Master of Computer Application
Syllabus Structure

1st Semester:

Course	*Title of the Paper*	*Credits*			
		L	*T*	*P*	*Total*
MCA 101	Formal Language and Automata	2	1	1	4
MCA 102	Computer Programming and Problem Solving	2	1	1	4
MCA 103	Digital Design	2	1	1	4
MCA 104	Numerical Analysis and Statistical Techniques	2	1	1	4
Optional (any one)					
MCA 105	Accounting and Financial Management	2	1	1	4
MCA 106	Oral and Written Communication	2	1	1	4
MCA 107	Organizational Behaviour	2	1	1	4
Audit Course					
MCA 108	Discrete Mathematics	**(Audit Course)**			
Total Credit					**20**

2nd Semester:

Course	*Title of the Paper*	*Credits*			
		L	*T*	*P*	*Total*
MCA 201	Data and File Structures	2	1	1	4
MCA 202	Data Communication and Computer Network	2	1	1	4
MCA 203	Computer Organisation and Architecture	2	1	1	4
MCA 204	Object Oriented Programming and Design (Java)	2	1	1	4
Optional (any one)					
MCA 205	Optimization Techniques and Queuing Theory	2	1	1	4
MCA 206	Graph Theoretical Algorithm	2	1	1	4
MCA 207	Fuzzy Sets and Applications	2	1	1	4
Audit Course					
MCA 208	Computer Graphics and Multimedia	**(Audit Course)**			
Total Credit					**20**

3rd Semester:

Course	*Title of the Paper*	*Credits*			
		L	*T*	*P*	*Total*
MCA 301	Design and Analysis of Algorithm	2	1	1	4
MCA 302	Database Management System	2	1	1	4
MCA 303	Operating Systems	2	1	1	4
MCA 304	Software Engineering	2	1	1	4
Optional (any one)					
MCA 305	Introduction to Data Science	2	1	1	4
MCA 306	Cloud Computing	2	1	1	4
MCA 307	Cryptography and Internet Security	2	1	1	4
Audit Course					
MCA 308	Artificial Intelligence	**(Audit Course)**			
Total Credit					**20**

4th Semester:

Course	*Title of the Paper*	*Credits*			
		L	***T***	***P***	***Total***
MCA 401	Data Warehousing and Data Mining	2	1	1	4
MCA 402	Web Technology	2	1	1	4
Optional Course (any one)					
MCA 403	Image Processing and Pattern Classification	2	1	1	4
MCA 404	Scientific Writing using LateX	2	1	1	4
MCA 405	Python Programming	2	1	1	4
Project					
MCA 406	*Major Project*				*10*
Total Credit					**22**

Note:

i) ***In all the semesters the centre will offer the optional papers as per the availability of respective faculty members. Accordingly, the students will be equally distributed for each optional paper offered.***

ii) ***The result of the Audit course will be reflected in the grade sheet.***

Course No:	*Title of the Paper:*	*Credits*			
MCA 101	Formal Language and Automata	L: 2	T: 1	P: 1	Total: 4

Objective:

This course is designed with an objective to

- Identify different formal language classes and their relationships
- Design grammars and recognizers for different formal languages

Learning Outcome:

On completion of the course, students will be able to:

- Design automata, regular expressions and context-free grammars accepting or generating a certain language.
- Transform between equivalent deterministic and non-deterministic finite automata, and regular expressions.
- Simplify automata and context-free grammars.
- Determine if a certain word belongs to a language.

Total Marks: 100

(In Semester Evaluation –40 & End Semester Evaluation-60)

Unit I: Introductory Concept Topic **5 Marks**

Alphabets, Languages, Grammars.

Unit II : Finite Automata (Deterministic and Nondeterministic) **10 Marks**

Equivalence of DFA's and NDFA's, conversion, automata with ε - transition, Moore and Mealy machines, properties of regular sets, minimization of finite automata

Unit III: Regular Grammar **15 Marks**

Regular expressions, regular languages, regular expression and equivalence to FA, Algebraic laws for regular expressions Pumping Lemma and applications push down automata and context free languages, properties of context free languages.

Unit IV: Context Free Language **10 Marks**

context-free grammars and languages , parsing (or derivation) and parse trees, ambiguity of grammar and language, pushdown automaton (PDA), equivalence between CFG and PDA , normal form of CFG

Unit V: Context Sensitive Language **5 Marks**

Context sensitive languages, linear bound automata

Unit V: Turing Machines **15 Marks**

Turing hypothesis, Turning compatibility, Turing machines as a transducer, recognizer and acceptors, Variations of tuning machines – non-deterministic, multiple tape, two-way infinite tape,

multidimensional, multihead. Universal turning machines, recursively enumerable languages, Undecidable problems.

Text Books:

1. Linz P., "An Introduction to Formal Language and Automata", Jones and Bartlett Publishers, Inc., USA, 2011.
2. MishraK. L. P., "Theory of Computer Science: Automata, Languages and Computation" PHI, 3rd Edition, 2009.

Reference Books:

1. Nagpal C. K, "Formal Languages And Automata Theory" ,OXFORD UNIVERSITY PRESS, 2011
2. Hopcroft, John E.; Motwani, Rajeev; Ullman, Jeffrey D, "Introduction to Automata Theory, Language and Computation", Addison –WEISLEY, 3rd edition, 2013.

Discussion

- Finite Automata
- Regular Language and Expression
- Context free Grammar, Push Down Automata (PDA) and Turing Machines

Practical

Total Marks: 50

(In Semester Evaluation –20 & End Semester Evaluation-30)

(Practical will be as per the content of the paper)

Course No:	*Title of the Paper:*	*Credits*			
MCA 102	Computer Programming and Problem Solving	L: 2	T: 1	P: 1	Total: 4

Objective:

This course is designed with an objective to

- Describe the fundamentals of C programming language.
- Demonstrate C coding.
- Explain the skills for problem solving.

Learning Outcome:

On completion of the course, students will be able to:

- Solve problems through simple C programs.
- Develop advance C program to solve real life problems.
- Analyze the basics of graphics programming.

Total Marks: 100

(In Semester Evaluation –40 & End Semester Evaluation-60)

Unit I: C fundamentals **10 Marks**

C fundamentals, variables, data types, operator & expression, console I/O, Conditional Statements, Control statements, The C preprocessor.

Unit II: Array and String **15 Marks**

Defining an array, array initialization, processing an array, passing array to a function, multidimensional array, string functions.

Unit III: Function and Pointers **15 Marks**

Overview of a function, defining a function, accessing a function, function prototypes, call by value, call by reference, recursion, Storage classes, other functions (sqrt(), exit(), malloc(), free()).

Pointer declarations, passing pointer to a function, pointer and one dimensional array, Operation on pointers, pointers and multidimensional arrays, array of pointers, pointers to functions, function returning pointers, Command-line parameters.

Unit IV: Structures and Unions **10 Marks**

Structures, Declaration and Initializing Structure, Accessing Structure members, Structure Assignments, Arrays of Structure, Passing Structure to function, Structure Pointer, Unions.

Unit V: File **10 Marks**

Defining and opening a file, closing a file, input/output operations on files, error handling during I/O operations, random access files, command line arguments, programming examples. Dynamic Memory Allocation: Dynamic memory allocation, allocating a block of memory: malloc, allocating multiple blocks of memory: calloc, releasing the used space: Free, altering the size of a block: realloc, programming examples.

Text Books:

1. Kanetkar Y., "*Let Us C*", BPB Publications; 14th edition, 2016
2. Balagurusamy, E. '*Programming in ANSI C*', McGraw Hill Education (India), 6th Edition, 2012
3. Griffiths, D., '*Head First C*", Shroff/O'Reilly,' First edition, 2012.

Reference Books:

1. Kernighan, Brian W., Ritchie, Dennis M., '*The C Programming Language*",' PHI, 2nd edition.
2. Herbert, S., "*C: the Complete Reference"*, McGraw Hill Education; 4th edition.
3. Gottfried, Byron S., '*Theory and Problems of Programming with C*', Tata McGraw Hill Publication

Practical

Total Marks: 50

(In Semester Evaluation –20 & End Semester Evaluation-30)

(Practical will be as per the content of the paper)

Course No:	*Title of the Paper:*	*Credits*			
MCA 103	Digital Design	L: 2	T: 1	P: 1	Total: 4

Objective:

The course is designed with an objective to

- Represent and manipulate decimal numbers in different coding systems.
- Introduce several levels of digital systems from simple logic circuits to programmable logic devices and hardware description language, analysis and design.

Learning Outcome:

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

- Construct logic circuits using logic gates.
- Design both combinational and sequential circuits.
- Identify, formulate and implement problems of digital logic.

Total Marks: 100

(In Semester Evaluation –40 & End Semester Evaluation –60)

Unit I: Representation of Information: 10 Marks

Number System: Binary, Octal, Hexadecimal, Positive and Negative Number, 1's and 2's complement, Arithmetic Operations: Addition, Subtraction, etc. Character codes: ASCII and BCD. Error detection and correction, parity codes and Hamming codes.

Unit II: Logic Design 10 Marks

Logic Gates and their characteristics, Boolean Algebra, Boolean variables and functions- canonical and standard forms, minimization of Boolean functions – Karnaugh Map.

Unit III: Combinational and Sequential Design: 20 Marks

Implementation of Boolean function and logic gates, concept of combinational design-Adder, Subtractor, Multiplexer, decoders, encoders, simple arithmetic and logic circuits.

Concept of latch, Clock, Study of Flip-Flop- S-R, J-K, D,T. Counters- synchronous and asynchronous, Modes of counter, registers.

Unit IV: Memory and Programmable logic Design 10 Marks

PLA, PAL, FPGA concept and volatility.

Unit V: Basic CPU Organization : 10 Marks

Simple functional block diagram of a CPU, instruction execution process, Memory Units**,** Access time and cost considerations: random access, serial access, direct access.

