SECURITY

L	T	P	C
3	0	0	3

PRE-REQUISITES
16MDS35, 16MDS44

ASSESSMENT : THEORY

COURSE OUTCOME

- *Understand the basics of number theory used for Cryptography.*
- *Describe the fundamental aspects of Information Security for Web, Networked world, Systems and Communication channels.*
- *Analyze and construct when and where to use the symmetric and asymmetric algorithms to preserve confidentiality, integrity and authenticity of information.*
- *Analyze the security requirement of a given computing system and develop cryptography algorithms to protect information resources.*
- *Design new cryptography and network security solutions for enterprises including Government, Industry, Academia and Society.*

INTRODUCTION

Security : Goal, Vulnerabilities, threats, attacks, and services and mechanisms **(4)**

CRYPTOSYSTEMS

Symmetric Key Cryptography : Terminology and Background, Substitution Ciphers, Transpositions, Encryption Algorithms, Data Encryption Standard, AES Algorithm- Number Theory - Modular Arithmetic, Euler's Theorem, Euclid's Algorithm, Chinese Remainder theorem, Discrete logarithm - Public Key Cryptography - Principles of public key cryptosystems-The RSA algorithm-Key management -Diffie Hellman Key exchange-Elliptic curve arithmetic-Elliptic curve cryptography. **(12)**

MESSAGE INTEGRITY AND AUTHENTICATION

Authentication functions-Message authentication codes-Hash functions- Secure Hash Algorithm - Digital signature Standard. **(9)**

NETWORK SECURITY AND PROGRAM SECURITY

Application Layer Security-PGP and S/MIME, Transport Layer Security-SSL - Network Layer Security- IPSec - Program Security: Secure Programs, Non-malicious Program Errors, Viruses and Other Malicious Code, Controls against Program Threats **(10)**

DATA SECURITY AND PRIVACY

Security Requirements, Reliability and Integrity, Sensitive data, Inference, Multilevel Databases -Multilevel Security - Introduction - Privacy Concepts-Privacy Principles and Policies-Authentication Privacy-Case Study - social network analysis- web privacy - Privacy and Machine learning. **(10)**

TOTAL : 45

TEXT BOOKS

1. *William Stallings, "Cryptography and Network Security: Principles and Practices", Fifth Edition, Prentice Hall, 2010.*
2. *Charles P. Pfleeger, Shari Lawrence Pfleeger, "Security in Computing", Fourth Edition, Pearson Education, 2007.*
3. *Mark Stamp, "Information Security: Principles and Practice", Wiley Inter Science, 2011.*

REFERENCE BOOKS

1. *Michael Whitman, Herbert J. Mattord, "Management of Information Security", Third Edition, Course Technology, 2010.*
2. *Matt Bishop, "Introduction to Computer Security", Addison-Wesley, 2004.*
3. *William Stallings, Network Security Essentials, Applications and Standards, 3rd edition, Pearson Education, 2007.*

16MDS83 - DATA VISUALIZATION

L	T	P	C
3	0	0	3

PRE-REQUISITES
Consent of the Instructor

ASSESSMENT : THEORY

COURSE OUTCOME

- *Understand different data visualization techniques.*
- *Gain practical experience in building and evaluating visualization systems.*
- *Determine the methods of presentation to an audience once an insight has been found.*

INTRODUCTION TO DATA VISUALIZATION

Seven stages of visualizing data-getting started with processing-mapping-Time Series- Connections and Correlations-scatterplot maps-trees, hierarchies & recursions-Networks and graphs-Acquiring data-Parsing data **(15)**

DATA REPRESENTATION

Computer graphics and visualization-Discrete data representation in visualization applications-Visualization pipeline. **(10)**

TECHNIQUES FOR DATA VISUALIZATION

Fundamental techniques for scalar visualization-Vector visualization techniques- Tensor visualization techniques- Information visualization techniques. **(10)**

INTRODUCTION TO D3

Technology Fundamentals: Embedding with HTML, DOM, CSS, Javascript, SVG-Drawing with data-Scales **(10)**

TOTAL : 45

TEXT BOOKS

1. *Ben Fry, O'Reilly, "Visualizing data: Exploring and Explaining data with the processing environment", 2007. (Para I)*
2. *Alexandru C Telea, "Data Visualization Principles and Practice, CRC Press", 2nd edition, 2014. (Para II, III)*
3. *Scott Murray, O'Reilly," Interactive data visualization for the web", 2013 (Para IV)*

16MDS84 - DATA PRIVACY AND SECURITY LABORATORY

L	T	P	C
0	0	4	2

PRE-REQUISITES
16MDS82

ASSESSMENT : PRACTICAL

COURSE OUTCOME

- *Determine the security threats, attacks and controls on information resources.*
- *Construct symmetric and asymmetric algorithms to preserve confidentiality, integrity and authenticity of information.*
- *Demonstrate network security tools including Packet capturing, Port scanning, Firewall, Intrusion detection, Mac Spoofing and full disk encryption.*
- *Implement Steganography under various media including text, images and audio.*
- *Devise own defensive measures for securing information resources for different enterprises including Government, Industry, Academia and Society.*

LIST OF PROGRAMS

1. Implementing Substitution and Transposition cipher.
2. Implementing DES, BLOWFISH, AES algorithms.
3. Implementing RSA, Key exchange algorithm, ECC algorithm.
4. Implementing MAC, SHA, MD5, DSA algorithms.
5. Learning to install and work with Packet capturing tool Wireshark.
6. Learning to install and work with Port scanning tool Nmap.
7. Learning to install and work with MAC Spoofing tool Smac.
8. Learning to install and work with Disk encryption software VeraCrypt.
9. Implementing Steganography techniques.
10. Implementing Privacy Preserving techniques.

16MDS85 - DATA VISUALIZATION LABORATORY

L	T	P	C
0	0	4	2

PRE-REQUISITES
Consent of the Instructor

ASSESSMENT : PRACTICAL

COURSE OUTCOME

- *Enhance the ability to understand and communicate data through visualization tools.*
- *Use tools like D3, Shinning to visualize the insights derived from large data.*
- *Explore the various methods to visualize data from various domains.*
- *Design of new interactive systems for data visualization and data analysis.*

Concepts to be Covered:

Softwares Required : D3(HTML, Javascript, CSS) , Shiny tool in R

D3

1. Setting up D3
2. Adding DOM and SVG elements
3. Binding data to DOM elements
4. Using data bound to DOM elements
5. Creating SVG elements based on data
6. Using SVG co-ordinate space
7. SVG basic shapes and D3
8. D3 Scales
9. D3 text element
10. D3 Axes

Shiny Tool

1. Input and output widgets in shiny
2. Creating dynamic user interface
3. Reactive Programming
4. Interactive Plotting
5. Generating reports
6. Client server programs

16MDS91 - INFORMATION RETRIEVAL

L	T	P	C
3	0	0	3

PRE-REQUISITES
Consent of the Instructor

ASSESSMENT : THEORY

COURSE OUTCOME

- *To impart basic theories and concepts related to Information Retrieval.*
- *To develop an understanding of Query languages and operations.*
- *To describe aspects pertaining to Text, Multimedia Information Retrieval.*
- *To describe the concepts for effective design of User Interfaces.*
- *To create awareness on the working of real world IR systems.*

INTRODUCTION

Basic Concepts - Retrieval Process - Modeling - Classic Information Retrieval - Set Theoretic, Algebraic and Probabilistic Models - Structured Text Retrieval Models - Retrieval Evaluation **(10)**

QUERY LANGUAGES

Key Word based Querying - Pattern Matching - Structural Queries - Query Operations - User Relevance Feedback - Local and Global Analysis - Text and Multimedia languages **(10)**

TEXT OPERATIONS AND USER INTERFACE

Document Preprocessing - Clustering - Text Compression - Indexing and Searching - Inverted files - Boolean Queries - Sequential searching - Pattern matching - User Interface and Visualization - Human Computer Interaction - Access Process - Starting Points -Query Specification - Context - User relevance Judgment - Interface for Search **(12)**

MULTIMEDIA INFORMATION RETRIEVAL

Data Models - Query Languages - Spatial Access Models - Generic Approach - One Dimensional Time Series - Two Dimensional Color Images - Feature Extraction. **(6)**

SEARCHING THE WEB

Introduction- Challenges - Characterizing the Web - Search Engines - Browsing - Metasearchers - Online IR systems - Online Public Access Catalogs - Digital Libraries - Architectural Issues - Document Models, Representations and Access - Prototypes and Standards. **(7)**

TOTAL HOURS : 45

TEXT BOOKS

1. *Ricardo Baeza-Yate, Berthier Ribeiro-Neto, "Modern Information Retrieval", Second Edition, ACM Press Books, 2011.*
2. *Daniel Jurafsky and James H. Martin, "Speech and Language Processing", Second Edition, Prentice Hall, 2009.*

REFERENCE BOOKS

1. *Christopher D. Manning, Prabhakar Raghavan and Hinrich Schütze, "Introduction to Information Retrieval", Cambridge University Press, 2008.*
2. *Charles T. Meadow, Bert R. Boyce, Donald H. Kraft, "Text Information Retrieval Systems", Third Edition, Academic Press, 2007.*

16MDS92 - DEEP LEARNING

L	T	P	C
3	0	0	3

PRE-REQUISITES
16MDS52

ASSESSMENT : THEORY

COURSE OUTCOME

Upon completion of the course, the students will be able to

- *Understand basics of deep learning.*
- *Explain how traditional feed-forward networks are constructed and why they can approximate almost any function.*
- *Summarise the key components in convolutional neural networks (CNNs) and their key advantages.*
- *Describe common types of recurrent neural networks (RNN) and their applications.*
- *Apply popular Deep learning models to their research problems.*

INTRODUCTION

Deep Learning: Overview of Methods, Learning, Numerical, Machine Learning Basics.

Deep Feed-forward Networks: Gradient-Based Learning, Hidden Units, Architecture Design, Back Propagation and other Differentiation Algorithms **(6)**

REGULARIZATION

Parameter Norm Penalties, Norm Penalties as Constrained Optimization, Regularization and Under-Constrained Problems Dataset Augmentation, Noise Robustness, Semi-Supervised Learning, Multitask Learning, Early Stopping, Parameter Tying and Parameter Sharing, Sparse Representations, Bagging and Other Ensemble Methods, Dropout, Adversarial Training, Tangent Distance, Tangent Prop and Manifold Tangent Classifier. **(9)**

OPTIMIZATION FOR TRAINING DEEP MODELS

Pure Optimization, Challenges in Neural Network Optimization, Basic Algorithms, Parameter Initialization Strategies, Algorithms with Adaptive Learning Rates, Approximate Second-Order Method, Optimization Strategies and Meta-Algorithms. **(9)**

CONVOLUTIONAL NETWORKS

The Convolution Operation, Motivation, Pooling, Convolution and Pooling as an Infinitely Strong Prior, Variants of the Basic Convolution Function, Structured Outputs, Data Types, Efficient Convolution Algorithms, Random or Unsupervised Features, The Neuroscientific Basis for Convolutional Networks, Convolutional Networks and the History of Deep Learning. **(9)**

SEQUENCE MODELING: RECURRENT AND RECURSIVE NETS

Unfolding Computational Graphs, Recurrent Neural Networks, Bidirectional RNNs, Encoder-Decoder Sequence-to-Sequence Architectures, Deep Recurrent Networks, Recursive Neural Networks, The Challenge of Long-Term Dependencies, Echo State Networks, Leaky Units and Other Strategies for Multiple Time Scales, The Long Short-Term Memory and Other Gated RNNs, Optimization for Long-Term Dependencies, Explicit Memory

APPLICATIONS

Speech Recognition, Natural Language Processing **(12)**

TOTAL : 45

TEXT BOOK

1. *Ian Goodfellow, Yoshua Bengio and Aaron Courville, "Deep Learning", MIT Press, 2016.*

REFERENCE BOOKS

1. *Deng & Yu," Deep Learning: Methods and Applications", Now Publishers, 2013.*
2. *Michael Nielsen, "Neural Networks and Deep Learning", Determination Press, 2015.*

16MDS93 - INFORMATION RETRIEVAL LABORATORY

L	T	P	C
0	0	4	2

PRE-REQUISITES
16MDS91

ASSESSMENT : PRACTICAL

COURSE OUTCOME

- *Define the tasks of information retrieval, web search and clustering, and the differences between them.*
- *Understand the main concepts, challenges and strategies used in IR, in particular the retrieval models currently used.*
- *Develop strategies suited for specific retrieval, clustering and classification situations, and recognize the limits of these strategies.*
- *Understand (the reasons for) the evaluation strategies developed for the tasks covered.*

CONCEPTS TO BE COVERED

1. Boolean Operators.
2. Boolean Retrieval and Indexing:Implementation of Boolean Operators. Term manipulations; equivalence classes, stemming.
3. Spelling Correction and Tolerant Retrieval: Wildcards, Spelling Correction.
4. Index Construction and Compression: BSBI, SPIMI, Distributed indexing, Dictionary compression, Byte- and bit-level codes.
5. The Vector Space Model, VSM and Term weighting.
6. Evaluation: Test Collections, Relevance, Precision, Recall, MAP, 11pt interpolated average precision.
7. Clustering: Proximity metrics, hierarchical vs. Partitional clustering, Clustering algorithms, Evaluation metrics.
8. Link Analysis: PageRank, Hubs and Authorities.

16MDS94 - DEEP LEARNING LABORATORY

L	T	P	C
0	0	4	2

PRE-REQUISITES
16MDS92

ASSESSMENT : PRACTICAL

COURSE OUTCOME

Upon completion of the course, the students will be able to

- *Demonstrate how traditional feed-forward networks are constructed and why they can approximate almost any function.*
- *Implement the key components in convolutional neural networks (CNNs) and their key advantages.*
- *Describe common types of recurrent neural networks (RNN) and their applications.*
- *Apply popular Deep learning models to their research problems.*

Implement the following concepts using Python and use the necessary libraries like Tensorflow, Keras,Theano, Torch, etc.,

1. Logistic Regression
2. Multilayer perceptron
3. Deep Convolutional Network
4. Linear Factor Models : PCA, ICA etc.
5. Auto Encoders, Denoising Autoencoders
6. Monte Carlo methods
7. Stacked Denoising Auto-Encoders Restricted Boltzmann Machines
8. Deep Belief Networks

16MDSE1 - BUSINESS INTELLIGENCE

L	T	P	C
3	0	0	3

PRE-REQUISITES

16MDS35, 16MDS45, 16MDS63

ASSESSMENT : THEORY

COURSE OUTCOME

The student should be made to:

- *Be exposed with the basic rudiments of business intelligence system.*
- *Understand the modeling aspects behind Business Intelligence.*
- *Understand of the business intelligence life cycle and the techniques used in it.*
- *Be exposed with different data analysis tools and techniques.*

BUSINESS INTELLIGENCE

Effective and timely decisions - Data, information and knowledge - Role of mathematical models - Business intelligence architectures: Cycle of a business intelligence analysis - Enabling factors in business intelligence projects - Development of a business intelligence system - Ethics and business intelligence. **(9)**

KNOWLEDGE DELIVERY

The business intelligence user types, Standard reports, Interactive Analysis and Ad Hoc Querying, Parameterized Reports and Self-Service Reporting, dimensional analysis, Alerts/Notifications, Visualization: Charts, Graphs, Widgets, Scorecards and Dashboards, Geographic Visualization, Integrated Analytics, Considerations: Optimizing the Presentation for the Right Message. **(9)**

EFFICIENCY

Efficiency measures - The CCR model: Definition of target objectives- Peer groups - Identification of good operating practices; cross efficiency analysis - virtual inputs and outputs - Other models. Pattern matching - cluster analysis, outlier analysis. **(9)**

BUSINESS INTELLIGENCE APPLICATIONS

Marketing models - Logistic and Production models - Case studies. **(9)**

FUTURE OF BUSINESS INTELLIGENCE

Future of business intelligence - Emerging Technologies, Machine Learning, Predicting the Future, BI Search & Text Analytics - Advanced Visualization - Rich Report, Future beyond Technology. **(9)**

TOTAL : 45

TEXT BOOK

1. *Efraim Turban, Ramesh Sharda, Dursun Delen, "Decision Support and Business Intelligence Systems", 9th Edition, Pearson 2013*

REFERENCES BOOKS

1. *Larissa T. Moss, S. Atre, "Business Intelligence Roadmap: The Complete Project Lifecycle of Decision Making", Addison Wesley, 2003.*
2. *Carlo Vercellis, "Business Intelligence: Data Mining and Optimization for Decision Making", Wiley Publications, 2009.*

16MDSE2 - WEB MINING

L	T	P	C
3	0	0	3

PRE-REQUISITES
16MDS63

ASSESSMENT : THEORY

COURSE OUTCOME

- *To outline on a detailed overview of the data mining process and techniques, specifically those that are relevant to Web mining.*
- *Identify and differentiate between application areas for web content mining, web structure mining and web usage mining.*
- *To demonstrate the basics of Information retrieval and Web search with special emphasis on web Crawling.*
- *To apply the use of machine learning approaches for Web Content Mining, the role of hyper links in web structure mining and the various aspects of web usage mining.*
- *Develop skills of using recent data mining software for solving practical problems of Web Mining.*

INTRODUCTION

Introduction - Web Mining - Theoretical background -Algorithms and techniques - Association rule mining - Sequential Pattern Mining -Information retrieval and Web search - Information retrieval Models-Relevance Feedback- Text and Web page Pre-processing - Inverted Index - Latent Semantic Indexing - Web Search - Meta-Search - Web Spamming **(9)**

WEB CONTENT MINING

Web Content Mining - Supervised Learning - Decision tree - Naïve Bayesian Text Classification - Support Vector Machines - Ensemble of Classifiers. Unsupervised Learning - K-means Clustering - Hierarchical Clustering -Partially Supervised Learning - Markov Models - Probability-Based Clustering - Evaluating Classification and Clustering - Vector Space Model - Latent semantic Indexing - Automatic Topic Extraction - Opinion Mining and Sentiment Analysis - Document Sentiment Classification. **(9)**

WEB LINK MINING

Web Link Mining - Hyperlink based Ranking - Introduction -Social Networks Analysis- Co-Citation and Bibliographic Coupling - Page Rank -Authorities and Hubs -Link-Based Similarity Search - Enhanced Techniques for Page Ranking - Community Discovery - Web Crawling -A Basic Crawler Algorithm- Implementation Issues- Universal Crawlers- Focused Crawlers- Topical CrawlersEvaluation - Crawler Ethics and Conflicts - New Developments **(9)**

STRUCTURED DATA EXTRACTION

Structured Data Extraction: Wrapper Generation - Preliminaries- Wrapper Induction- Instance-Based Wrapper Learning ·- Automatic Wrapper Generation: Problems - String Matching and Tree Matching -. Multiple Alignment - Building DOM Trees - Extraction Based on a Single List Page and Multiple pages- Introduction to Schema Matching - Schema-Level Match -Domain and Instance-Level Matching - Extracting and Analyzing Web Social Networks. **(9)**

WEB USAGE MINING

Web Usage Mining - Click stream Analysis -Web Server Log Files - Data Collection and PreProcessing - Cleaning and Filtering-Data Modeling for Web Usage Mining - The BIRCH Clustering Algorithm -Affinity Analysis and the A Priori Algorithm - Binning. Discovery and Analysis of Web Usage Patterns - Modeling user interests -Probabilistic Latent Semantic Analysis - Latent Dirichlet Allocation Model- Applications- Collaborative Filtering- Recommender Systems - Web Recommender systems based on User and Item - PLSA and LDA Models **(9)**

TOTAL : 45

TEXT BOOKS

1. *Bing Liu, "Web Data Mining: Exploring Hyperlinks, Contents, and Usage Data (Data-Centric Systems and Applications)", Springer; 2nd Edition 2009. (Para 1, Para 2, Para 3, Para 4, Para 5)*

2. *Guandong Xu ,Yanchun Zhang, Lin Li, "Web Mining and Social Networking: Techniques and Applications", Springer; 1st Edition, 2010. (Para 1, Para 2, Para 4)*
3. *Zdravko Markov, Daniel T. Larose, "Data Mining the Web: Uncovering Patterns in Web Content, Structure, and Usage", John Wiley & Sons, Inc., 2007. (Para 5, Para 2)*

REFERENCE BOOKS

1. *Soumen Chakrabarti, "Mining the Web: Discovering Knowledge from Hypertext Data", Morgan Kaufmann; edition 2002.*
2. *Adam Schenker, "Graph-Theoretic Techniques for Web Content Mining", World Scientific Pub Co Inc, 2005.*
3. *Min Song, Yi Fang and Brook Wu, Handbook of research on Text and Web mining technologies, IGI global, information Science Reference - imprint of : IGI publishing, 2008.*

16MDSE3 - SOCIAL NETWORK ANALYSIS

L	T	P	C
3	0	0	3

PRE-REQUISITES
16MDS53, 16MDS63, 16MDS83

ASSESSMENT : THEORY

COURSE OUTCOME

- *Work on the internal components of the social network.*
- *Model and visualize the social network.*
- *Mine the behaviour of the users in the social network.*
- *Predict the possible next outcome of the social network.*
- *Preserving privacy in social networks and real time social network application.*

INTRODUCTION

Introduction to Web - Limitations of current Web - Development of Semantic Web - Emergence of the Social Web - Statistical Properties of Social Networks -Network analysis - Development of Social Network Analysis - Key concepts and measures in network analysis - Discussion networks - Blogs and online communities - Web-based networks **(9)**

MODELING AND VISUALIZATION

Visualizing Online Social Networks - A Taxonomy of Visualizations - Graph Representation - Centrality- Clustering - Node-Edge Diagrams - Visualizing Social Networks with Matrix Based Representations- Node-Link Diagrams - Hybrid Representations - Modelling and aggregating social network data - Random Walks and their Applications -Use of Hadoop and Map Reduce - Ontological representation of social individuals and relationships. **(9)**

MINING COMMUNITIES

Aggregating and reasoning with social network data, Advanced Representations - Extracting evolution of Web Community from a Series of Web Archive - Detecting Communities in Social Networks - Evaluating Communities - Core Methods for Community Detection & Mining - Applications of Community Mining Algorithms - Node Classification in Social Networks. **(9)**

EVOLUTION

Evolution in Social Networks - Framework - Tracing Smoothly Evolving Communities - Models and Algorithms for Social Influence Analysis - Influence Related Statistics - Social Similarity and Influence - Influence Maximization in Viral Marketing - Algorithms and Systems for Expert Location in Social Networks - Expert Location without Graph Constraints - with Score Propagation - Expert Team Formation - Link Prediction in Social Networks - Feature based Link Prediction - Bayesian Probabilistic Models - Probabilistic Relational Models. **(9)**