Text Books:

1. Morris M. M., "*Digital Logic and Computer Design*", Pearson ,2004
2. Morris M. M., Cillet M. D."*Digital Design*", Pearson, 5th edition, 2013.

Reference Books:

1. WakerlyJ.F.,"*Digital Design: Principles And Practices*",Pearson,4th Edition,2008

2. SalivahananS,Arivazhagan S., "*Digital Circuits and Design*", VIKAS Publishing House PVT LTD,4th Edition,2012.
3. Hamacher V.C. Vranestic Z.G, Zaky,S.G. "*Computer Organization"*, McGraw-Hill, 5th edition, 2011.

Discussion:

Emphasis should be given to

- Logic circuits.
- Characteristics and functions of different electronics components.
- Simple mentioning of the fundamentals of memory units.

Practical

Total Marks: 50

(In Semester Evaluation –20 & End Semester Evaluation-30)

(Practical will be as per the content of the paper)

Course No:	*Title of the Paper:*	*Credits*			
MCA 104	Numerical Analysis and Statistical Techniques	L: 2	T: 1	P : 1	Total: 4

Objective:

This course is designed with an objective to

- Discuss different methods of Numerical Analysis.
- Explain different statistical methods and techniques.

Learning Outcome:

On completion of the course, students will be able to:

- Apply different numerical methods in practical problems.
- Use and apply various statistical techniques in real life problems.
- Write computer programs on different numerical and statistical techniques.
- Create software on different numerical and statistical techniques.

Total Marks: 100

(In Semester Evaluation –40 & End Semester Evaluation –60)

Unit I: Interpolation **12 Marks**

Interpolation : Interpolation with equal intervals – Newton's forward and backward interpolation formula, use of operators Δ and E in polynomial interpolation, interpolation with unequal intervals – relation between divided differences and simple differences, Newton's general divided difference formula, and Lagrange's interpolation formula.

Unit II: Numerical Differentiation and Integration **12 Marks**

Maximum or minimum value of the function using numerical differentiation. General quadrature formula of numerical integration, Trepezoidal rule, Simpsons one –third and three-eight's rule's, Weddle's rule. Numerical Solution of Differential Equations: Euler's method, Picard's method of successive approximation and Runge-Kutta method. Solution of system of Linear equation: Cramer's rule, elimination method by Gauss, Jordan's method, Gauss-Seidel's method. Solution of numerical equation using Newton-Raphson method.

Unit III: Probability theory **12 Marks**

Basic terminology, different definitions of probability, elementary theorem with illustration, conditional probability – Bayes theorem (without proof) with real life examples, Random variables and their density and distribution functions. Mathematical expectations and its use in decision making (problems), variance and covariance, addition and multiplication theorem of expectation, moments and moment generating functions and their application.

Unit IV: Probability distributions and Test of significance: **12 Marks**

Binomial, Poisson and Normal distributions and their simple properties (without derivation of the distribution), tests of significance, t-test, F-test (Emphasis should be given on numerical problems).

Unit V: Correlation and Regression Analysis **12 Marks** Karl-Pearson's coefficient of correlation, Rank correlation coefficient, Lines of regression, Method of Least squares, Fitting of second degree polynomial using the method of least squares.
Text Books: 1. Rao, G.S.S. B., "*Probability and Statistics for Engineers*", 3rd edition, Scitech Publications, 2006. 2. Das N.G, "Statistical Methods", 4th Edition, Tata McGraw Hill, 2012.
Reference Books: 1. Gupta, S.P. "*Statistical Methods*", 5th edition, Chand & Sons publication, 2012. 2. Gupta, S.C. and V.K. Kapoor, "*Fundamentals of Mathematical Statistics*", 5th edition, S Chand & Sons publication, 2010.
Discussion: • Real life applications with programming approach
Practical Total Marks: 50 (In Semester Evaluation –20 & End Semester Evaluation-30) **(Practical will be as per the content of the paper)**

Course No:	***Title of the Paper:***	***Credits***			
MCA 105 **(Optional)**	Accounting and Financial Management	L: 2	T: 1	P: 1	Total: 4

Objective:

This course is designed with an objective to

- To impart basics of formal accounting process.
- To give idea about financial statements and its preparation.
- To give basics of financial management and management accounting.

Learning Outcome:

On completion of the course, students will be able to:

- Prepare financial statements and able to prepare reports on financial matters.

Total Marks: 100

(In Semester Evaluation –40 & End Semester Evaluation-60)

Unit I: Recording of Transactions **15 Marks**

Meaning and definition of accounting, parties or users interested in accounting, branches of accounting. Accounting concepts and conventions. Basic accounting terminologies, Classification of accounts, Journal entry, ledger posting and balancing of ledger. Subsidiary Books- meaning and importance, preparation of cash book.

Unit II: Preparation of financial statements **15 Marks**

Preparation of Trial Balance: Financial Statements – meaning, objectives, preparation of Trading and Profit and Loss Accounts, Balance Sheet – meaning and objectives and Preparation of Balance Sheet of sole Trading concern and corporate entities. Classification of Assets and Liabilities. Depreciation – meaning, causes, accounting for depreciation. Accounting Software – Tally (introductory part).

Unit III: Conceptual framework of finance **15 Marks**

Financial Management - meaning and objectives, functions of financial management. Concept of capital structure-computation of cost of capital, concept and consequences of over and under capitalization, Management of Working Capital-need of working capital, operating cycle, sources of working capital.

Unit IV: Management Accounting Tools **15 Marks**

Budget and Budgetary Control – definition, objectives of budget, classification, advantage, characteristics of budget, Preparation of production/sales and cash budget. Capital Budgeting: meaning, importance and methods of capital budgeting. Concept of Marginal Costing, Cost – Volume- Profit analysis, Break-even Point. Standard costing and variance analysis-material and labour variances

Text Books:

1. B.B.Dam, R.A.Sarda, R.Barman, B.Kalita, '*Theory and Practice of Accountancy (V-I),*'Capital Publishing Company, Guwahati.

2. R.K.Sharma, S.K.Gupta, '*Management Accounting*' Kalyani Publishers, Ludhiana
Reference Books: 1. M.Y. Khan, P.K.Jain, '*Principles of Financial Management*' Tata McGraw Hills, New Delhi. 2. Ravi M. Kishore, '*Cost and Management Accounting*' Taxmann, New Delhi
Discussion: • Real life approach of Accounting techniques
Practical Total Marks: 50 (In Semester Evaluation –20 & End Semester Evaluation-30) **(Practical will be as per the content of the paper)**

Course No:	*Title of the Paper:*	*Credits*			
MCA 106 **(Optional)**	Oral and Written Communication	L: 2	T: 1	P: 1	Total: 4

Objective:

This course is designed with an objective to

- Develop skills in writing, digital presentation, and oral communication as complementary parts of communication and literacy.
- Develop and refine their own voice and sense of style.
- Practice and refine different forms of communication that are appropriate for the multiple contexts and disciplines that they engage with.
- Realize thoroughly the relationship between form and content.

Learning Outcome:

On completion of the course, students will be able to:

- Apply skills in writing, digital presentation, and oral communication as complementary parts of communication and literacy.
- Refine their own voice and sense of style.
- Apply different forms of communication that are appropriate for the multiple contexts and disciplines that they engage with.
- Relate the relationship between form and content.
- Use the role of drafting, revising, presenting, and receiving, processing, and using feedback as important parts of the writing process.

Total Marks: 100

(In Semester Evaluation – 40 & End Semester Evaluation – 60)

Unit I: Language and Communication: 15 Marks

Definition of Communication; Function and purpose of Communication; Process of Communication; Barriers of Effective Communication; Types of communication, Verbal communication, on-verbal communication; The Impact of Communication on Performance, Advantages and disadvantages of oral communication; Improving oral communication; One-to-One oral communication; Oral Presentations

Unit II: Listening Skills: 15 Marks

What is listening; Types of Listening; Barriers of Effective Listening; Strategies for Effective Listening; Semantic Markers; Listening to Complaints.

Unit III: Reading and Writing Skills: 15 Marks

Introduction, Definition and Meaning of Reading, Purpose of Reading, Types of Reading, SQ3R Technique of Reading, Note Taking; Paraphrasing; Elements of writing; Business Letter Writing; Other Business Communications.

Unit IV: Organizational Documents: 15 Marks

Introduction; Business Letter Writing, Types of Business Letter, Job application, Other Business Communication. Memo; Circulars and Notices.

Practical

Total Marks: 50

(In Semester Evaluation –20 & End Semester Evaluation-30)

(Practical will be as per the content of the paper)

Course No:	***Title of the Paper:***	***Credits***			
MCA 107 **(Optional)**	Organizational Behaviour	L: 2	T: 1	P: 1	Total: 4

Objective:

This course is designed with an objective to

- Describe current research in organizational behavior and identify how can be applied to workplace settings
- Understand how application of OB frameworks, tools, and concepts can enhance individual, group, and organizational effectiveness
- Reflect one's own beliefs, assumptions and behaviors with respect to how individuals, groups and organizations act in order to expand the approaches and increase his / her organizational effectiveness

Learning Outcome:

On completion of the course, students will be able to:

- Describe current research in organizational behavior and identify how can be applied to workplace settings
- Distinguish how application of OB frameworks, tools, and concepts can enhance individual, group, and organizational effectiveness
- Reflect his / her own beliefs, assumptions and behaviors with respect to how individuals, groups and organizations act in order to expand the approaches to increase his / her organizational effectiveness.

Total Marks: 100
(In Semester Evaluation –40 & End Semester Evaluation-60)

Unit I: Focus and Purpose **5 Marks**

Definition, need and importance of organizational behaviour – Nature and scope – Frame work – Organizational behaviour models.

Unit II: Individual Behaviour **15 Marks**

Personality – types – Factors influencing personality – Theories – Learning – Types of learners – The learning process – Learning theories – Organizational behaviour modification.
Misbehaviour – Types – Management Intervention.
Emotions - Emotional Labour – Emotional Intelligence – Theories.
Attitudes – Characteristics – Components – Formation – Measurement- Values.
Perceptions – Importance – Factors influencing perception – Interpersonal perception- Impression Management.
Motivation – importance – Types – Effects on work behavior.