PRIVACY IN SOCIAL NETWORKS AND APPLICATIONS

Introduction - Privacy breaches in Social Networks - Privacy definitions for publishing data - privacy preserving mechanisms. APPLICATION : A learning based approach for Real Time Emotion Classification of Tweets - Assessing the opinion of users in Social Network enviroments. **(9)**

TOTAL : 45

TEXT BOOKS

1. *Peter Mika, "Social Networks and the Semantic Web", Springer, 1st edition, 2007.*
2. *Borko Furht, "Handbook of Social Network Technologies and Applications, Springer", 1st edition, 2011.*
3. *Charu C. Aggarwal, "Social Network Data Analytic", Springer; 2014.*

REFERENCE BOOKS

1. *Ajith Abraham, Aboul Ella Hassanien, Václav Snášel, "Computational Social Network Analysis: Trends, Tools and Research Advances", Springer, 2012*
2. *Giles, Mark Smith, John Yen, "Advances in Social Network Mining and Analysis", Springer, 2010.*
3. *Guandong Xu , Yanchun Zhang and Lin Li, "Web Mining and Social Networking - Techniques and applications", Springer, 1st edition, 2012*
4. *Przemyslaw Kazienko, Nitesh Chawla,"Applications of Social Media and Social Network Analysis", Springer, 2015 CP5007 BIO-INSPIRED CO.*

16MDSE4 - GEOGRAPHICAL INFORMATION ANALYSIS

L	T	P	C
3	0	0	3

PRE-REQUISITES
Consent of the Instructor

ASSESSMENT : THEORY

COURSE OUTCOME

The student will be able to

- *Describe the issues in spatial data analysis and categorize the spatial data using data fields.*
- *Apply the suitable spatial data analytical technical methods to geographical application.*
- *Generate the procedure to analyze the spatial data based on the spatial objects and field objects.*

INTRODUCTION

Geographic Information Analysis and Spatial Data : Spatial Data Types - Scales for Attribute Description - GIS and Spatial Data Manipulation . The Pitfalls and Potential of Spatial Data: The Pitfalls of Spatial Data - The Potential of Spatial Data. **(6)**

MAPPING AND MAP PROCESS

Mapping It Out : The Cartographic Tradition - Geovisualization and Analysis - The Graphic Variables of Jacques Bertin - New Graphic Variables - Issues in Geovisualization - Mapping and Exploring Points - Mapping and Exploring Areas - Mapping and Exploring Fields - The Spatialization of Nonspatial Data. Maps as Outcomes of Processes: Introduction: Maps and Processes - Processes and the Patterns They Make - Predicting the Pattern Generated by a Process - Stochastic Processes in Lines, Areas, and Fields. **(10)**

POINT PATTERN ANALYSIS

Basics - Describing a Point Pattern - Assessing Point Patterns Statistically - Monte Carlo Testing. Practical Point Pattern Analysis: Problems of Spatial Statistical Analysis - Alternatives to Classical Statistical Inference - Alternatives to IRP/CSR 162 - Point Pattern Analysis in the Real World - Dealing with homogeneity - Focused Approaches - Cluster Detection: Scan Statistics - Using Density and Distance: Proximity Polygons - A Note on Distance Matrices and Point Pattern Analysis. **(10)**

AREA OBJECTS, LOCAL STATISTICS

Types of Area Objects - Geometric Properties of Areas - Measuring Spatial Autocorrelation - An Example: Tuberculosis in Auckland 2001-2006 - Other Approaches. Local Statistics: Think Geographically, Measure Locally Introduction - Defining the Local: Spatial Structure - An Example: The Getis-Ord Gi and Gi * Statistics - Inference with Local Statistics - Other Local Statistics. **(9)**

ANALYZING FIELDS AND STATISTICS OF FIELDS

Describing and Analyzing Fields : Scalar and Vector Fields Basics - Modeling and Storing Field Data - Spatial Interpolation - Derived Measures on Surfaces - Map Algebra. Knowing the Unknowable : The Statistics of Fields: Regression on Spatial Coordinates: Trend - Surface Analysis - The Square Root Differences Cloud and the (Semi-) Variogram - A Statistical Approach to Interpolation: Kriging. Map Overlay: Boolean Map Overlay and Sieve Mapping - A General Model for Alternatives to Boolean Overlay - Indexed Overlay and Weighted Linear Combination - Weights of Evidence - Model-Driven Overlay Using Regression. **(10)**

TOTAL : 45

TEXT BOOK

1. *David O'Sullivan and David J. Unwin, "Geographic Information Analysis", John Wiley Inc., Second Edition, 2010.*

16MDSE5 - HEALTH CARE ANALYTICS

L	T	P	C
3	0	0	3

PRE-REQUISITES

16MDS35, 16MDS63, 16MDS82

ASSESSMENT : THEORY

COURSE OUTCOME

- *To process the different types of health care data stored in health data sources.*
- *To apply the appropriate biomedical image and text analysis techniques for analyzing biomedical image and clinical text data.*
- *To generate the prediction health care model using temporal, sensor and text mining techniques.*

INTRODUCTION

Introduction to Healthcare Data Analytics - Healthcare Data Sources and Basic Analytics, Advanced Data Analytics for Healthcare, Applications and Practical Systems for Healthcare, Resources for Healthcare Data Analytics. **(7)**

HEALTHCARE DATA SOURCES AND BASIC ANALYTICS

Electronic Health Records (EHR): A Survey- History and components of EHR, Coding Systems, Benefits of EHR - Barriers to Adopting EHR - Challenges of Using EHR Data. **(7)**

HEALTHCARE DATA ANALYTICS

Biomedical Image Analysis-Biomedical Imaging Modalities, Object Detection, Image Segmentation, Image Registration, Feature Extraction. Natural Language Processing and Data Mining for Clinical Text-Natural Language Processing, Mining Information from Clinical Text, Challenges of Processing Clinical Reports, Clinical Applications. Social Media Analytics for Healthcare- Social Media Analysis for Detection and Tracking of Infectious Disease Outbreaks, Social Media Analysis for Public Health Research, Analysis of Social Media Use in Healthcare**.** **(12)**

ADVANCED DATA ANALYTICS FOR HEALTHCARE

Temporal Data Mining for Healthcare Data-Association Analysis, Temporal Pattern Mining, Sensor Data Analysis, Other Temporal Modelling Methods. Information Retrieval for Healthcare-Knowledge-Based Information in Healthcare and Biomedicine, Content of Knowledge-Based Information Resources, Indexing, Retrieval, Evaluation. Privacy-Preserving Data Publishing Methods in Healthcare- Data Overview and Pre-processing, Privacy-Preserving Publishing Methods, Challenges with Health Data. **(12)**

APPLICATIONS AND PRACTICAL SYSTEMS FOR HEALTHCARE

Fraud Detection in Healthcare, Mobile Imaging and Analytics for Biomedical Data-Image Formation, Data Visualization, Image Analysis, Image Management and Communication. **(7)**

TOTAL : 45

TEXT BOOK

1. *Chandan K. Reddy and Charu C. Aggarwal, "HealthCare Data Analytics", CRC Press.*

REFERENCE BOOKS

1. *Laura B. Madsen, "Data-Driven Healthcare: How Analytics and BI are Transforming the Industry", Wiley and SAS Business Series, 2014.*
2. *Trevor L. Strome, "Healthcare Analytics for Quality and Performance Improvement", John Wiley & Sons, Inc., 2013.*

16MDSE6 - INFORMATION SECURITY ANALYTICS

L	T	P	C
3	0	0	3

PRE-REQUISITES
16MDS64, 16MDS82

ASSESSMENT : THEORY

COURSE OUTCOME

- *To give insights into the practice of analytics.*
- *To utilize analytic techniques to identify trends.*
- *To provide a wealth of analytics experience to demonstrate practical, hands-on techniques through case studies.*

ANALYTICS DEFINED AND ANALYTICAL SOFTWARE TOOLS

Introduction to Security Analytics - Concepts and Techniques in Analytics - Data for Security Analytics - Analytics in Everyday life - Security Analytics Process. Introduction - Statistical Programming- Introduction to Databases and Big Data Techniques- Introduction to R- Introduction to Python-Introduction to Simulation. **(10)**

ANALYTICS AND INCIDENT RESPONSE

Introduction - Scenarios and Challenges in intrusions and incident identification- Analysis of Log files- Loading the Data-Another Potential Analytical Data Set: Unstacked Status Codes- Other Applicable Security Areas and Scenarios. **(9)**

SIMULATIONS AND SECURITY PROCESSES

Simulation - Designing and Creating a Model- Adding Data and Parameters to the Model - Running and Analyzing the Simulation. **(7)**

ACCESS ANALYTICS

Introduction -Technology Primer- Scenario, Analysis and Techniques - Case Study- Analyzing the Results. **(7)**

TEXT MINING AND SECURITY INTELLIGENCE

Scenarios and challenges in security Analytics with Text Mining - Use of Text mining Techniques to analyze and find patterns in unstructured Data - Step by Step Text Mining Example in R- other Applicable Security Areas and Scenarios. Security Intelligence Overview - Security Breaches - Practical Applications. **(12)**

TOTAL : 45

TEXT BOOK

1. *Mark Talabis, Robert McPherson, I Miyamoto, Jason Martin," Information Security Analytics: Finding Security Insights, Patterns and Anomalies in Big Data", SyngressMedia,U.S. 2014.*

REFERENCE BOOK

1. *Jay Jacobs, Bob Rudis," Data-Driven Security: Analysis, Visualization and Dashboards", Wiley ,2014.*

16MDSE7 - IMAGE PROCESSING

L	T	P	C
3	0	0	3

PRE-REQUISITES
Consent of the Instructor

ASSESSMENT : THEORY

COURSE OUTCOME

- *Students can apply the image fundamentals and mathematical transforms necessary for image processing.*
- *Students can apply the image enhancement techniques.*
- *Students can apply image restoration procedures.*
- *Students can apply the image compression procedures.*
- *Students can apply the image segmentation and representation techniques.*

FUNDAMENTALS OF IMAGE PROCESSING

Introduction - Elements of visual perception, Steps in Image Processing Systems - Image Acquisition - Sampling and Quantization - Pixel Relationships - Colour Fundamentals and Models, File Formats- Introduction to the Mathematical tools. **(9)**

IMAGE ENHANCEMENT AND RESTORATION

Spatial Domain Gray level Transformations Histogram Processing Spatial Filtering - Smoothing and Sharpening. Frequency Domain: Filtering in Frequency Domain - DFT, FFT, DCT, Smoothing and Sharpening filters - Homomorphic Filtering., Noise models, Constrained and Unconstrained restoration models. **(9)**

IMAGE SEGMENTATION AND FEATURE ANALYSIS

Detection of Discontinuities - Edge Operators - Edge Linking and Boundary Detection - Thresholding - Region Based Segmentation - Motion Segmentation, Feature Analysis and Extraction. **(9)**

MULTI RESOLUTION ANALYSIS AND COMPRESSIONS

Multi Resolution Analysis: Image Pyramids - Multi resolution expansion - Wavelet Transforms, Fast Wavelet transforms, Wavelet Packets. Image Compression: Fundamentals - Models - Elements of Information Theory - Error Free Compression - Lossy Compression - Compression Standards - JPEG/MPEG. **(9)**

APPLICATIONS OF IMAGE PROCESSING

Representation and Description, Image Recognition- Image Understanding - Image Classification - Video Motion Analysis - Image Fusion - Steganography - Colour Image Processing. **(9)**

TOTAL : 45

TEXT BOOKS

1. *Rafael C.Gonzalez and Richard E.Woods, "Digital Image Processing", Pearson Education, Third Edition, 2008.*
2. *Milan Sonka, Vaclav Hlavac and Roger Boyle, "Image Processing, Analysis and Machine Vision", Brooks Cole, Third Edition, 2008.*

REFERENCE BOOKS

1. *Anil K.Jain, "Fundamentals of Digital Image Processing", Prentice-Hall India, 2007.*
2. *Madhuri A. Joshi, 'Digital Image Processing: An Algorithmic Approach", Prentice Hall India, 2006.*
3. *Rafael C.Gonzalez , Richard E.Woods and Steven L. Eddins, "Digital Image Processing Using MATLAB", Pearson Education, First Edition, 2004.*

16MDSE8 - BIO INFORMATICS

L	T	P	C
3	0	0	3

PRE-REQUISITES
Consent of the Instructor

ASSESSMENT : THEORY

COURSE OUTCOME

- *To introduce a new scientific discipline Bioinformatics, the combined power of biology, mathematics and computers.*
- *To impart knowledge in computer science with biology to unite raw data with powerful software tools and mathematical models.*
- *It represents a frontier in biological research and the best path toward finding meaning in a world of complex data.*

INTRODUCTION

System approach in molecular biology, Central dogma of molecular biology, important definitions, bioinformatics approach, Applications, European molecular biology network - national center for bio technology information. **(7)**

CODING

Common health care language, coding techniques - coded and quasi-coded data - Medical vocabulary - industry wide communication standards HL7 - unified medical language system - quality of care paradigms, risk management bioethics. **(8)**

PATIENT RECORD MAINTENANCE

Electronic patient record - models or ERP - environmental services - metrics - telemedicine - community networks - telemedicine peripherals and equipment selection - anatomy of video conferencing technology. **(8)**

PROTEIN INFORMATION RESOURCES

Biological data basics - primary secondary data basics - protein pattern data basics - DNA sequences data basics, DNA analysis, Genes structure and DNA sequences - interpretation of EST structures - different approach to EST analysis. **(8)**

ALIGNMENT TECHNIQUES

Data base searching, comparison of two sequences - identity and similarity - global and global similarity - global and local alignment, multiple sequence alignment - data basis of multiple alignments - secondary database **(7)**

PROBLEM SOLVING IN BIOINFORMATICS

Gnome analysis for DNA sequences, protein sequences, Strategies and options for similarity search, Practical considerations in sequence analysis, Flow chart for protein structure prediction -Illustrations **(7)**

TOTAL : 45

TEXT BOOK

1. *Teresa Attwood, David Parry-Smith, "Introduction to Bioinformatics", Pearson Education, New Delhi, 2001.*

REFERENCE BOOKS

1. *Arthur M. Lesk, "Introduction to Bio-Informatics", Oxford Press, New Delhi, 2004.*
2. *Pierre Baldi, Soren Brunak, " Bioinformatics - The Machine Learning Approach", East-West Press, New Delhi, 2003.*
3. *Rastogi.S.C, Namita Mendiratta, Parag Rastogi, "Bioinforamtics - Concepts, Skills, Applications", CBS Publications & Distributors, New Delhi, 2003.*

16MDSE9 - KNOWLEDGE ENGINEERING

L	T	P	C
3	0	0	3

PRE-REQUISITES
Consent of the Instructor

ASSESSMENT : THEORY

COURSE OUTCOME

- *Describe how the integrated KM cycle combines the advantages of other KM life-cycle models.*
- *Link the KM frameworks to key KM concepts and the major phases of the KM cycle.*
- *Describe the major techniques used to elicit tacit knowledge from subject matter experts.*
- *Analyze the type of knowledge to be captured and codified, select the best approach to use, and discuss.*
- *Discuss how communities can be linked to organizational memory in order to foster organizational learning and innovation.*

KNOWLEDGE MANAGEMENT

KM Myths - KM Life Cycle - Understanding Knowledge - Knowledge intelligence - Experience - Common Sense - Cognition and KM - Types of Knowledge - Expert Knowledge - Human Thinking and Learning. **(9)**

KNOWLEDGE MANAGEMENT SYSTEM LIFE CYCLE

Challenges in Building KM Systems - Conventional Vs KM System Life Cycle (KMSLS) - Knowledge Creation and Knowledge Architecture - Nonaka's Model of Knowledge Creation and Transformation - Knowledge Architecture. **(9)**

CAPTURING KNOWLEDGE

Evaluating the Expert - Developing a Relationship with Experts - Fuzzy Reasoning and the Quality of Knowledge - Knowledge Capturing Techniques, Brain Storming - Protocol Analysis - Consensus Decision Making - Repertory Grid- Concept Mapping - Blackboarding. **(9)**

KNOWLEDGE CODIFICATION

Modes of Knowledge Conversion - Codification Tools and Procedures - Knowledge Developer's Skill Sets - System Testing and Deployment - Knowledge Testing - Approaches to Logical Testing, User Acceptance Testing - KM System Deployment Issues - User Training - Post implementation. **(9)**

KNOWLEDGE TRANSFER AND SHARING

Transfer Methods - Role of the Internet - Knowledge Transfer in e-world - KM System Tools - Neural Network - Association Rules - Classification Trees - Data Mining and Business Intelligence - Decision Making Architecture - Data Management - Knowledge Management Protocols - Managing Knowledge Workers. **(9)**

TOTAL : 45

TEXT BOOKS

1. *Elias.M. Award & Hassan M. Ghaziri,"Knowledge Management" Pearson Education, 2007.*
2. *KimizDalkir, Knowledge Management in Theory and Practice, MIT Press, 2011.*

REFERENCES

1. *Guus Schreiber, Hans Akkermans, AnjoAnjewierden, Robert de Hoog, NigelShadbolt, Walter Van de Velde and Bob Wielinga, "Knowledge Engineering andManagement", Universities Press, 2001.*
2. *C.W. Holsapple, "Handbooks on Knowledge Management", International Handbooks on Information Systems, Vol 1 and 2, 2003.*

16MDSE10 - NATURAL LANGUAGE PROCESSING

L	T	P	C
3	0	0	3

PRE-REQUISITES
16MDS32, 16MDS54

ASSESSMENT : THEORY

COURSE OUTCOME

Upon completion of the course, the students should be able to:

- *Describe the mathematical and linguistic foundations, underlying approaches to the areas in NLP.*
- *Apply techniques such as HMM for word processing.*
- *Evaluate approaches to syntax, semantic and pragmatic processing in NLP.*
- *Design models using CFG, PCFG, Lexical and Computational concepts for syntax and semantic processing based applications.*
- *Design, implement and test algorithms for NLP problems.*

INTRODUCTION

Knowledge in Speech and Language processing - Ambiguity - Models and Algorithms - Language, Thought and Understanding - Brief History.

Words and Transducers : Finite-State Morphological Parsing - Building a Finite-State Lexicon -Finite-State Transducers - Sequential Transducers and Determinism - FSTs for Morphological Parsing -Transducers and Orthographic Rules - Combining FST Lexicon and Rules - Lexicon-Free FSTs -Word and Sentence Tokenization -Detecting and Correcting Spelling Errors - Minimum Edit Distance. **(8)**

WORDS PROCESSING

N-grams : Counting words - Training and test sets - Evaluating N-grams - smoothing. Parts-of-speech tagging : English word classes - Tagsets - POS tagging - Rule based POS tagging - HMM POS tagging - Transformation based tagging - Evaluation and error analysis. Hidden Markov Model : Markov chains - HMM - Forward algorithm - Viterbi algorithm - Training HMM. **(9)**

SPEECH

Phonetics: Articulatory phonetics - Phonological categories.Speech Synthesis: Text normalization - Phonetic analysis - Prosodic analysis. Automatic Speech Recognition: Architecture - HMM to speech - Feature extraction - Lexicon and Language model - Search and Decoding - Embedding training - Evaluation. **(9)**

SYNTAX

Formal grammars of English: Context free grammars - Grammar rules - Treebanks - Normal forms - Finite state and CFG - Dependency grammar - spoken language syntax. Parsing with CFG: Parsing as search - Ambiguity - Dynamic programming parsing methods. Statistical Parsing: Probabilistic CFG - Probabilitic CKY parsing - Problems with PCFGs - Improving PCFGs. **(9)**

SEMANTICS AND PRAGMATICS

Representing meaning - Computational semantics - Lexical semantics - Computational Lexical semantics. Applications: Information Retrieval - Machine Translation. **(10)**

TOTAL : 45

TEXT BOOK

1. *Daniel Jurafsky and James H Martin, "Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics and Speech Recognition", Prentice-Hall, Upper Saddle River, NJ, 2000.*

REFERENCE BOOKS

1. *James Allen,"Natural language Understanding", Pearson Education, Second Edition, 1994.*
2. *Manning, Christopher D. and HinrichSchutze, "Foundations of Statistical Natural Language Processing", Cambridge, MA: MIT Press.*

16MDSE11 - ECONOMETRIC ANALYSIS

L	T	P	C
3	0	0	3

PRE-REQUISITES
16MDS13, 16MDS22, 16MDS31, 16MDS41

ASSESSMENT : THEORY

COURSE OUTCOME

At the end of this course the students will be able to

- *Understand the analysis of economic data using Simple and Multiple Regression Models.*
- *Analyse the properties of Ordinary Least Square (OLS) Estimators, assumptions underlying Multiple Linear Regression Equation and understand the properties of sampling distribution of OLS Estimators.*
- *Get a good knowledge in using Dummy Variables in Regression Analysis.*
- *Analyse time series data using Regression models.*

REVIEW OF MATHEMATICS AND STATISTICS

The Nature of Econometrics and Economic Data-What is Econometrics? - Steps in Empirical Economic Analysis-The structure of Economic Data- Causality and the Notion of Ceteris Paribus in Econometric Analysis-Regression Analysis with Cross-Sectional Data - The Simple Regression Model-Properties of OLS on any sample of data- Units of measurement and functional form-Expected values and Variances of OLS Estimators-Assumptions of Simple Regression - Regression through the origin and Regression on a constant. **(9)**

MULTIPLE LINEAR REGRESSION (MLR) - OLS ESTIMATES

Analysis Estimation- Motivation for Multiple Regression: The Model with two independent variables- The Model with k independent variables- Obtaining OLS Estimates-Mechanics and Interpretation of the OLS Regression Equation-Meaning of holding other factors fixed in Multiple Regression-Changing more than one independent variable simultaneously-OLS fitted values and residuals-Goodness of fit-Regression through origin-The expected values of OLS Estimators-Assumptions of MLR-Including irrelevant variables in MLR-Omitted Variable bias-Variance of the OLS -The components of the OLS Variance: Multicollinearity-Estimating :Standard errors of OLS Estimators- -Efficiency of OLS-Gauss Markov Theorem. **(9)**

MLR INFERENCE

Multiple Regression Analysis Inference-Sampling distribution of OLS estimators-Testing Hypotheses about a single population parameter-The t-test-Confidence Intervals- Testing hypotheses about a single linear combination - Testing Multiple Linear Restrictions: The F test-Reporting regression results Multiple Regression Analysis - Further Issues: Effects of data scaling on OLS Statistics-More on functional form- More on goodness of fit and selection of regressors-Prediction and residual analysis **(9)**