Unit III: Group Behaviour **15 Marks**

Organization structure – Formation – Groups in organizations – Influence – Group dynamics – Emergence of informal leaders and working norms – Group decision making techniques – Team building - Interpersonal relations – Communication – Control.

Unit IV: Leadership and Power **10 Marks**

Meaning – Importance – Leadership styles – Theories – Leaders Vs Managers – Sources of power –

Power centers – Power and Politics.

Unit V: Dynamics of Organizational Behaviour **15 Marks**

Organizational culture and climate – Factors affecting organizational climate – Importance.
Job satisfaction – Determinants – Measurements – Influence on behavior. Organizational change – Importance – Stability Vs Change – Proactive Vs Reaction change – the change process – Resistance to change – Managing change.
Stress – Work Stressors – Prevention and Management of stress – Balancing work and Life.
Organizational development – Characteristics – objectives –. Organizational effectiveness

Text Books:

1. Stephen P. Robins, "*Organisational Behavior*", PHI Learning / Pearson Education, 11th edition, 2008.
2. Fred Luthans, "*Organisational Behavior*", McGraw Hill, 11th Edition, 2001

Reference Books:

1. Schermerhorn, Hunt and Osborn, "*Organisational behavior*", John Wiley, 9th Edition, 2008.
2. Udai Pareek, "*Understanding Organisational Behaviour*", 2nd Edition, Oxford Higher Education, 2004.
3. Mc Shane & Von Glinov, "*Organisational Behaviour*", 4th Edition, Tata Mc Graw Hill, 2007.
4. Hellrigal, Slocum and Woodman, "*Organisational Behavior*", Cengage Learning, 11th Edition 2007.
5. Ivancevich, Konopaske & Maheson, "*Oranisational Behaviour & Management*", 7th edition, Tata McGraw Hill, 2008

Practical

Total Marks: 50

(In Semester Evaluation –20 & End Semester Evaluation-30)

(Practical will be as per the content of the paper)

Course No: MCA 108	***Title of the Paper:*** Discrete Mathematics	***Audit Course***

Objective:

This course is designed with an objective to

- Provide tools from the topics of Discrete Mathematics for analysis and design of computer hardware and computer software.
- Provide the foundation for imbedding logical reasoning in computer science from the topics of propositional calculus.
- Provide tools to reason for the efficiency of an algorithm.

Learning Outcome:

On completion of the course, students will be able to:

- Learn some fundamental mathematical concepts and terminology.
- Write an argument using logical notation and determine if the argument is or is not valid.
- Use recursive definitions.
- Count some different types of discrete structures.
- Demonstrate an understanding of relations and functions and be able to determine their properties.
- Model problems in Computer Science.
- Learn techniques for constructing mathematical proofs, illustrated by discrete mathematics examples.

Total Marks: 100

(In Semester Evaluation –40 & End Semester Evaluation-60)

Unit I: Set **10 Marks**

Basic concepts of set, terminology, notation; Operation on sets, Algebra of sets, Countable and Uncountable set, Fuzzy set, Computer representation of sets.

Unit II: Relations and function **10 Marks**

Relations, equivalence relations, Types of relation, properties of relation; Function, classification of functions, types of function, Some special functions ;

Unit III: Logic **10 Marks**

Logic operators, Truth table, Normal forms, Theory of inference and deduction, Mathematical induction, Predicate calculus; predicates and quantifiers.

Unit IV: Combinatorics **10 Marks**

Basic counting techniques, Recurrence relations and their solutions. Generating functions.

Unit V: Ordered sets **10 Marks**

Introductions, Ordered sets, Hase Diagrams of Partially Ordered sets, consistent enumerations supremum and infimum, isomorphic ordered sets well-ordered sets,

Unit VI: Lattice **10 Marks** lattices, bounded lattices, distributive lattices, complements, complemented lattices
Text Books: 1. Kenneth H. Rosen : Discrete Mathematics and Its Applications, Mcgraw-Hill College; 6th edition (January 5, 2006). 2. Biggs N.L., "Discrete Mathematics", 2nd Edition, Oxford University Press, 2009.
Reference Books: 1. Liu, C. L.: Introduction to Discrete Mathematics. McGraw Hill Education (India) Private Limited (2008) 2. Trembley, Manohar: Discrete Mathematical Structures. McGraw Hill Education (India) Private Limited (2 February 2001). 3. Jiri Matousek, Invitation to Discrete Mathematics, Clarendon Press (23 July 1998)
Discussion • Basics of Discrete Mathematics with suitable examples.

Course No:	*Title of the Paper:*	*Credits*			
MCA 201	Data and File Structures	L: 2	T: 1	P: 1	Total: 4

Objective:

This course is designed with an objective to

- Explain linear and non-linear data structures and its applications.
- Demonstrate the sorting and searching techniques and its efficiencies.
- Illustrate various algorithm design techniques.
- Implementing data structure techniques using C programs.
- Explain various file structures and their utilities.

Learning Outcome:

On completion of the course, students will be able to:

- Apply and analyze the concept of time, space complexity of an algorithm.
- Identify well-known generic data structures such as stack, queue, tree and related algorithms and apply them to solve problems.
- Design data structures and algorithms to solve problems.
- Comprehend the concept of file structures.
- Implement selected data structures and searching/sorting algorithms Using C language.

Total Marks: 100

(In Semester Evaluation –40 & End Semester Evaluation-60)

Unit I: Fundamental Notions: 12 Marks

Primitive and composite data types, Time and Space Complexity of Algorithms, Concept of Big-O, small-o & Big-Ω.

Unit II: Linear Data Structure: 12 Marks

Stacks, Queues, Arrays, Linked Lists, Circular & Doubly Linked Lists.

Unit III: Trees 12 Marks

Introduction to Trees, Properties of Trees, Pedant vertices in a Tree, Center of a Tree, Rooted Binary Trees, Concepts of Trees, Extended Binary Trees, Complete Binary Trees, General Trees, Binary Search Trees, Weight balanced and Height balanced Trees, AVL Tree, Balanced Multi-Way Trees, Threaded Binary Trees.

Unit IV: Sorting and Searching: 12 Marks

Selection-sort, Insertion-sort, Bubble-sort, Quick-sort, Heap-sort, Merge-sort. Searching Techniques; Binary search, Linear search.

Unit V: File Structures: 12 Marks

Concepts of Fields, Records and Files, Concepts of Blocks, Clusters, Sectors. Sequential File Organization, Variable length Records and Text Files, Indexing Structures like B-trees, ISAM, Hashing Techniques for Direct Files, Inverted lists, Multilists.

Text Books: 1. Seymour L," Data Structures", Tata McGraw Hill, Reprint, 2012. 2. Baluja G.S., "Data Structure Through C", Dhanpat Rai Publication, Reprint, 2012
Reference Books: 1. Cormen, Leiserson, Rivest, "*Introduction to Algorithms*", Mil Press & McGraw - Hill Publication,2012
Practical Total Marks: 50 (In Semester Evaluation –20 & End Semester Evaluation-30) **(Practical will be as per the content of the paper)**

Course No: MCA 202	***Title of the Paper:*** Data Communication and Computer Network	***Credits***			
		L: 2	T:1	P:1	Total: 4

Objective:

The course is designed with an objective to

- Describe the general principles of data communication.
- Introduce computer communication network design and its operations

.

Learning Outcome:

On completion of the course, students will be able to:

- Design and analyze computer network.
- Simulate and set up small networks.

Total Marks: 100

(In Semester Evaluation –40 & End Semester Evaluation –60)

Unit I: **15 Marks**

Overview : Objectives and Applications of Computer Communication.

Computer Communication Network Architecture : ISO-OSI reference model, Layer-wise functionality.

Unit II: **15 Marks**

Physical Layer : modulation and multiplexing methods, communication media.

Medium Assess Control protocols: ALOHA, CSMA, CSMA/CD, token ring, token bus, FDDI, satellite networks.

Unit III: **15 Marks**

Data link layer: Framing, error control techniques, SDLC protocol.

Network layer: Routing, Congestion and deadlock control, Internetworking issues and devices, IP protocol.

Unit IV: **15 Marks**

Transport layer: TCP/IP Protocol, concept of ATM network.

End-to-end Data: Presentation formatting issues, data Compression, concept of encryption.

Applications: E-mail, Remote login, File transfer, Network file system, Network management.

Text Books

1. Forouzan, B. A. , Mosharraf .F ,: "*Computer Networks: A Top-Down Approach*", McGraw Hill Education (India) Private Limited,2011.
2. Forouzan, B. A. "*Data Communication and Networking* "Tata Mc Graw Hill, 6th edition, 2014.

Reference Books

1. Trivedi. B," *Data Communication and Networks* ", Oxford University Press 1st Edition, 2016.
2. Stallings, W."*Data and computer communications*", Pearson education Asia, 7th Edition, 2011.

Discussion: ➢ Applications: E-mail, Remote login, File transfer, Network file system, Network management. ➢ Hands on practice on network setup
Practical Total Marks: 50 (In Semester Evaluation –20 & End Semester Evaluation-30) **(Practical will be as per the content of the paper)**

Course No: MCA-203	*Title of the Paper:* Computer Organization and Architecture	**Credits**			
		L: 2	T: 1	P: 1	Total: 4

Objective:

The course is designed with an objective to

- Describe the basic structure and operations of a digital computer.
- Illustrate the different ways of communicating with I/O devices and standard I/O interfaces.
- Indicate the relationship between a computer's instruction set architecture and its assembly language instruction set.
- Describe fundamental embedded systems design paradigms, architectures.

Learning Outcome:

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

- Create the programs for microprocessor and microcontroller based system.
- Develop independent learning skills and be able to illustrate more about different computer architecture and hardware.
- Identify high performance architecture design.