MLR INCLUSION OF DUMMY VARIABLES

Multiple Regression Analysis with qualitative information Dummy variables-Describing qualitative information - A single dummy independent variable-Using Dummy variables for multiple categories-Interactions involving dummy variables-A binary dependent variable-The linear probability model-Interpreting Regression results with discrete dependent variables. **(9)**

ANALYSIS OF TIME SERIES DATA

Regression Analysis with Time Series Data Nature of Time Series Data-Examples of Time Series Regression Models-Static models-Finite distributed lag models. **(9)**

TOTAL : 45

TEXT BOOK

1. *Wooldridge J.M." Introductory Econometric", A Modern Approach, Fifth Edition, South-Western(2009)*

REFERENCE BOOKS

1. *Gujarati, "Basic Econometrics", Fourth Edition, The McGraw Hill Companies, 2004.*
2. *William H.Greene, "Econometric Analysis ", Fifth Edition, Prentice Hall ,2002.*
3. *Koutsoyiannis, A. "Theory of Econometrics", Second Edition,Palgrave Macmillian ,2001.*

16MDSE12 - BUSINESS PROCESS MANAGEMENT

L	T	P	C
3	0	0	3

PRE-REQUISITES
Consent of the Instructor

ASSESSMENT : THEORY

COURSE OUTCOME

- *Discover the processes associated with the given business problem.*
- *Analyze the business process and identify the issues of the process.*
- *Design the business process by applying the necessary changes.*
- *Develop the IT solution to automate the business process.*
- *Infer Business Process Management as a cross-disciplinary field, striking a balance between business management and IT aspects.*

INTRODUCTION TO BUSINESS PROCESS MANAGEMENT (BPM)

Business Process Definition - Origin and History of BPM - The BPM Lifecycle **(7)**

PROCESS IDENTIFICATION AND MODELING

Focusing on Key Processes - Designing a Process Architecture - BPMN Initiation - Branching and Merging - Information Artifacts - Resources. **(9)**

ADVANCED PROCESS MODELING

Process Decomposition - Process Reuse - Rework and Repetition - Handling Events - Handling Exceptions - Processes and Business Rules. **(10)**

PROCESS DISCOVERY

The Setting of Process Discovery - Discovery Methods - Process Modeling Method - Process Model Quality Assurance. **(9)**

PROCESS ANALYSIS AND REDESIGN

Qualitative Process Analysis: Value-Added Analysis - Root Cause Analysis - Issue Documentation and Impact Assessment. Quantitative Process Analysis: Performance Measures - Flow Analysis - Queues - Simulation. Redesign: Definition and Need - Heuristic Process Redesign - The Case of a Health Care Institution - Product-Based Design. **(10)**

TOTAL : 45

TEXT BOOK

1. *Marlon Dumas, Marcello La Rosa, Jan Mendling and Hajo A. Reijers, "Fundamentals of Business Process Management", Springer-Verlag Publication, 2013.*

REFERENCE BOOK

1. *Forrest W. Breyfogle III, "The Business Process Management Guidebook: An Integrated Enterprise Excellence BPM System", Citius Publishing, 2013.*

16MDSE13 - ACCOUNTING FOR DECISION MAKING

L	T	P	C
3	0	0	3

PRE-REQUISITES
Consent of the Instructor

ASSESSMENT : THEORY

COURSE OUTCOME

- *Apply basic knowledge on various accounting procedures in managerial decision making.*
- *Apply ratio and budgeting concepts in analysing and planning activities for business operations.*
- *Estimate costs for manufactured units.*
- *Identity the best projects for a company using capital budgeting techniques.*
- *Establish costing system.*

INTRODUCTION

Introduction to Managerial Accounting - Need and Importance - role of managerial accounting in support of planning, directing, and controlling. Financial Management Objectives and scope of Financial Management - Analysis and Interpretation of Financial Management - Ratio Analysis - financial system - Cash Flow and Fund Flow Analysis. **(10)**

WORKING CAPITAL MANAGEMENT

Meaning, Concepts, Classification and Importance of working capital - Excess or Inadequate working capital, its disadvantages - Objective of working capital - Factors determining working capital requirements; Forecast of working capital requirement - Working Capital Financing Determining the working capital Financing Mix. **(9)**

CAPITAL BUTGETING

Capital investment decision through Pay-back Period Method, Average Rate of Return - Internal Rate of Return - cost of capital - discounted cash flow analysis by using spread sheet - Time Value of Money. **(9)**

COST-VOLUME-PROFIT ANALYSIS - CVP, Fixed costs, variable costs, semi variable costs, operating leverage, contribution margin, breakeven point- Break-even Analysis - Marginal Costing and Decision Making - Relevant Costs in Decision making - Shut down/continue, make/buy, Processing of joint products, introducing a new product, effect of sunk costs. **(9)**

PROCESS COSTING AND ACTIVITY-BASED COSTING

Purpose and functioning of a process cost accounting system - equivalent units of production - Assigning total cost to completed units and units in process - Activity-based costing systems. **(8)**

TOTAL : 45

TEXT BOOKS

1. *M.Y. Khan & P.K. Jain, Management Accounting, Tata McGraw Hill, 2011.*
2. *R. Narayanaswamy, Financial Accounting - A managerial perspective, PHI Learning, New Delhi, 2011.*

REFERENCE BOOKS

1. *C.T. Horngren, Accounting for Management Control: An Introduction, Prentice Hall, New Delhi*
2. *J. H. Rossell, W.W. Frasure and D.H. Taylor, Managerial Accounting, 3rd ed., Merrill, Columbus.*
3. *Prasanna Chandra: Managers Guide to Finance and Accounting, Tata McGraw Hill.*
4. *R. Balakrishanan, K. Sivaramakrishnan and G. Sprinkle, Managerial Accounting, John Wiley & Sons, Inc., First Edition, 2009.*
5. *Dr. S.N. Maheshwari, "Principles of Management Accounting Vol I and II", S. Chand & Company Ltd, Seventeenth Revised Edition 2012*
6. *I M Pandey "Financial Management", 10th Edition Vikas Publishing House Pvt. Ltd.*
7. *Sharma R K, Shashi K Gutpa, "Management Accounting and Financial Management", Kalyani Publishers, 1996.*

16MDSE14 - BUSINESS ECONOMICS

L	T	P	C
3	0	0	3

PRE-REQUISITES
Consent of the Instructor

ASSESSMENT : THEORY

COURSE OUTCOME

- *Evaluate the Concepts of economics in the managerial decision making process.*
- *Analyse the production and cost function to maximise profit and minimise cost.*
- *Assess the basics of market structures in the business environment.*
- *Enumerate the GDP and assess its impact on the economic policy.*
- *Develop the micro and macro economic approaches in business decisions.*

PRINCIPLES OF ECONOMICS

Decisions, Interaction, Economy as a Whole Works. **Economist as Scientist :** Scientific Method, Assumptions, Economic Model, Microeconomics and Macroeconomics. **Economist as policy advisor :** Positive Vs Normative analysis, Economists disagree in scientific judgment. **Values :** Perception Vs Reality. **(9)**

THE MARKET FORCES OF SUPPLY AND DEMAND

Market and Competition, Demand, Supply, Supply and Demand Equilibrium. **Elasticity and Its Application :** Elasticity of Demand, Elasticity of Supply, Applications of Elasticity of demand and supply. **(9)**

PRODUCTION AND COSTS

Production function, Types of costs, costs in short run and in the long run. **Firm and market structure :** Competitive Markets, Monopolistic Competition, Oligopoly and Monopoly. **(9)**

MONETARY SYSTEM

Functions of Money, Kinds of Money, Banks and the Money Supply. **Money Growth and Inflation :** Classical Theory of Inflation, Costs of Inflation. **Measuring a Nation's Income :** Economic Income and Expenditure, Gross Domestic Product, Components of GDP, Real versus Nominal GDP. **(9)**

AGGREGATE DEMAND AND AGGREGATE SUPPLY

Key Facts about Economic Fluctuations, Explaining Short-Run Economic Fluctuations, Aggregate-Demand Curve, Aggregate-Supply Curve, Causes of Economic Fluctuations. **Influence of Monetary and Fiscal Policy on Aggregate Demand:** Monetary Policy Influences, Fiscal Policy Influences and Using Policy to Stabilize the Economy. **(9)**

TOTAL : 45 HOURS

REFERENCE BOOKS

1. *N. Gregory Mankiw, 2012, Principles of Macroeconomics, 6th Edition, South-Western Cengage Learning, USA.*
2. *N.Gregory Mankiw, 2012, Principles of Microeconomics, 7th Edition, Cengage Learning, Stamford, USA.*
3. *Varshney R.L & Maheshwari.K.L, 2013, Managerial Economics. Sultan Chand & Sons, New Delhi.*
4. *Mehta P.L, 2008, Managerial Economics, Sultan Chand & Sons: New Delhi.*

16MDSE15 - PARALLEL AND DISTRIBUTED COMPUTING

L	T	P	C
3	0	0	3

PRE-REQUISITES

16MDS33, 16MDS34, 16MDS44

ASSESSMENT : THEORY

COURSE OUTCOME

- *Describe different parallel architectures; inter-connect networks, programming models, and algorithms for common operations such as matrix-vector multiplication.*
- *Given a problem, develop an efficient parallel algorithm to solve it.*
- *Given a parallel algorithm, an input to it, and the number of processors, show the steps performed by that algorithm on that input.*
- *Given a parallel algorithm, develop message-passing parallel programs with MPI.*
- *Design distributed system using appropriate communication protocols, synchronization mechanisms and NFS.*

INTRODUCTION TO PARALLEL COMPUTING

Scope of Parallel Computing - Parallel Programming Platforms - Implicit Parallelism - Limitations of Memory System Performance - Control Structure of Parallel Platforms - Communication Model of Parallel Platforms - Physical Organization of Parallel Platforms - Communication Costs in Parallel Machines - Impact of Process - Processor Mapping and Mapping Techniques. **(8)**

PARALLEL ALGORITHM DESIGN

Preliminaries - Decomposition Techniques - Characteristics of Tasks and Interactions - Mapping Techniques for Load Balancing - Methods for Containing Interaction Overheads - Parallel Algorithm Models - Basic Communication Operations - One-to-All Broadcast and All-to-One Reduction - All-to-All Broadcast and Reduction - All-Reduce and Prefix Sum Operations - Scatter and Gather - All-to-All Personalized Communication- Circular Shift - Improving the Speed of some Communication Operations. **(8)**

PROGRAMMING USING MESSAGE PASSING AND SHARED ADDRESS SPACE

Principles of Message Passing Programming - Building Blocks - Send and Receive Operations - MPI - Message Passing Interface - Topologies and Embedding - Overlapping Communication with Computation - Collective Communication and Computation Operations - Groups and Communicators - POSIX thread API **(8)**

DISTRIBUTED COMPUTING

Introduction - Definition, Goals, Hardware concepts, Software concepts, Client-Server model. Communication - Layered Protocols- Remote Procedure Call- Remote Object Invocation- Java RMI- Distributed Objects- The Roles of Client and Server, Remote Method Calls, Message-Oriented Communication, Stream-Oriented Communication. **(8)**

PROCESSES AND SYNCHRONIZATION

Processess-Threads, Synchronization- Clock synchronization, Logical clocks. **(8)**

CASE STUDY

Sun Network File System - Distributed object based system: CORBA. **(5)**

TOTAL : 45

TEXT BOOKS

1. *Ananth Grama, Anshul Gupta, George Karypis and Vipin Kumar, Introduction to Parallel Computing, Second Edition, Pearson Education, 2009.*
2. *Andrew S. Tanenbaum, Maarten van Steen, "Distributed Systems - Principles and Paradigms", Prentice Hall of India, 2007.*

REFERENCE BOOKS

1. *Michael Quinn, "Parallel Computing - Theory and Practice", Second Edition, Tata McGraw Hill, 2002.*
2. *Norman Matloff, "Parallel Computing for Data Science - With Examples in R, C++ and CUDA", Chapman and Hall/CRC, 2015.*
3. *Wan Fokkink, "Distributed Algorithms: An Intuitive Approach", MIT Press, 2013.*
4. *M.L. Liu, "Distributed Computing - Principles and Applications", First Edition, Pearson Education, 2011.*

16MDSE16 - CLOUD COMPUTING

L	T	P	C
3	0	0	3

PRE-REQUISITES

16MDS33, 16MDS34, 16MDS35, 16MDS44

ASSESSMENT : THEORY

COURSE OUTCOME

- *Understand the basics of Cloud and its models.*
- *Understand about virtualization technology.*
- *Know to protect and manage cloud data.*
- *Design and Code Cloud based Applications.*

INTRODUCTION

Cloud Computing Defined, The SPI framework for Cloud Computing, The Traditional Software Model, The Cloud Services Delivery Model, Cloud Deployment Models, Key Drivers to Adopting the Cloud, The Impact of Cloud Computing on users, Governance in the Cloud, Barriers to Cloud Computing Adoption in the Enterprise. **(7)**

CLOUD SERVICES

Understanding the Multitenant Nature of SaaS Solutions, Understanding SOA. Platform as aService (PaaS)-IT Evolution Leading to the Cloud, Benefits of Paas Solutions, Disadvantages of Paas Solutions. Infrastructure as a Service (Iaas)-Understanding IaaS, improving performance through Load Balancing, System and Storage Redundancy, Utilizing Cloud-Based NAS Devices, Advantages, Server Types. Identity as a service (IDAAS) - Understanding Single Sign-On(SSO), OpenID, Mobile ID Management. Cloud Data Storage. **(12)**

VIRTUALIZATION

Understanding Virtualization, History, Leveraging Blade Servers, Server Virtualization, Desktop Virtualization, Virtual Networks, Data Storage Virtualization. **(7)**

SECURING THE CLOUD

General Security Advantages of Cloud-Based Solutions, Introducing Business Continuity and Disaster Recovery. Disaster Recovery- Understanding the Threats. Service Oriented Architecture-Understanding SOA, Web Services Are Not Web Pages, Understanding Web Service Performance, Reuse and Interoperability. **(7)**

MANAGING THE CLOUD

Migrating to the Cloud, Governing the Cloud, Designing Cloud Based Solutions, Coding Cloud Based Applications. **(12)**

TOTAL : 45

TEXT BOOKS

1. *Tim Mather, Subra Kumaraswamy and Shahed Latif, "Cloud Security and Privacy", O'Reilly Media, Inc, 2010.*
2. *Kris Jamsa, Cloud Computing: SaaS, PaaS, IaaS, Virtualization, Security and more.*

REFERENCES BOOKS

1. *Barrie Sosinsky, "Cloud Computing Bible", Wiley Publishing, 2011.*
2. *Michael Miller, "Cloud computing", Pearson Education, New Delhi, 2011.*
3. *Anthony T Velte, Toby J Velte and Robert Elsenpeter, "Cloud Computing - A Practical Approach", Tata McGraw Hill, New Delhi, 2010.*

16MDSE17 - MOBILE COMPUTING

L	T	P	C
3	0	0	3

PRE-REQUISITES
16MDS44

ASSESSMENT : THEORY

COURSE OUTCOME

- *Identify basic problems, limitations, and strengths of various wireless technologies.*
- *Differentiate roles of the protocols at various layers of WLAN protocol stack from that of wired LAN stack.*
- *Illustrate roles of the protocols and architectural components employed in cellular networks.*
- *Justify need to modify the existing Internet and Transport layer protocols to support mobility.*

INTRODUCTION

Vision of Next generation Mobile computing - Challenges. Layer 1 and 2: Wireless Communication: Frequency Spectrum - Signal propagation - Modulation - Multiplexing - Spread Spectrum Medium Access Control: Motivation for a specialized MAC - Accessing the medium: SDMA - FDMA - TDMA- CDMA. **(9)**

WIRELESS TECHNOLOGIES

GSM : Services - Architecture - Radio interface - Protocols - Localization - Handover - Security - Data Services - 3G Cellular System: UMTS. **(9)**

WIRELESS LAN TECHNOLOGIES

Infrastructure and ad-hoc networks - IEEE 802.11: Architecture - Physical Layer - MAC layer - MAC Management - Newer developments- Security in wireless LAN. Bluetooth: Architecture - Protocols - Security. **(9)**

HIGHER LAYERS

Mobile Network Layer: Mobile IP - Dynamic host configuration Protocol - Mobile ad-hoc networks - Ad-hoc network security. Mobile Transport Layer: Traditional TCP -Classical TCP Improvements to support mobility- TCP over 2.5G/3G wireless Networks. **(9)**

MOBILE APPLICATION DEVELOPMENT

Mobile hardware - Software Platforms - Comparison of software platforms - Mobile development supporting tools-Mobile Application Challenges: Location Aware mobile computing - Mobile Messaging. **(9)**

TOTAL : 45

TEXT BOOKS

1. *Jochen Schiller, "Mobile Communications", Addison-Wesley, 2004.*
2. *Pei Zheng and Lionel Ni, "Smart Phone and Next Generation Mobile Computing", Elsevier Inc, 2006. (para 5).*

REFERENCE BOOK

1. *Asoke K Talukder and Roopa R Yavagal, "Mobile computing: technology, applications, and service creation", Tata McGraw Hill, 2005.*
2. *Raj Kamal, Mobile Computing, Oxford university press, 2nd edition, 2012.*

16MDSE18 - GPU COMPUTING

L	T	P	C
3	0	0	3

PRE-REQUISITES

Consent of the Instructor

ASSESSMENT : THEORY

COURSE OUTCOME

- *Describe the architecture of Modern GPUs for parallel Programming.*
- *Demonstrate parallel applications using OpenACC, CUDA programming Model,OpenCL Programming Model for matrix applications.*
- *Apply appropriate CUDA threading Models in constructing Parallel Applications.*
- *Analyze the performance of the CUDA applications and OpenCL applications with different memory types and threading models.*
- *Estimate the speed-up that could be achieved by parallel code using tools and techniques that are available for CUDA code and OpenCL code.*

INTRODUCTION

GPU as parallel computers, Architecture of Modern GPUs, Motivation, Parallel programming Models - OpenACC, CUDA, OpenCL **(10)**

OpenACC

Introduction, Memory Model, Execution Model, Basic OPenACC programs **(5)**

BASICS OF CUDA

CUDA Program structure, Example - Matrix-Matrix Multiplication, Device Memories and Data Transfer, Kernel Functions and Threading. **(10)**

CUDA THREAD ORGANIZATION

Using BlockIdx and ThreadIdx, Synchronization and Transparent Scalability, Thread Assignment, Thread Scheduling and Latency Tolerance. **(10)**

CUDA MEMORY

Memory Hierarchy, Strategy for reducing global memory traffic, Memory as a limiting factor to parallelism. Efficiently using GPU memory- Techniques to increase Parallelism **(10)**

TOTAL : 45

TEXT BOOKS

1. *David. B. Krik and Wen-Mei W. Hwu, "Programming Massively parallel processors- A Hands on Approach", Second Edition, Margan and Kaufmann Publishers, 2010.*
2. *Anath Grama, Anshul Gupta, George Karypis and Vipin Kumar, "Introduction to Parallel Computing" Second Edition, Pearson Education, 2003.*
3. *Michael J Quinn, " Parallel Programming in C and OpenMP", Tata McGraw-Hill Edition, 2003.*
4. *Rob Farber, "Parallel Programming with OpenACC",First Edition,Morgan Kaufman, 2016*
5. *Rob Farber,"CUDA Application Design and Development", Morgan Kaufman, 2011.*
6. *Jason Sanders and Edward Kandrot, "CUDA BY EXAMPLE- An introduction to General Purpose GPU Programming", Addison-Wesley, 2010*
7. *OpenCL Programming Guide for the CUDA Architecture, Version 3.2, 2010.*

16MDSE19 - CLOUD SECURITY AND PRIVACY

L	T	P	C
3	0	0	3

PRE-REQUISITES
16MDS64, 16MDS82

ASSESSMENT : THEORY

COURSE OUTCOME

- *To provide an overview on cloud computing and its models.*
- *To understand cloud architecture.*
- *To focus on security, privacy and auditing of cloud-based services.*

INTRODUCTION

Cloud Computing Defined, The SPI framework for Cloud Computing, The Traditional Software Model, The Cloud Services Delivery Model, Cloud Deployment Models, Key Drivers to Adopting the Cloud, The Impact of Cloud Computing on users, Governance in the Cloud, Barriers to Cloud Computing Adoption in the Enterprise. **(9)**

INFRASTRUCTURE SECURITY

Infrastructure Security: The Network Level-The Host Level, the Application Level. Data Security and Storage - Aspects of Data Security, Data Security Mitigation, Provider Data and its Security. **(9)**

IDENTITY AND ACCESS MANAGEMENT

Trust Boundaries and IAM, IAM Challenges, Definitions, Architecture and Practice, IAM Standards and Protocols for Cloud Services, Cloud Authorization Management. **(9)**

SECURITY MANAGEMENT IN THE CLOUD

Security Management Standards, Security Management in the Cloud, Availability Management: SaaS, PaaS, IasS, Access Control, Security Vulnerability. Privacy- Privacy, Data Life Cycle, Key Privacy concerns in the Cloud, Protecting Privacy, Privacy Risk Management, Laws and Regulations. **(9)**

AUDIT AND COMPLIANCE

Internal Policy Compliance, Governance, Risk, and Compliance (GRC), Illustrative Control Objectives for Cloud Computing, Incremental CSP-Specific Control Objectives, Additional Key Management Control Objectives, Control Considerations for CSP Users, Regulatory/External Compliance, Other Requirements, Cloud Security Alliance, Auditing the Cloud for Compliance. **(9)**

TOTAL : 45

TEXT BOOK

1. *Tim Mather, Subra Kumaraswamy and Shahed Latif, "Cloud Security and Privacy", O'Reilly Media, Inc, 2010.*

REFERENCES

1. *Kris Jamsa, Cloud Computing: SaaS, PaaS, IaaS, Virtualization, Security and more.*
2. *Barrie Sosinsky, "Cloud Computing Bible", Wiley Publishing, 2011.*
3. *Anthony T Velte, Toby J Velte and Robert Elsenpeter, "Cloud Computing - A Practical Approach", Tata McGraw Hill, New Delhi, 2010.*

16MDSE20 - DATA CENTRIC COMPUTING

L	T	P	C
3	0	0	3

PRE-REQUISITES

16MDS53, 16MDS64, 16MDSPE16

ASSESSMENT : THEORY

COURSE OUTCOME

- *To understand the importance of Data-Intensive Computing and the need for Parallel Computing.*
- *To provide knowledge on Data-Intensive architecture and techniques.*
- *To learn security in Data-Intensive Computing.*