Total Marks: 100

(In Semester Evaluation -40& End Semester Evaluation -60)

Unit I: CPU Architecture: 12 Marks

Instruction format - operand addressing formats; Instruction execution process - fetch and execution cycles, data path organization - single and two buses, micro programmed and hardwired control, RISC vs CISC.

Unit II: I/O Architecture: 12 Marks

Characteristics of simple I/O devices their controllers; I/O interface, data transfer synchronization - memory - mapped and isolated I/O scheme, Bus arbitration mechanism; Modes of data transfer, direct memory access data transfer , Interrupt mechanism ; priority schemes - daisy chaining , interrupt masking , Concept of DMA - cycle stealing and burst mode.

Unit III: Memory Concepts: 12 Marks

Memory hierarchies - cache memory- Locality of reference, Direct Mapping, Associative Mapping, Block set associative mapping techniques ,Efficiency of cache system ,virtual memory -address space ,address mapping using pages memory page table.

Unit IV: Introduction to Embedded System: 12 Marks

Overview of Embedded System, Features, Applications, Hardware and software in Embedded System- RTOS, Basic differences of microprocessor and microcontroller, Concept of different controllers like 8051,PIC.

Unit V: Programming concept of microprocessor and microcontroller: 12 Marks

Introduction to 8085 microprocessor, addressing modes, Instruction sets, Assembly level programming, Programming concept of 8051 microcontroller.

Practical Total marks:50 (In Semester-20 and End Semester-30) Assembly language programming for: ➢ Using arithmetic and logical instructions ➢ Memory related operations Using looping techniques
TEXT BOOKS: 1. Hamacher.V.C., Vranestic Z.G., Zaky S.G. "Computer Organization", McGraw-Hill,5th Edition,2011. 2. Mano M.M., "Computer System architecture", Pearson, 3rd Edition. 3. Kamal R," Embedded systems: architecture, programming and design ",Tata McGraw Hill publications,2nd edition,2013
REFERENCES: 1. Hamachar C.,VranesicZ. ,Zaky S., Manjikian N."Computer organization & Embedded Systems", McGraw Hill International Edition , 6th Edition, 2007. 2. Ram, B.,"Fundamentals of Microprocessors and Microcomputers", 5th edition, Dhanpat Rai Publications, 2012.
DISCUSSION: ➢ Microprocessor 8085

Course No: MCA 204	***Title of the Paper:*** Object Oriented Programming and Design (Java)	**Credits**			
		L: 2	T: 1	P:1	Total: 4

Objective:

The course is designed with an objective to:

- Explain Object-Oriented programming concepts and techniques.
- Demonstrate core level Java Programs, debugging and testing.
- Show implementation of Object-Oriented concept using Java Programs.
- Explain System modelling techniques using UML
- Illustrate the Use cases, Class diagramand Sequence and Activity diagrams.
- Create the Object Oriented design of a system from the requirements model using UML class, object, and sequence diagrams.

Learning Outcome:

On completion of the course, students will be able to:

- Resolve programming problems using object oriented principles.
- Apply Java programming syntax, control structures and Java programming concepts.
- Develop Java Applications.
- Identify Java standard libraries and classes.
- Write, compile, execute and troubleshoot Java programming.
- Utilize Java Graphical User Interface in the program writing.
- Analyze and design a Java Program to solve real world problems based on object-oriented principles.
- Apply the principles and practice of object oriented modelling and design in the construction of robust and maintainable programs.

Total Marks: 100
(In Semester Evaluation –40& End Semester Evaluation –60)

Unit I: Encapsulation and Data Abstraction: **12 Marks**
Class, Objects, Methods, Constructors, Memory Allocation, Garbage Collection, Packages and Interfaces, Access Specifiers.

Unit II: Polymorphism and Inheritance **12 Marks**
Overloading, Overriding, Dynamic Method Dispatch.
Single, Multilevel, Hierarchical, Extending a class, implementing an Interface.

Unit III: Exception Handling and Multithreading **12 Marks**
Exception types, try, catch and finally blocks, custom exception, throw and throws. Creating threads, Join() and Sleep() methods, Synchronization, wait() and notify() methods.

Unit IV: The Java Library: **12 Marks**
String handling, Collection framework, Input/ Output.

Unit V: Object Oriented Modelling as a Design Technique: **12 Marks**

Introduction to UML, Overview, History, Usage, Diagrams.

Objects, Classes, Class Diagrams, Values and Attributes, Operation and Methods, Links and Associations, Multiplicity, Generalization and Inheritance, Aggregation.

Events, States, Transitions and Conditions, State Diagrams.

Use Case Models, Use Case Diagrams, Sequence Models, Scenarios, Sequence Diagram, Activity Models, Activity Diagram.

Text Books:

1. Blaha M.R.,Rumbaugh J, "*Object Oriented Modeling and Design with UML*", Pearson Education, 2nd Edition, Reprint-2015.
2. MalhotraS,Choudhary S, "*Programming in Java*", Oxford University Press, 2nd Edition,2015.

REFERENCE BOOKS:

1. Bruce E, "*Thinking in Java"*, Pearson Publication.
2. Jaime N, Frederick A. H, "*Introduction to Programming and Object-Oriented Design Using Java*", Wiley Publication.

Practical

Total Marks: 50

(In Semester Evaluation –20 & End Semester Evaluation-30)

(Practical will be as per the content of the paper)

Course No:	*Title of the Paper:*	*Credits*			
MCA 205 **(Optional)**	Optimization Techniques and Queuing Theory	L: 2	T: 1	P: 1	Total: 4

Objective:

This course is designed with an objective to

- Discuss different optimization techniques.
- Explain different queuing models.

Learning Outcome:

On completion of the course, students will be able to:

- Apply different optimization methods in practical problems.
- Use and apply various queuing models in real life problems.
- Write computer programs on optimization methods.
- Create own software on optimization techniques.

Total Marks: 100

(In Semester Evaluation –40 & End Semester Evaluation-60)

Unit I: Basics of Linear Programming **12 Marks**

Introduction to Operations Research and OR models ,Introduction to and Formulation of Linear programming problem (LPP), Assumptions of LPP, Feasible solution, Degenerate and Non-degenerate solution, Convex sets and properties.

Unit II: Methods for solving Linear Programming **12 Marks**

Graphical method of solution of LPP, simplex method, revised simplex method, Primal and Dual problem, sensitivity analysis.

Unit III: Transportation and Assignment Problems **12 Marks**

North-West Corner Method, Least cost Method, Vogel's Method, Modi Method, Hungarian Methods etc.

Unit IV: Integer and Dynamic Programming **12 Marks**

Idea of Integer and Dynamic Programming, Introduction and Method of solution; Gomory's method for All-integer programming problem and its algorithm, Branch and Bound method. Dynamic programming approach to solving LPP

Unit V: Queuing Models **12 Marks**

Essential features of a queuing system; Performance measures of a queuing system – transient and steady-state; Role of Poisson and Exponential distribution in Queue --- Distributions of arrivals, of inter arrivals times, of departures and of service times, and their applications in specific queuing models, classification of queuing models. Single server queue models --- {(M/M/1) : (∞ /FCFS)}, {(M/M/1) : (N/FCFS)} (Sans Derivations) and their applications Multi-server queuing models (birth & death processes).

Text Books:

1. Lieberman F.J., "*Introduction to Operations Research*", 9th edition, McGraw hill education, 2012.
2. Verma A.P., "*Introduction to Operations Research*", 4th edition, SKK and Sons-New Delhi, 2010.

Reference Books:

1. Srinath L.S., "*Linear Programming*", 4th edition, East-West, New Delhi, 2010.
2. Gillett, B.G., "*Introduction to Operation Research – a computer oriented algorithmic approach*", 5th edition,McGraw-Hill, 2011.

Discussion:

Real life applications with programming approach

- Model Formulation
- Case study on Simplex and Graphical Method.
- Advantages of Vogel's and MODI method
- Case study on Queuing models

Practical

Total Marks: 50

(In Semester Evaluation –20 & End Semester Evaluation-30)

(Practical will be as per the content of the paper)

Course Code:	***Title of the Paper:***	**Credits**			
MCA 206 (Optional)	Graph Theory	L: 2	T: 1	P: 1	Total:4

Objective:
The Course is design with an objective to:

- Explain the overview of graph and its application in problem solving.
- Discuss different application of graph in real world

Learning outcomes:
On completion of this course students will able to:

- Apply different graph approach in practical problems.
- Formulate related problems in the language of graphs
- Write computer programs and apply it in different problems.

Total Marks: 100
(In semester evaluation 40 & End semester evaluation 60)

Unit I: **Introduction** **15 Marks**
Incidence and degree, Handshaking Lemma, Isomorphism, Sub-graphs and Union of graphs; Connectedness; Walks, Paths and Circuits; Components and Connectedness; Shortest Path Algorithms, Eulerian graph, Eulerian necessary and sufficient conditions; Bipartite graph maximum degree, isomorphic graphs, isomorphism.

Unit II: **Planner Graph** **10 Marks**
Combinatorial and geometric dual, kuratowski's graph, detection of planarity, Thickness and Crossings, Adjacency; matrices and their properties, cut-sets and cut-vertices.

Unit III: **Matrix representations of graph** **10 Marks**
Incidence; Adjacency; matrices and their properties.

Unit IV: **Coloring Thechniques** **10 Marks**
Chromatic number, Chromatic polynomial, The six and five colour theorems, vertex colouring and upper bounds and its applications, structure of k- chromatic graph.

Unit V:**Theoretical algorithms** **15 Marks**
Topological sort, minimum spanning trees, DFS, BFS, shortest paths, maximum flow, Ford- Fulkerson method, Maximum bipartite matching.

Text Books:

1. Deo N., "*Graph Theory with Applications to Engineering and Computer Science*" PHI learning,New Edition,2014.
2. Robin J. W.,"*Introduction to Graph Theory*",Prentice Hall publication,5th edition, 2010.