DATA-INTENSIVE COMPUTING - INTRODUCTION

A Challenge for the 21st century - Characterizing Data-Intensive Applications - Anatomy of Data-Intensive Computing Applications. **(8)**

DATA-INTENSIVE COMPUTING ARCHITECTURE

Hardware Architectures - Data Management Architecture - Overview of Cloud Computing - Large-scale Data Management Techniques in Cloud Computing Platform - Data-Intensive applications with MapReduce, High Performance Network Architecture for Data-Intensive Computing. **(9)**

DATA-INTENSIVE SOFTWARE SYSTEMS

Architecting Data-Intensive Computing Software systems - ECL/HPCC: A unified approach to Big Data - Scalable Storage for Data-Intensive Computing. **(9)**

TECHNOLOGIES AND TECHNIQUES

Load Balancing Techniques for Data-Intensive Computing - Parallel Processing, Multiprocessors and Virtualization in Data-Intensive Computing. **(9)**

SECURITY IN DATA-INTENSIVE COMPUTING

Security in Data-Intensive Computing systems - Data Security and Privacy in Data-Intensive Computing clusters - Information Security in large scale distributed systems - Privacy and Security requirements of Data-Intensive Computing Clouds. **(10)**

TOTAL : 45

TEXT BOOKS

1. *Ian Gorton, Deborah K. Gracio, "Data-Intensive Computing - Architectures, Algorithms and Applications", Cambridge University Press, 2013.*
2. *BorhoFurht, Armando Escalante, "Handbook of Data-Intensive Computing", Springer*

REFERENCE BOOK

1. *Frederic Magoules, Jie Pan, FeiTeng, "Cloud Computing - Data-Intensive Computing and Scheduling", CRC Press, Taylor & Francis Group*

16MDSE21 - EMBEDDED SYSTEMS

L	T	P	C
3	0	0	3

PRE-REQUISITES
16MDS15, 16MDS34

ASSESSMENT : THEORY

COURSE OUTCOME

- *To identify the functions of an embedded systems.*
- *To build and configure embedded system models.*
- *To identify factors that influence purchasing decisions.*

INTRODUCTION TO EMBEDDED SYSTEMS

Microprocessors vs Microcontrollers - RISC vs CISC - Embedded System: Definition - Software and Hardware Units of Embedded System - Examples - Introduction to INTEL 8051 Microcontroller - 8051 Architecture: CPU, Oscillator, On Chip RAM and ROM, Timers, Interrupts, IO and Serial ports, Registers and SFRs. **(9)**

MICROCONTROLLER PROGRAMMING TECHNIQUES

8051 Addressing Modes - Instruction Set: Arithmetic, Logical and Branching Instructions - 8051 Programming techniques: Timer, IO, Interrupt and Serial port programming models. **(10)**

INTER PROCESS COMMUNICATION

Device Drivers and Interrupt Servicing Mechanism - Program Modeling Concepts in Single and Multiprocessor Systems - IPC and Synchronization of Processes, Tasks and Threads. **(9)**

REAL TIME OPERATING SYSTEM

Operating System Vs Real Time Operating System - RTOS: Definition - Services - Process Management - Memory Management - Device Management - Interrupt Routines in RTOS Environment - RTOS Task Scheduling Models - Interrupt Latency and Response Time of Tasks. **(9)**

SOFTWARE AND HARDWARE TOOLS

Embedded Software Development Tools - Debugging Techniques - Real Time Examples. **(8)**

TOTAL : 45

TEXT BOOKS

1. *Rajkamal, "Embedded Systems Architecture, Programming and Design", TATA McGraw-Hill, First reprint Oct. 2003*
2. *Muhammad Ali Mazidi, Rolin McKinlay, Janice Gillispie Mazidi,"The 8051 Microcontroller and Embedded Systems Using Assembly and C" 2 Edition, Pearson, 2007.*

REFERENCE BOOKS

1. *David E Simon, "An Embedded Software Primer", Pearson Education Asia, First Indian Reprint, 2000*
2. *Kenneth J Ayala, "The 8051 Microcontroller Architecture, Programming and Applications", Second Edition, Thomson Delmar Learning, 2006*

16MDSE22 - INTERNET OF THINGS

L	T	P	C
3	0	0	3

PRE-REQUISITES
16MDS44

ASSESSMENT : THEORY

COURSE OUTCOME

- *Recognize the challenges for smart object.*
- *Given an application, assess the different IoT technologies that suits the application.*
- *Demonstrate knowledge of MAC and routing protocols developed for Low Power and Lossy networks.*
- *Design simple IoT systems comprising sensors, edge devices, wireless network connections and data analytics capabilities.*
- *Demonstrate knowledge of main architectures and paradigms for the Internet of Things.*

INTRODUCTION

Smart Objects - Challenges for Smart Objects - IP for Smart Objects: motivation and main challenges - Security for Smart objects - Web services for Smart Objects - Connectivity models for Smart Object Networks - Introduction to the Internet of Things: application scenarios, current solutions. **(9)**

SMART OBJECTS AND LLNS

Hardware and Software - Energy Management - Communication for Smart Objects: IEEE 802.15.4: main features, topologies, addressing and MAC frame format - Low Power and Lossy Networks (LLN): Introduction to 6LoWPAN - 6LoWPAN architecture: simple, extended and ad-hoc networks - 6LoWPAN adaptation layer -Issues in determining IPv6 links in LLNs - IPv6 addressing in 6LoWPAN- 6LoWPAN forwarding: route-over and mesh - under approaches - Neighbour Discovery optimizations and extensions to the ND protocol for 6LoWPAN networks. **(11)**

ROUTING IN LOW POWER AND LOSSY NETWORKS

Mesh-under and route-over solutions - Routing Requirements - Routing metrics - The IPv6 Routing Protocol for LLNs (RPL)- Protocol operation - use of destination oriented directed acyclic graphs - DODAG formation - RPL Messages. **(9)**

CoAP

Interaction model - Messages and Request/Response Model - Resource observing - Service discovery - Resource discovery - CORE Link Format. **(9)**

APPLICATIONS

Smart Cities and Urban automation - Home Automation - Building Automation - Structural Health Monitoring. **(7)**

TOTAL : 45

TEXT BOOK

1. *J.-P. Vasseur, A. Dunkels, "Interconnecting Smart Objects with IP: The Next Internet", Morgan Kaufmann, 2010.*

REFERENCE BOOKS

1. *Z. Shelby, C, "Bormann. 6LoWPAN: The Wireless Embedded Internet", Wiley, 2009.*
2. *Z. Sahelby, K. Hartke, K. Hartke, "The Constrained Application Protocol (CoAP)", RFC 7252, 2014.*

16MDSE23 - HUMAN COMPUTER INTERACTION

L	T	P	C
3	0	0	3

PRE-REQUISITES
Consent of the Instructor

ASSESSMENT : THEORY

COURSE OUTCOME

The student should be made to:

- *Learn the foundations of Human Computer Interaction.*
- *Be familiar with the design technologies for individuals and persons with disabilities.*
- *Be aware of mobile HCI.*
- *Learn the guidelines for user interface.*

FOUNDATIONS OF HCI

The Human: I/O channels - Memory - Reasoning and problem solving; The computer: Devices - Memory - processing and networks; Interaction: Models - frameworks - Ergonomics - styles - elements - interactivity- Paradigms. **(9)**

DESIGN & SOFTWARE PROCESS

Interactive Design basics - process - scenarios - navigation - screen design - Iteration and prototyping. HCI in software process - software life cycle - usability engineering - Prototyping in practice - design rationale. Design rules - principles, standards, guidelines, rules. Evaluation Techniques - Universal Design. **(9)**

MODELS AND THEORIES

Cognitive models -Socio-Organizational issues and stake holder requirements -Communication and collaboration models-Hypertext, Multimedia and WWW. **(9)**

MOBILE HCI

Mobile Ecosystem: Platforms, Application frameworks- Types of Mobile Applications: Widgets, Applications, Games- Mobile Information Architecture, Mobile 2.0, Mobile Design: Elements of Mobile Design, Tools. **(9)**

WEB INTERFACE DESIGN

Designing Web Interfaces - Drag & Drop, Direct Selection, Contextual Tools, Overlays, Inlays and Virtual Pages, Process Flow. Case Studies. **(9)**

TOTAL: 45

TEXT BOOKS

1. *Alan Dix, Janet Finlay, Gregory Abowd, Russell Beale, "Human Computer Interaction", 3rd Edition, Pearson Education, 2004.*
2. *Brian Fling, "Mobile Design and Development", First Edition ,O'Reilly Media Inc., 2009.*
3. *Bill Scott and Theresa Neil, "Designing Web Interfaces", First Edition, O'Reilly, 2009.*

16MDSE24 - ENTERPRISE COMPUTING

L	T	P	C
3	0	0	3

PRE-REQUISITES
16MDS48

ASSESSMENT : THEORY

COURSE OUTCOME

- *Describe the role of Component Technologies in developing reusable and easy accessible enterprise application.*
- *Develop the client applications (browser / Java client) using J2EE platform by analyzing the requirements of the given system.*
- *Design and Develop the web tier components of an enterprise application using Servlet.*
- *Construct the application components includes Process and Data components using Enterprise Java Bean Technologies.*
- *Integrate the client, web and application components using web 2.0 to generate rich internet applications using J2E platform.*

INTRODUCTION

Challenges of Enterprise Application Development - The Platform for Enterprise Solutions - Enterprise Application Scenario - J2EE platform Technologies: Component Technologies, Platform Roles, Platform Services, Service Technologies, Communication Technologies - Java Database Connectivity Framework - Java Naming and Directory Interface. **(9)**

THE CLIENT TIER

Client Considerations - Design Issues and Guidelines for Browser Clients - Design Issues and Guidelines for Java Clients.**The Web Tier:** Web Tier Technologies - Web Tier Application Structure - Web Tier Application Framework Design - Programming Servlets. **(10)**

THE ENTERPRISE JAVA BEAN TIER

Business Logic and Business Objects - Enterprise Beans as J2EE Business Objects - Remote and Local Client Views - Entity Beans - Session Beans - Message Driven Beans - Design Guidelines - Portability - Guidelines - Programming Enterprise Java Beans. **(10)**

INTEGRATING WITH THE ENTERPRISE INFORMATION SYSTEM TIER

Integration Scenarios - J2EE Integration Technologies - Application Integration Design Approaches - Developing an Integration Layer- Packaging and Deployment: Roles and Tasks - Packaging J2EE Application - Deployment Description - Deployment Tools. **(6)**

USING WEB 2.0

Introduction to Web 2.0: Web 2.0 Definition - Web 2.0 Versions and Generations - Characteristics and Memes of Web 2.0.**User generated contents:** Wikis - Blogs - Communities - Collaborations and Collaborative Technologies.
Rich internet applications : Practices, Technologies and Frameworks - Content Aggregation, Syndication and Federations using RSS and Atom - Web 2.0 Architecture Case Studies. **(10)**

TOTAL : 45

TEXT BOOKS

1. *Sing.I, Stearns. B, Johnsons. M and The Enterprise Team, "Designing Enterprise Applications with the J2EE Platform", Addison Wesley, Boston, 2002.*
2. *Stephen Asbury and Scott R.Weiner, "Developing Java Enterprise Applications", Wiley Publications, Second Edition, Reprint, 2008.*
3. *Krishna Sankar and Susan A Bouchard, "Enterprise Web 2.0 Fundamentals", Cisco Press, First Edition, 2009.*