Reference Books:

1. *Douglas B. W.,"Introduction to Graph Theory", Prentice Hall India Learning Private*

Limited, 2nd edition, 2015. ***2.*** *Harary F.,"Graph Theory",Narosa publishing house, 2013.*
Discussion: Emphasis should be given to the following topics ➢ Theoretical algorithms
Practical Total Marks: 50 (In Semester Evaluation –20 & End Semester Evaluation-30) **(Practical will be as per the content of the paper)**

Course No:	*Title of the Paper:*	*Credits*			
MCA 207 (Optional)	Fuzzy Sets and Applications	L: 2	T: 1	P: 1	Total: 4

Objective:

This course is designed with an objective to

- Recognize the basic knowledge of fuzzy sets and fuzzy logic.
- Gain knowledge in fuzzy relations.
- Be familiar with the concept of fuzzy numbers and arithmetic operations.

Learning Outcome:

On completion of the course, students will be able to:

- Illustrate basic fuzzy system modeling methods and knowledge of fuzzy information processing.

Total Marks: 100

(In Semester Evaluation –40 & End Semester Evaluation-60)

Unit I: Fuzzy Set **10 Marks**

Basic definition, level sets, convex fuzzy sets, basic operations on fuzzy sets, types of fuzzy sets.

Unit II: Extension principle and application **10 Marks**

Zadeh extention principle, image and inverse image of fuzzy sets, fuzzy numbers, elements of fuzzy arithmetic.

Unit III: Fuzzy Relations **10 Marks**

Fuzzy relations on fuzzy sets, composition of fuzzy relations, min-max composition and its properties, fuzzy equivalence relation, fuzzy graph.

Unit IV: Fuzzy Logic **10 Marks**

Fuzzy logic, Fuzzy propositions, fuzzy quantifiers, linguistic variable, inference from conditional fuzzy propositions, compositional rule of inference, applications.

Unit V: Fuzzy Control **10 Marks**

Introduction to fuzzy controllers, fuzzy rule base, fuzzy inference engine, fuzzification, defuzzification and various defuzzification methods, fuzzy nueral network, autometa and dynamical systems.

Unit VI: Decision making in fuzzy environment **10 Marks**

Individual decision making, multiperson decision making, multicriteria decision making, multistage decision making, fuzzy ranking methods, fuzzy linear programming, applications.

Text Books:

1. Klir, G.J. and Yuan, B. "*Fuzzy Sets and Fuzzy Logic: Theory and Applications*", Prentice Hall of India, New Delhi, 1997.
2. Zimmermann, H. J., "*Fuzzy set theory and its Applications*", Allied publishers Ltd., New Delhi, 1991.

Reference Books:

1. Dubois, D. and Prade, H. "*Fuzzy sets and systems: theory and applications*", Academic Press, New York, 1980
2. Kandel, A. "*Fuzzy mathematical techniques with applications*", Addison-Wesley, Reading, Mass, 1986
3. Kaufmann, A. and Gupta, M. M. "*Introduction to fuzzy arithmetic: theory and applications*", Van Nostrand Reinhold, New York, 1985.
4. Kosko, B. "*Fuzzy Thinking: the new science of fuzzy logic*", Flamingo, 1994.

Discussion

- Practical application oriented.

Practical

Total Marks: 50

(In Semester Evaluation –20 & End Semester Evaluation-30)

(Practical will be as per the content of the paper)

Course No: MCA 208	***Title of the Paper:*** Computer Graphics And Multimedia	***Audit Course***

Objective:

The Course is design with an objective to:

- Discuss different graphics packages, demonstrate functionality of display devices.
- Explain all aspects of computer graphics including hardware, software and applications.
- Explain how an animation is created.
- Write program functions in C to implement different graphics primitives.

Learning outcomes:

On completion of this course students will able to:

- Develop graphical algorithm to design different graphical pattern
- Design simple graphical pattern using C
- Resolve programming problem using graphics packages.

Total Marks: 100
(In semester evaluation 40& End semester evaluation 60)

Unit I:Display Devices **20 Marks**

Different display devices, Video Controller, Digital frame buffer , Plasma panel displays, Liquid Crystal Display(LCD), Color-display techniques (Shadow mask and penetration CRT,
, Line Drawing Algorithm, Circle drawing Algorithm.

Unit II: Display Description and Interactive Graphics **15 Marks**

Different Screen co-ordinates, Graphical function, The view algorithms; Clipping Algorithm, Two - dimensional transformation, Techniques and Applications, Definition of image, filtering, image processing, Pointing and positioning devices.

Unit III: **3 -D Graphics** **15 Marks**

Wire-frame perspective display, Parallel Projection, Perspective depth, Projective transformations, Surface Rendering, Bezier Curves and its properties, B-Splines Curves, Constructive solids –geometry methods, Hidden line and surface elimination, Transparent solids Shadowing Color Models

Unit IV:**Multimedia** **10 Marks**

Introduction to multimedia, Multimedia applications, Basics of Animation, Music and sounds, Audio basic Concepts, Digital and Analog basic concepts. MIDI concept, different File format (image, audio, video), Image Compression, Sound Compression, Video Compression.

Text Books: 2. *HearnD. ,Baker M.P. , "Computer Graphics", PHI, 2nd edition2011.* 3. Bhattacharya S, "*Computer Graphics*", Oxford higher education,1st edition 2015.
Reference Books: *1. Pakhira K*, "*Computer Graphics Multimedia & Animation"2nd edition,Phi Learning Pvt. ltd* *2. Mukherjee D.P.*, "*Fundamentals Of Computer Graphics And Multimedia" Phi Learning, 1st Edition ,*
Discussion ➢ Algorithms implementation using C

Course No:	***Title of the Paper:***	**Credits:**			
MCA 301	Design And Analysis of Algorithms	L: 2	T: 1	P: 1	Total: 4

Objective:

The course is designed with an objective to

- Explain the concepts of algorithms.
- Create strong logic and problem solving approach.
- Design a better algorithm before programming.

Learning Outcome:

On completion of the course, students will be able to:

- Analyze the efficiency of the algorithms,
- Design and analyze algorithms before its implementation

Total Marks: 100

(In Semester Evaluation –40 & End Semester Evaluation-60)

Unit I: Introduction to algorithms **12 Marks**

Order notations, mathematical induction, recurrence relations.

Unit II: Algorithm design techniques **20 Marks**

Greedy algorithms, divide-and-conquer algorithms, dynamic programming, optimization problems, Amortized Analysis.

Unit III: NP-completeness **12 Marks**

Classes P and NP, reduction, NP-completeness, examples of NP-complete problems.

Unit IV: Approximation algorithms **8 Marks**

Introduction to Approximation algorithms, TSP, PTAS and FPTAS.

Unit V:Randomized algorithms **8 Marks**

Introduction to Randomized algorithms, Monte Carlo and Las Vegas algorithms.

Text Books:

1. Charles E. L., Thomas H. C., Ronald L. R., Clifford S., "*Introduction to Algorithms*", 3rd Edition, PHI Learning Pvt. Ltd., 2009
2. Sridhar S., "*Design and Analysis of Algorithms*", Oxford University Press, 1st Edition, 2015.
3. Mohan, Chandra I., "*Design and Analysis of Algorithms*", PHI Learning Pvt. Ltd, 2nd edition, 2010.

Reference Books: 1. Aho, A. V., Hopcroft J.E.,Ullman, J. D., '*The Design and Analysis of Computer Algorithms*,' Addision Wesly. 2. Richard, J, "*Algorithms*", 1st Edition, Pearson Education, 1994.
Practical Total Marks: 50 (In Semester Evaluation –20 & End Semester Evaluation-30) **(Practical will be as per the content of the paper)**

Course No:	*Title of the Paper:*	*Credits*			
MCA 302	Database Management System	L: 2	T: 1	P: 1	Total: 4

Objective:

This course is designed with an objective to

- Illustrate the basic database concepts, including the structure and operation of the relational data model.
- Construct simple and moderately advanced database queries using Structured Query Language (SQL).
- Illustrate logical database design principles, including E-R diagrams and database normalization.

Learning Outcome:

On completion of the course, students will be able to:

- Create a database using a DBMS package.
- Construct queries using SQL.
- Normalize a database.

Total Marks: 100

(In Semester Evaluation –40 & End Semester Evaluation-60)

Unit I: Introduction to DBMS & ER Models 12 Marks

Concept DBMS, Advantage of using DBMS, Data Models (object based logical models, record based logical models), DBMS users, Overall System Structure.

ER diagrams, generalization, specialization, aggregation. Database models - Network model, Hierarchical model, and Relational model.

Unit II: Relational Model 12 Marks

Underlying concepts, Structure, Study of Relational Languages (relational algebra, relational calculus, SQL), Storage and File Structure, File Organization.

Unit III: Indexing and Relational Database Design 12 Marks

Primary and Secondary, B+ Tree Indexed Files, B - Tree Indexed Files, Static and Dynamic Hashing, Multiple Key Access, Grid File, Partitioned Hashing.

Integrity constraints (domain constraints, referential, assertions, triggers, functional dependencies), Normalization (using FDs, multivalued dependencies, join dependencies), Domain-key normal form.

Unit IV: Transactions and Concurrency Control 12 Marks

Concepts, State, ACID properties, Serializability and Recoverability, Testing for Serializability.

Lock - based Protocols, Timestamp Based Protocols, Validation Based Protocols, Multiversion Schemes, and Deadlock Handling.

Unit V: Recovery System **12 Marks** Log based recovery (deferred and immediate database modification), Checkpoints, Shadow paging, Recovery with concurrent with transactions , Buffer managements in recovery, Recovery from loss of non - volatile storage, Logical undo logging, Transaction rollback, Restart recovery
Text Books: 1. Silberschatz A, Korth H.F., Sudersan S., '*Principles of Database Systems*', McGrawHill Publication, 5th Edition,2006. 2. Elmarsi R.,NavatheS.B.,'*Fundamentals of Database Systems*', Narosa publishing Company, 4th edition,2007.
Reference Books: 1. UllmanJ.D .,WidomJ., 'A First Course in Database Systems",3rd Edition,Pearson,2014. 2. Bayross I., 'Database Concepts and Systems', Shroff Publications, 3rd Edition,2011
Discussion: ➢ Emphasis to SQL, ER Model, Normalization, transactions.
Practical Total Marks: 50 (In Semester Evaluation –20 & End Semester Evaluation-30) **(Practical will be as per the content of the paper)**

Course No:	*Title of the Paper:*	*Credits*			
MCA 303	Operating Systems	L: 2	T: 1	P: 1	Total: 4

Objective:

This course is designed with an objective to

- Explain the concepts and internal working of various operating systems.
- Illustrate the concepts of processes, resource control (concurrency etc.), physical and virtual memory, scheduling, I/O and files
- Demonstrate working of different operating system.

Learning Outcome:

On completion of the course, students will be able to:

- Analyze the concepts, structure and design of operating Systems.
- Explain operating system design and its impact on application system design and performance.
- Demonstrate competence in recognizing and using operating system features.
- Work on different OS environment.

Total Marks: 100

(In Semester Evaluation –40 & End Semester Evaluation-60)

Unit I: Introduction **12 Marks**

Batch processing, multiprogramming, time-sharing, distributed system, Functions, components and structure of an operating system.

Unit II: Process Management **12 Marks**

Support for concurrent processes - Shared data, Critical sections, Mutual exclusion, Mutual exclusion, busy form of waiting, lock and unlock primitives, semaphore, Synchronization, block and wakeup, Inter process communication, message passing mechanism, Multithreading Models, Threading issues, Pthreads, Process states, interrupt mechanisms, scheduling algorithms, implementation of concurrency Primitives. System deadlock - Prevention, detection and avoidance.

Unit III: Memory Management **12 Marks**

Contiguous and non - contiguous memory allocation; Swapping Virtual memory paging and Segmentation -page replacement and space allocation policies.

Unit IV: Input/Output and File Systems **12 Marks**

I/O Management I / O Software goals and structure, Device drivers, Terminal handling, Block and character devices. System Structure, File management strategies, tradeoffs, Directory structures, File system protection, Security, Integrity, Device independence.

Unit V: Distributed Operating System **12 Marks**

Concepts of Distributed Operating System - UNIX / LINUX.

Text Books: 1. Stallings W., "Operating systems" 2nd edition, Prentice Hall, 1995. 2. Silberschatz A., Galvin P.B, "Operating System Concepts" 5th edition, Addison-Wesley Publishing Company, 1998. 3. Deitel H.M., "Operating System" 2nd edition, Addison-Wesley Publishing Company 1990.
Reference Books: 1. Tanenbaum A.S., "*Modern Operating Systems",* 2nd edition, Prentice Hall of India, New Delhi, 2002. 2. Chandra P., Bhatt P., "*An Introduction to Operating Systems Concept"*, Prentice Hall of India.
Practical Total Marks: 50 (In Semester Evaluation –20 & End Semester Evaluation-30) **(Practical will be as per the content of the paper)**

Course No:	*Title of the Paper:*	*Credits*			
MCA 304	Software Engineering	L: 2	T: 1	P: 1	Total: 4

Objective:

The course is designed with an objective to

- Illustrate software process models such as the waterfall and evolutionary models.
- Discuss the role of project management including planning, scheduling, risk management, etc.
- Test software using testing approaches such as unit testing and integration testing.

Learning Outcome:

On completion of the course, students will be able to

- Design software system using SDLC models.
- Create the SRS document.
- Write programs using appropriate rules.
- Test software using testing approaches such as unit testing and integration testing.

Total Marks: 100

(In Semester Evaluation –40 & End Semester Evaluation –60)

Unit I: Software Engineering & Software Project Management 12 Marks

Software development and life cycle, project size and its categories.

Planning of a software project, project - control and project team standards, Scheduling, Risk management, Configuration management, Software cost estimation and evaluation techniques.

Unit II: Software requirements & Software Design 12 Marks

Different methodologies and techniques of Software requirement analysis, Various design concepts and notations, Modern design techniques, high level design and detailed design, Structured design, object -oriented design.

Unit III: Coding, Verification, Validation and Testing 12 Marks

Standards and guidelines for coding, coding walkthrough, code inspection.

Documentation and implementation procedures, Performance of software systems, software metrics and models, Documentation of project systems, manuals and implementation.

Structural Testing, Unit Testing of a test suite etc.

Unit IV: Software Reliability: 12 Marks

Definition and concepts of software reliability, Software errors, faults, repair and availability - re-availability and models, use of database as a case tool, Software Quality Control and Management.

Unit V: Software Maintenance: 12 Marks

Categories of maintenance, Problems during maintenance, solution to maintenance problems, Maintenance process, Maintenance models, Reverse Engineering Software Re-Engineering, Estimation of Maintenance costs.

Text Books: 1. Mall R., '*Fundamentals of Software Engineering*', Prentice-Hall of India, 4th edition, 2014. 2. JaloteP., '*An Integrated Approach to Software Engineering*', Narosa Publishing House, 3rd edition, 2014..
Reference Books: 1. Pressman R.S., '*Software Engineering: A Practitioner's Approach*', McGraw Hill Publication, 8th edition, 2014. 2. James K.L., "*Software Engineering*", PHI Learning, 2nd Edition.
Practical Total Marks: 50 (In Semester Evaluation –20 & End Semester Evaluation-30) **(Practical will be as per the content of the paper)**

Course No: MCA 305 **(Optional)**	*Title of the Paper:* Introduction to Data Science	**Credits**			
		L: 2	T:1	P:1	Total: 4

Objective:

This course is designed with an objective to

- Develop practical Data analysis skills
- Develop fundamental knowledge of concepts underlying data science projects.
- Develop practical skills in modern analytics
- Give hands on experience with real world data analysis

Learning Outcome:

On completion of the course, students should have following competences:

- Ability to reflect developed methods of activity i.e. mathematical models.
- Ability to propose a model to invest and test methods and tools of professional activity.
- Capability to solve real world data analytics problems.
- Capability of developing new research methods to solve data analytics problems.

Total Marks: 100

(In Semester Evaluation –40 & End Semester Evaluation-60)

Unit I: Introduction to Data Science **12 Marks**

Basic concepts of data, types of data, data collecting methods, problem solving in Data Science, Data Science components, Introduction to R.

Unit II: Exploratory Data analysis **12 Marks**

Analytics problem solving, Exploratory Data analysis**,** Inferential Statistics, data visualization in R.

Unit III: Probability and Regression **12 Marks**

Basics of probability, Conditional probability, Bayes theorem, Basics of Correlation, Scattered diagram, Simple linear regression, Multiple linear regression, Naïve bayes and logistic regression

Unit IV: Classification and Clustering **12 Marks**

KNN, Decision tree, SVM.

Unit V: Ensemble method **12 Marks**

Random forest

Books Recommended:

1. Saltz, J, S., Stanton, J, M., “An Introduction to Data Science”, SAGE Publications, 2018.
2. James, G., Witten, D., Hastie, T., Tibshirani, R., “An Introduction to Statistical Learning with Applications in R”, Springer, 2013.
3. Wickham, H., Grolemund, G., “R for Data Science”, O’REILLY publications, 2017.

Practical Total Marks: 50 (In Semester Evaluation –20 & End Semester Evaluation-30) **(Practical will be as per the content of the paper)**

Course No:	*Title of the Paper:*	*Credits*			
MCA 306 **(Optional)**	Cloud Computing	L : 2	T : 1	P : 1	Total: 4

Objective:

This course is designed with an objective to

- To introduce the broad perceptive of cloud architecture and model
- To understand the concept of Virtualization.
- To be familiar with the lead players in cloud.
- To understand the features of cloud simulator
- To apply different cloud programming model as per need.
- To be able to set up a private cloud.
- To understand the design of cloud Services.
- To learn to design the trusted cloud Computing system

Learning Outcome:

On completion of the course, students will be able to:

- Compare the strengths and limitations of cloud computing
- Identify the architecture, infrastructure and delivery models of cloud computing
- Apply suitable virtualization concept.
- Choose the appropriate cloud player.
- Choose the appropriate Programming Models and approach.
- Address the core issues of cloud computing such as security, privacy and interoperability
- Design Cloud Services
- Set a private cloud

Total Marks: 100

(In Semester Evaluation –40 & End Semester Evaluation –60)

Unit I: Cloud Architecture And Model **12 Marks**

Technologies for Network-Based System – System Models for Distributed and Cloud Computing – NIST Cloud Computing Reference Architecture. Cloud Models: - Characteristics – Cloud Services – Cloud models (IaaS, PaaS, SaaS) – Public vs Private Cloud –Cloud Solutions - Cloud ecosystem – Service management – Computing on demand.

Unit II: Virtualization **12 Marks**

Basics of Virtualization - Types of Virtualization - Implementation Levels of Virtualization - Virtualization Structures - Tools and Mechanisms - Virtualization of CPU, Memory, I/O Devices - Virtual Clusters and Resource management – Virtualization for Data-center Automation.

Unit III: Cloud Infrastructure **12 Marks**

Architectural Design of Compute and Storage Clouds – Layered Cloud Architecture Development – Design Challenges - Inter Cloud Resource Management – Resource Provisioning and Platform Deployment – Global Exchange of Cloud Resources.

Unit IV : Programming Model **12 Marks**

Parallel and Distributed Programming Paradigms – MapReduce , Twister and Iterative MapReduce – Hadoop Library from Apache – Mapping Applications - Programming Support - Google App Engine,

Amazon AWS - Cloud Software Environments -Eucalyptus, Open Nebula, OpenStack, Aneka, CloudSim

Unit V : Security In The Cloud **12 Marks**

Security Overview – Cloud Security Challenges and Risks – Software-as-a-Service Security – Security Governance – Risk Management – Security Monitoring – Security Architecture Design – Data Security – Application Security – Virtual Machine Security - Identity Management and Access Control – Autonomic Security.