16MDSE25 - SOFTWARE ARCHITECTURE AND DESIGN PATTERNS

L	T	P	C
3	0	0	3

PRE-REQUISITES
16MDS45

ASSESSMENT : THEORY

COURSE OUTCOME

On Completion of the course, the students should be able to

- *Describe the various types of software patterns and their needs in software development.*
- *Apply design patterns to solve the issues in designing the objects.*
- *Design the software architectures using appropriate architectural patterns based on the quality attributes and documenting them.*

INTRODUCTION TO PATTERNS

Definition - Making a pattern - Pattern categories - Relationship between patterns - Patterns and software architecture. **(8)**

DESIGN PATTERNS

Introduction - Creational patterns - Structural patterns - Behavioral patterns - Case study. **(10)**

INTRODUCTION TO SOFTWARE ARCHITECTURE

Software architecture definition and needs. Introduction: Architectural patterns - Reference models - Reference architecture - Architectural structures and views. **(8)**

ARCHITECTURAL STYLES

Pipes and filters - Data abstraction and object oriented organization - Event based, Implicit invocation - Layered style - Repository - Interpreter - Process control - Distributed - Case study. **(9)**

THE ARCHITECTURAL BUSINESS CYCLE

Creating an architecture: Understanding quality attributes - Achieving qualities - Designing the architecture - Documenting the architecture - Case study. **(10)**

TOTAL : 45

TEXT BOOKS

1. *Frank Buschmann, Regine Meunier, Hans Rohnex, Peter Sommerland & Michael, "Pattern - Oriented Software Architecture - A Systems of Patterns Volume - I", 1996 (Reprint 2001) (Para - I).*
2. *Erich Gamma, Richard Helm, Ralph Johnson, John Vlissides, "Design Patterns - Elements of reusable Object Oriented Software", Pearson Education, 1999. (Para II).*
3. *Mary Shaw, David Garlan, "Software Architecture - Perspectives on an Emerging Discipline", PHI,1996 (Para IV).*
4. *Len Bass, Paul Clements, Rick Kazman, "Software Architecture in Practice", 2nd Edition, Pearson Education, First Indian Reprint, 2003. (Para III & V).*

16MDSEL1 - BUSINESS INTELLIGENCE LABORATORY

L	T	P	C
0	0	4	2

PRE-REQUISITES
16MDSE1

ASSESSMENT : PRACTICAL

COURSE OUTCOME

- *Design appropriate data warehouse model for a given decision making problem.*
- *Generate the different views of analyzed data.*
- *Develop a dashboard to present the analyzed data in a format that help the decision makers to do the prediction.*

LIST OF EXPERIMENTS

1. Create highly formatted templates, reports, and documents such as flash reports, checks, KPI and Score cards
2. Create BI dashboards and reports to turn insights into actions by providing the ability to invoke business processes
3. Design the analysis template to enable the business analyst to create new analyses from scratch or modify existing analyses
4. Present the analysed data using maps and spatial visualizations format
5. Generate a powerful, multi-step alert engine that can trigger workflows based on business events and notify stakeholders via their preferred medium and channel

16MDSEL2 - WEB MINING LABORATORY

L	T	P	C
0	0	4	2

PRE-REQUISITES
16MDSE2

ASSESSMENT : PRACTICAL

COURSE OUTCOME

- *Identify and differentiate between application areas for web content mining, web structure mining and web usage mining.*
- *Develop skills of using recent data mining s/w for solving practical problems of web mining.*
- *To apply the use of machine learning techniques for web content mining, the role of hyper links in web structure mining and the various aspects of web usage mining.*

WEB CONTENT MINING

1. Keyword based association analytics
2. Automatic document classification similarity detection
3. Cluster documents containing information from a common source
4. Sequence Analysis: predicting a recurring event
5. Trend Analysis: discovering trends
6. Anomaly detection: find information that violates usual patterns.
7. Discovery of frequent phrases
8. Text segmentation (into logical chunks)
9. Web Data Mining Query Language
    a. Covers
    b. Covered By
    c. Like
    d. Close To

WEB STRUCTURE MINING

10. Page Rank
11. Weighted Page Rank
12. Correlation Algorithm for Relevance Ranking
13. Improve structure of a sites web page

WEB USAGE MINING

14. Personalization
15. Determining frequent access behaviour of users
16. Aid in caching and prediction of future page references
17. Improve design of individual pages
18. Gathering Statistics

16MDSEL3 - IMAGE PROCESSING LABORATORY

L	T	P	C
0	0	4	2

PRE-REQUISITES
16MDSE7

ASSESSMENT : PRACTICAL

COURSE OUTCOME

- *Student can implement the image fundamentals and mathematical transforms necessary for image processing.*
- *Students can apply various enhancement and Filtering techniques.*
- *Students can execute various image segmentation techniques.*

LIST OF EXPERIMENTS

1. Display of Grayscale Images.
2. Histogram Equalization.
3. Filtering in frequency domain.
4. Display of color images.
5. Conversion between color spaces.
6. Non-linear Filtering.
7. Edge detection using Operators.
8. 2-D DFT and DCT.
9. DWT of images.
10. Segmentation using watershed transform.

16MDSEL4 - CLOUD COMPUTING LABORATORY

L	T	P	C
0	0	4	2

PRE-REQUISITES
16MDSE16

ASSESSMENT : PRACTICAL

COURSE OUTCOME

- *Demonstrate knowledge on creating, cloning, migrating virtual machines using VirtualBox, a virtualization tool.*
- *For a given system configuration, can use EC2 to acquire instances.*
- *Develop an application, launch it on Google App Engine, and access it with proper authentication mechanisms.*
- *Construct a private cloud using the open source cloud technologies such as OpenStack/CloudStack/OpenNebula for a given requirement.*
- *Develop applications and deploy in cloud container.*

I. VIRTUALIZATION - VIRTUAL BOX

1. Create virtual machines of different configurations
2. Communication between host and virtual machine
3. Communication between virtual machine to virtual machine
4. Show the virtual machine migration from one node to the other.

II. PRIVATE CLOUD

1. Use Eucalyptus or OpenStack or CloudStack or equivalent to set up the cloud and demonstrate:
2. Find procedure to run the virtual machine of different configuration. Check how many virtual machines can be utilized at particular time.
3. Find procedure to attach virtual block to the virtual machine and check whether it holds the data even after the release of the virtual machine.
4. Install a C compiler in the virtual machine and execute a sample program.
5. Show the virtual machine migration from one node to the other.
6. Find procedure to install storage controller and interact with it.

III. PUBLIC CLOUD

1. Explore Amazon S3 and EC2
2. Create virtual machines in Amazon, run a sample java application on the EC2 instance
3. Communicate between two EC2 instances
4. Run an application in the GoogleAppEngine
5. Working with cloud container

16MDSEL5- MOBILE APPLICATION DEVELOPMENT LABORATORY

L	T	P	C
0	0	4	2

PRE-REQUISITES
16MDSE17, 16MDS26

ASSESSMENT : PRACTICAL

COURSE OUTCOME

- *To apply mobile application models/architectures and patterns to the development of a mobile application.*
- *To design and develop sophisticated mobile user interfaces for the Android platform.*
- *To develop mobile applications for the Android operating system that use basic and advanced mobile features.*
- *To gain experience of working in a mobile environment and thus utilise the opportunities for commercial and/or social benefit.*

TOPICS TO BE COVERED IN THE TUTORIAL

Mobile devices vs. desktop devices - ARM and Intel architectures - Android Architectures - Native, hybrid and web applications HTML5 - Mobile-specific enhancements (touch interfaces, screen orientation, geolocation, etc) - Android APIs.
Students must be trained for

HTML5

Creation of fully functional HTML5 app

ANDROID

Building a basic UI-driven App
Creating Android services
Applications carrying out data management with SQLite3
Image manipulation
Proximity and Location services (Android NFC, Bluetooth, GoogleMaps)
Using PhoneGap to package HTML5 apps into native apps

16MDSEL6 - EMBEDDED SYSTEMS LABORATORY

L	T	P	C
0	0	4	2

PRE-REQUISITES

16MDSE21, 16MDS15, 16MDS34

ASSESSMENT : PRACTICAL

COURSE OUTCOME

- *To acquire knowledge about the fundamentals of embedded software and hardware.*
- *To familiarize in embedded system design concepts.*
- *To gain knowledge on Embedded system development.*

CONCEPTS TO BE COVERED

1. Programs to learn the instruction set of 8051.
2. Getting used to the IDE features such as debug, watch window, memory window.
3. Timers/ Counter usage.
4. Parallel ports usage.
5. Serial ports usage.
6. Understand the µ COS code.
7. Real- time Applications using semaphore, Message box.

16MDSEL7 - INTERNET OF THINGS LABORATORY

L	T	P	C
0	0	4	2

PRE-REQUISITES

Consent of the Instructor

ASSESSMENT : PRACTICAL

COURSE OUTCOME

- *For a given requirement, choose the required sensor and calibrate.*
- *Devise simple interface for connecting a chosen sensor to Galileo board.*
- *Develop software for Galileo board to interact with the sensor to meet the requirements.*
- *Develop software to interact(send/receive data) with Web/Application server located in the Internet.*
- *Use data analytics tool to analyze the data collected and present the report to the end user.*

THE STUDENTS MUST BE TRAINED FOR

1. Developing applications using Cooja, L simulator
2. Developing applications using Galileo board, exploiting all features of the board.

16MDSEL8 - ENTERPRISE APPLICATION DEVELOPMENT LABORATORY

L	T	P	C
0	0	4	2

PRE-REQUISITES
16MDSE24

ASSESSMENT : PRACTICAL

COURSE OUTCOME

- *Develop the client application using HTML or Java Server Page.*
- *Construct web components to process the client request and generate response in online using Java Servlet.*
- *Design and Develop reusable business logic using Session EJB framework.*
- *Generate persistent entities using Entity EJB frameworks.*
- *Construct web feed to improve the user accessibility of the web application using web 2.0 framework.*

THE FOLLOWING TO BE PRACTICED IN THE LAB SESSIONS

1. Understand and design the generic business process model of an enterprise.
2. Design and implement online business processing through Servlet components.
3. Develop reusable business logics using Session EJB components.
4. Develop persistent entity objects using Entity EJB components.
5. Improve the business through developing enterprise blogs.
6. Improve the user accessibility of the application by creating web feeds.

16MDSEL9 -PARALLEL AND DISTRIBUTED COMPUTING LABORATORY

L	T	P	C
0	0	4	2

PRE-REQUISITES
16MDSE15

ASSESSMENT : PRACTICAL

COURSE OUTCOME

- *Given a parallel algorithm, develop the system using MPI.*
- *Given a parallel code, diagnose the errors and fix them.*
- *Develop client/server based distributed applications.*

TO BE COVERED

1. Write a program that takes data from process zero and sends it to all of the other processes by sending it in a ring.
2. Write a program using MPI topology routines to find a good ordering of processes, particularly for simple linear orderings
3. Write a simple program to determine the value of pi using MPI Collective operations
4. Write a program to provide fair reception of message from all sending processes using Wait some
5. Write a program using MPI Send recv to make head to head data exchange with processors.
6. Implement a simple Jacobi iteration for approximating the solution to a linear system of equations.
7. Write a program using MPI collective operations to modify Jacabi Iteration so that the computed solution is collected onto process 0, which then writes the solution to standard output.
8. Write a program using MPI persistent operations - non blocking operations for both sending and receiving to handle the buffering issues.
9. Create Distributed application over the network using Client/Server software architecture and Request-Reply communication paradigm.