Text Books:

1. Kai Hwang, Geoffrey C Fox, Jack G Dongarra, "Distributed and Cloud Computing, From Parallel Processing to the Internet of Things", Morgan Kaufmann Publishers, 2012.
2. John W.Rittinghouse and James F.Ransome, "Cloud Computing: Implementation, Management, and Security", CRC Press, 2010.

Reference Books:

1. Toby Velte, Anthony Velte, Robert Elsenpeter, "Cloud Computing, A Practical Approach", TMH, 2009.
2. Kumar Saurabh, " Cloud Computing – insights into New-Era Infrastructure", Wiley India,2011

Practical

Total Marks: 50

(In Semester Evaluation –20 & End Semester Evaluation-30)

(Practical will be as per the content of the paper)

Course No:	*Title of the Paper:*	*Credits*			
MCA 307 (Optional)	Cryptography and Internet security	L : 2	T : 1	P : 1	Total: 4

Objective:

This course is designed with an objective to

- Discuss and explain different online security tools to the students.

Learning Outcome:

On completion of the course, students will be able to:

- Exposure to Internet security.

Total Marks: 100

(In Semester Evaluation –40 & End Semester Evaluation –60)

Unit I: **12 Marks**

Introduction to Cryptography, Mathematical Foundation of Cryptography Secret Key.

Unit II: **12 Marks**

Cryptosystem : Stream and Block Ciphers; Pseudo-random pattern generators, LFSR based stream ciphers, other stream ciphers; Correlation attacks and other relevant attacks for steam ciphers; DES and Its Security, other Block Ciphers; Differential Cryptanalysis, Attacks on Block Ciphers.

Unit III: **12 Marks**

One-Way Hash Functions and Data Integrity: Snefru, MD4, MD5, SHA, HAVAL; Cryptanalysis of hash functions.

Unit IV: **12 Marks**

Public Key Cryptography: Mathematical Foundation, RSA, Security Analysis of RSA

Key Establishment Protocols: Symmetric key based and Asymmetric Key based protocols, KERBEROS, EKE, DH-EKE, PAKE, Secret Sharing

Unit V: **12 Marks**

Digital Signature Schemes: RSA and other related signature schemes, Possible Attacks, DSA and other related signature schemes.

Text Book:

1. M. Subramanian, Network Management, Principles and Practice, Prentice Hall; 2 edition (May 17, 2012)

2. C. Kaufman, R. Perlman,Network Security: Private Communication in a Public World, Prentice Hall; 2 edition (May 2, 2002)

Books/References:

1. William Stallings, Cryptography and Network Security: Principles and Practice, Pearson; 6 edition (March 16, 2013)

2. Manezes, Oorschot and Vanstone: Handbook of Applied Cryptography, CRC Press; 1 edition (October 16, 1996)

Practical

Total Marks: 50

(In Semester Evaluation –20 & End Semester Evaluation-30)

(Practical will as per content of the paper)

Course No: MCA 308	*Title of the Paper:* Artificial Intelligence	*Audit Course*

Objective:

This course is designed with an objective to

- Introduce the basic techniques of artificial intelligence: problem solving, heuristic search, knowledge representation, logic system and inference
- Provide insight into the artificial intelligence, neural networks and applications.
- Introduce students about this critically important technology to increase their understanding of its implications, to pique their curiosity about the remarkable developments that are taking place and help to familiarize students with many faces of Artificial Intelligence and Neural Networks.

Learning Outcome:

At the end of the course, students will be able to:

- Survey and design some practical artificial intelligence applications in any information system domain.
- Solve some natural problems in a systematic way to provide effective and optimal solutions.
- Identify core ideas, techniques, and applications that characterize the emerging fields of Artificial Intelligence.

Total Marks: 100

(In Semester Evaluation –40 & End Semester Evaluation-60)

Unit I: Introduction to Artificial Intelligence **5 Marks**

Natural and Artificial Intelligence, Definitions of AI, Nature of AI Solutions, Testing Intelligence , AI Techniques, Testing Intelligence (Turing Test, Chinese Room Test), Data Pyramid, Computer Based Information Systems in the Pyramid, AI Applications Areas (Mundane Tasks, formal Tasks and Expert Tasks).

Unit II: Problem Solving, Search and Heuristic Search Techniques **15 Marks**

Problems and Problem Spaces, Problem Characteristics, Production Systems, Control Strategies (Forward Chaining, Backward Chaining), Exhaustive Searches and Blind Methods (Depth First Search, Breadth First Search).

Heuristic Search Techniques, Generate and Test, Hill Climbing, Branch and Bound technique, Best First Search and A* Algorithm, Problem Reduction, AND / OR graphs, AO* Algorithm, Constraint Satisfaction Problems, Means Ends Analysis.

Unit III: Knowledge Representation and Knowledge Acquisition **12 Marks**

Knowledge Representation (KR): Formal KR (First Order Predicate Logic), Procedural KR (Rule, Semantic Nets, Frames, Conceptual Dependency, Scripts, and Semantic Web), KR Issues and Limitations.

Using Predicate logic: Syntax and Semantics for FOPL, Properties of Wff's, Conversion to clausal form, Horn's clauses, Unification, Resolution Principles, Deduction Rules
Knowledge Based Systems (KBS) Architecture, Knowledge Acquisition (KA): Techniques, Role of Knowledge Engineer (KE), Knowledge Sharing and Dealing with Multiple Experts, KA Issues and Limitations.

Unit IV: Probabilistic Reasoning and Uncertainties 8 Marks

Crisp and Fuzzy Logic, Fuzzy Membership Functions, Fuzzy Rule Based Systems, Probability and Bayes' Theorem, Certainty factors, Dempster-Shafer theory, Non Monotonic Reasoning and Truth Monitoring Systems.

Unit V: Artificial Neural Networks and Expert Systems 20 Marks

Introduction to Neural Computing and Artificial Neural Network (ANN), Fundamental Concepts: Biological Neuron, Artificial Neuron, Activation Function and Output Functions, Introduction to ANN Architectures, Applications of ANN and Expert Systems.
Neural Network Architectures: Hopfield Model, Parallel Relaxation; Perceptron, Lineraly Separable Problems, and Fixed Increment Perceptron; Learning: Multi-layer Perceptron, Non-Lineraly Separable Problems, and Back Propagation Learning; Self Organizing Networks: Kohonens Networks; Recurrent Networks.
Objectives of Learning, Hebb's Rule, Delta Rule, Supervised Learning, Unsupervised Learning.

Text Books:

1. Rich E., Knight K., Nair S.B., "*Artificial Intelligence*", Tata McGraw Hill Education, 3rd Edition, 2008.
2. Patterson D.W., "*Introduction to Artificial Intelligence and Expert Systems*", Prentice Hall of India, 1990.
3. Russell S., Norvig P., "*Artificial Intelligence: A Modern Approach*", Pearson Education, 3rd Edition, 2015.
4. Sivanandam S. N., Deepa S. N., "*Principles of Soft Computing*", Wiley India, 2nd Edition 2011

Reference Books:

1. Nilsson N.J., "*Principles of Artificial Intelligence*", Narosa Publishing House, New Delhi, Reprint 2002.
2. Jackson P., "*Introduction to Expert Systems*", Addison Wesley Publishing Company,1998

Discussion:

Real life applications with programming approach.

Course Code: MCA 401	***Title of the Paper:*** Data Mining and Machine Learning	**Credits**			
		L:2	T:1	P:1	Total: 4

Objective:

This course is designed with an objective to

- Determine the overall architecture of a data warehouse and techniques and methods for data gathering and data pre-processing using OLAP tools.
- Discuss different data mining models and techniques using MATLAB.

Learning Outcomes:

On completion of this course, the students will be able to

- Compare various data mining techniques, methods in integrating and interpreting different data sets
- Obtain improved mechanism for effective and efficient data analysis.
- Discuss the role of data warehousing and enterprise intelligence in industry and government.

Total Marks: 100

(In Semester Evaluation –40 & End Semester Evaluation-60)

Unit I: Data Mining **15 Marks**

Concept of data mining- learning- data warehouse and data mining. KDD and Data Mining. The Knowledge Discovery processes its different stages. Data Mining Techniques – Verification model, Discovery model. Issues and challenges in Data mining.

Unit II: Classification **15 Marks**

Bayes decision rule, error probability, normal distribution, linear discriminant function, Non-Linear decision boundaries, KNN classifier, Fisher's LDA, Single layer Perceptron, Multi-Layer perceptron. Fundamental concept of Association rule, Classification rule, Learning, Neural networks,

(example with practical case studies in MATLAB).

Unit III: Clusternig **20 Marks**

Basics of clustering, similarity dissimilarity measures, clusterning criteria, distance functions, K- means algorithm, single linkage and complete linkage algorithm, K-medoids, K mean algorithm, CLARA, CLARANS, DBSCAN. Genetic algorithm, Rough set techniques. Support vector mechanism, Web mining, Text mining, Sequence mining, Spatial Data mining,

(example with practical case studies in MATLAB).

Unit IV: Data Warehousing **10 Marks**

Concept of data warehousing its evolution. Scope of data warehouse type of data and their use, metadata & their types. Data warehouse schema. Fact data, Dimension data, Partitioning data, data marting. Database schemas – star, star flake, snowflake schemas, and multidimensional schemes, Multidimensional Data model, Data cube, OLAP operations.

Text Books:

1. Han J.,Kamber M., "*Data Mining: Concepts and Techniques*", Morgan Kaufmann, India,3rd edition, 2011,.
2. Pujari A K, "*Data Mining Techniques*", University Press, India,3rd edition, 2013.

Reference Books:

1. Han M, and Smyth, "*Principles of Data Mining*", PHI, India, 2nd edition, 2011.
2. Duffy, Dean G, "*Advanced Engineering Mathematics with MATLAB*", CRC Press, 2013.

Discussion:

- OLAP techniques
- Clustering and Classification
- Association Rule Mining

Practical

Total Marks: 50

(In Semester Evaluation –20 & End Semester Evaluation-30)

(Practical will be in line with the content of the paper)

Course No: MCA 402	***Title of the Paper:*** Web Technology	**Credits**			
		L : 2	T : 1	P : 1	Total: 4

Objective:

This course is designed with an objective to

- Discuss about various concepts related to internet and web.
- Explain about different web based technologies.

Learning Outcome:

On completion of the course, students will be able to:

- Write HTML, CSS and scripting languages.
- Use and apply various web programming languages.
- Create websites.
- Handle and maintain web based projects.

Total Marks: 100
(In Semester Evaluation –40 & End Semester Evaluation –60)

Unit I: Internet Basics. **15 Marks**

Network Connectivity Types- dial up- PPP, SLIP, leased, VSAT, ISP, HTTP,TCP/IP, IP Address, Domain Names, DNS, Services-email, WWW,URL,ARP,RARP,WWW, Search Engine, Concept of Client –Server computing, Thin Client vs. Flat Client, Middle ware, Client Pull, Server Push.

Unit II: Web Client **15 Marks**

Web Architecture, Browsers, Basic features & Functions, Static, dynamic, Active pages Client- side Inclusive- Scripts, VB Scripts, Java Scripts, Activex, ASP, Plugins, Case Study- IE, Firefox .

Unit III: File Server, Mail Server, Web Server **15 Marks**

FTP, Telnet, SMTP, MIME etc. Web Server : Stateful vs. Stateless Servers, Web Server Architecture, Basic features & Functions, URL, Server side inclusive – CGI, API, PERL,JSP,PHP,ASP.NET, Web database Connectivity- JDBC, ODBC, Case Study- IIS, Apache- Tomcat.

Unit IV: Web Application Development **15 Marks**

HTML,XML, DHTML with DTD concept <head> & <body> section, able, form, Frame, hyperlinks, CSS Web Page Design using HTML authoring tools- FrontPage/ Dream weaver, Visual Web Developer

Text Books:

1. Roy U.K., "*Web Technologies*", Oxford Higher Education, 9th edition 2015.
2. Godbole A., "*Web Technologies*", Tata McGraw Hill, 4th edition 2012.

Reference Books:

1. Bates C., "*Web Programming*", Willey India Ltd, 3rd edition 2012.
2. Jackson C., "*Web Technologies-A computer science perspective*", Pearson India, 4th edition 2010.

Discussion: ➢ Java Script, CSS, AJAX ➢ PHP,JSP and ASP.net ➢ Visual Web Development tools. ➢ Web based Project.
Practical Total Marks: 50 (In Semester Evaluation –20 & End Semester Evaluation-30) **(Practical will be as per the content of the paper)**

Course No:	*Title of the Paper:*	*Credits*			
MCA 403 **(Optional)**	Image Processing and Pattern Classification	L : 2	T : 1	P : 1	Total: 4

Objective:

This course is designed with an objective to

- Explain the basic concepts of Image processing and Pattern Classification.
- Explain different algorithms and techniques in Pattern recognition.

Learning Outcome:

On completion of the course, students will be able to:

- Understand the basic concepts of image processing and pattern classification.
- Apply the image processing techniques in different problems.
- Apply Pattern Recognition techniques in different problems.

Total Marks: 100

(In Semester Evaluation –40 & End Semester Evaluation –60)

Unit I: Digital Image Fundamentals **10 Marks**

Digital Image representation, Fundamental steps in Image processing, Elements of Digital Image Processing systems, Image acquisition, Sampling and Quantization.

Unit II: Image Transforms and Image Enhancement **15 Marks**

Fourier Transform, Discrete Cosine Transform and Hotelling Transforms and their properties.
Image Enhancement by point processing, Spatial filtering, Frequency domain enhancement, Color Image processing.

Unit-III: Image Compression and Segmentation **10 Marks**

Image Compression models, Error-free Compression, Lossy Compression, Image Compression Standards.
Image Segmentation: Detection of discontinuities, Edge Linking, Thresholding.

Unit-IV: Pattern Recognition Fundamentals: **15 Marks**

Basic concepts of Pattern recognition, Issues in Pattern recognition systems.
Feature selection and Extraction: Branch and Bound algorithm, Sequential forward/ backward selection algorithm, Probabilistic separability based criterion function, Interclass distance based Criterion functions, PCA.

Unit V: Pattern Classification **10 Marks**

Bayes Decision rule, Error probability, Normal distribution, Linear discriminant function, Non-Linear decision boundaries, Fisher's LDA, Single Layer Perceptron, Multi-Layer Perceptron, Introduction to Deep learning.

Text Books:

1. R.C. Gonzalez & R. /E. Woods, Digital Image Processing: Addison - Wesley Pub. comp
2. R.O. Duda, P.E. Hart and D.G. Stork," Pattern Classification", John Wiley,2001
3. Devi V.S., Murty.M.N, "Pattren Recognition:An Introduction", Universities Press,2011

Reference Books:

1. Ralph Gonzalez, Richard Woods, Steven Eddins, Digital Image Processing Using MATLAB, McGraw Hill Education (India) Private Limited; 2 edition (8 June 2010)
2. C.M. Bishop," Pattren Recognition and Machine Learning", Springer, 2006

Practical Total Marks: 50 (In Semester Evaluation –20 & End Semester Evaluation-30) **(Practical will be as per the content of the paper)**

CourseNo: MCA 404 **(Optional)**	***Title of the Paper:*** Scientific Writing using LaTex	***Credits***			
		L: 2	T: 1	P: 1	Total: 4

Objective:

This course is designed with an objectives to

- Describe scientific writing

Learning Outcome:

After completing this course the students will be able to

- Write Project report in LaTeX.
- Typesetting technical documents.
- Create presentation in beamer

Total Marks: 100

(In Semester Evaluation –40 & End Semester Evaluation –60)

Unit I: **5 Marks**

Installation of the software LaTeX, editors of latex.

Unit II: **10 Marks**

Understanding Latex compilation, Basic Syntex, Writing equations, Matrix, Tables.

Unit III: **15 Marks**

Page Layout – Titles, Abstract Chapters, Sections, Referrences, Equation references, citation. List making environments, Table of contents, Generating new commands, Figure handling numbering, List of figures, List of tables, Generating index.

Unit IV: **10 Marks**

Packages: Geometry, Hyperref, amsmath, amssymb, algorithms, algorithmic graphic, color, tilez listing.

Unit V: **10 Marks**

Classes: article, book, report.

Unit VI: **10 Marks**

Presentation using beamer.

Practical:

- Applications to:
  1. Writing Résumé,
  2. Writing question paper,
  3. Writing articles
  4. Writing research papers.
  5. Presentation.

Text Books:

1. Frank Mittelbach, Michel Goossens, Johannes Braams, David Carlisle, Chris Rowley., "The LaTeX Companion",PHI, 2nd Edition, 2009.

Reference Books:

1. Leslie Lamport, "LaTeX: A document preparation system, User's guide and reference manual" , Addison Wesley, 1994

Discussion ➢ Packages ➢ Editors of latex
Practical Total Marks: 50 (In Semester Evaluation –20 & End Semester Evaluation-30) **(Practical will be as per the content of the paper)**

Course No:	*Course Name:*	*Credits*			
MCA 405 **(Optional)**	Python Programming	L: 2	T: 1	P: 1	Total: 4

Objective:

- To learn basic construct and syntax of Python programming.
- To learn how to design and program Python based applications.
- To define the structure and components of a Python program.
- To learn how to write loops and decision statements in Python.
- To learn concept of string and string manipulation.
- To learn how to use List, Tuples and Dictionary.
- To learn how to write functions and pass arguments in Python, build package learn the concept of modules for reusability.
- To learn concept of exception handling in Python and its implementation.

Learning Outcome:

On completion of the course, students will be able to:

- Solve problems through Python programs.
- Develop advance Python program to solve real life problems.

Total Marks: 100

(In Semester Evaluation -40& End Semester Evaluation -60)

Unit I: Introduction to Python: **12 Marks**

Structure of a Python Program, Elements of Python, Python Interpreter, Using Python as calculator, Python shell, Indentation. Atoms, Identifiers and keywords, Literals, Strings and Operators.

Unit II: Conditional Statements, Looping and String Manipulation*:* **12 Marks**

Branching, Looping, Conditional Statement, Exit function, Difference between break, continue and pass. Understanding string, Accessing Strings, Basic Operations, String slices, Function and Methods.

Unit III: List, Tuples and Dictionary: **12 Marks**

Introduction to list, Accessing list, list operations, Working with lists, Function and Methods, Introduction to tuple, Accessing tuples, Operations, Working, Functions and Methods, Introduction to dictionaries, Accessing values in dictionaries, Working with dictionaries, Properties, Functions.

Unit IV: Python Functions and Modules: **12 Marks**

Defining a function, Calling a function, Types of functions, Function Arguments, Anonymous functions, Global and local variables, Organizing python codes using functions, Organizing python projects into modules, Importing own module as well as external modules, Understanding Packages, modules and external packages.

Unit V: **12 Marks**

Input-Output and Exception Handling: Printing on screen , Reading data from keyboard , Opening and closing file , Reading and writing files , Functions, Introduction to Exception, Exception Handling, Except clause, Try ? Finally clause, User Defined Exceptions.

TEXT BOOKS:

1. T. Budd, Exploring Python, TMH, 1st Ed, 2011.
2. John V Guttag, Introduction to Computation and Programming Using Python – Revised and Expanded Edition 2e, 2013.

REFERENCES:

1. Python Tutorial/Documentation www.python.or 2015.
2. Python Tutorial https://www.kaggle.com/learn/python

Course No.	*Title of the Paper:*	*Credit*
MCA 406	**Major Project**	10