

# **FACULTY OF COMPUTER SCIENCE & IT**

## **SYLLABUS**

**of**

**Master of Science (Computer Science)  
(Semester I-IV)**

**(Under Credit Based Continuous Evaluation Grading System)**

**Session: 2023-24**



**The Heritage Institution**

**KANYA MAHA VIDYALAYA  
JALANDHAR  
(Autonomous)**

**Program Specific Outcomes**  
**Master of Science (Computer Science)**  
**(Session 2023-24)**

After completing this programme, the students will be able to:

PSO1: Showcase their skillset to apply in the field of IT, academics and other competitive examinations.

PSO2: Comprehend the implementation logic behind the architecture of computers.

PSO3: Apply skills to provide IT based solutions for real world problems through development of software and websites.

PSO4: Contextualize and analyse the problems in hand to work for an IT based solution.

PSO4: Apply principles and techniques from the selective areas to develop special expertise.

# Kanya Maha Vidyalaya, Jalandhar (Autonomous)

SCHEME AND CURRICULUM OF EXAMINATIONS OF TWO YEAR DEGREE PROGRAMME

## Master of Science (Computer Science)

Credit Based Continuous Evaluation Grading System (CBCEGS)

(Session 2023-24)

Master of Science (Computer Science) Semester - I										
Course Code	Course Title	Course Type	Hours per week	Credit		Marks			Examination Time (in Hours)	
				L-T-P	L-T-P	Total	Total	Ext.		CA
			L					P		
MCSL-1111	Advanced Data Structures	C	3-1-0	3-1-0	4	100	80	-	20	3
MCSL-1112	Advanced Computer Architecture	C	3-1-0	3-1-0	4	100	80	-	20	3
MCSL-1113	Network Security Practices	C	3-1-0	3-1-0	4	100	80	-	20	3
MCSL-1114	Discrete Structures	C	3-1-0	3-1-0	4	100	80	-	20	3
MCSL-1115	Artificial Intelligence	C	4-0-0	4-0-0	4	100	80	-	20	3
MCSP-1116	Lab on Advanced Data Structures	C	0-0-4	0-0-2	2	50	-	40	10	3
	** Student can opt any one of the following Interdisciplinary courses	IDE			4	100	80		20	3
	<b>Total</b>				22	550				

**\*\* List of Interdisciplinary Courses as per student's own choice and decision (Not compulsory):**

Option 1 - Effective Communication Skills (IDEC-1101)

Option 2 –Basics of Music (Vocal) (IDEM-1362)

Option 3 - Human Rights and Constitutional Duties (IDEH-1313)

Option 4 - Indian Heritage: Contribution to the world (IDEW-1275)

**Note: C – Compulsory, IDE-Interdisciplinary optional Courses**

**\*\*Grade points of these courses will not be included in the SGPA/CGPA of Semester/ Programme.**

**NOTE: The ID Course opted in Semester I, can't be opted in Semester III**

# Kanya Maha Vidyalaya, Jalandhar (Autonomous)

SCHEME AND CURRICULUM OF EXAMINATIONS OF TWO YEAR DEGREE PROGRAMME

## Master of Science (Computer Science)

Credit Based Continuous Evaluation Grading System (CBCEGS)

(Session 2023-24)

Master of Science (Computer Science) Semester - II										
Course Code	Course Title	Course Type	Hours per week	Credit		Marks			Examination Time (in Hours)	
			L-T-P	L-T-P	Total	Total	Ext.			CA
							L	P		
MCSL-2111	Theory of Computation	C	3-1-0	3-1-0	4	100	80	-	20	3
MCSL-2112	Image Processing	C	3-1-0	3-1-0	4	100	80	-	20	3
MCSL-2113	Advanced Programming Concepts	C	4-0-0	4-0-0	4	100	80	-	20	3
MCSL-2114	Cloud Computing	C	4-0-0	4-0-0	4	100	80	-	20	3
MCSL-2115	Distributed Database Systems	C	3-1-0	3-1-0	4	100	80	-	20	3
MCSP-2116	Lab on Advanced Programming Concepts	C	0-0-4	0-0-2	2	50	-	40	10	3
	Total				22	550				

**Note:**

**C - Compulsory**

# Kanya Maha Vidyalaya, Jalandhar (Autonomous)

SCHEME AND CURRICULUM OF EXAMINATIONS OF TWO YEAR DEGREE PROGRAMME

## Master of Science (Computer Science)

Credit Based Continuous Evaluation Grading System (CBCEGS)

(Session 2023-24)

### Master of Science (Computer Science) Semester – III

Course Code	Course Title	Course Type	Hours per week	Credit		Marks			Examination Time (in Hours)		
				L-T-P	L-T-P	Total	Total	Ext.		CA	
								L			P
MCSL-3111	Data Mining and Data Warehousing	C	4-0-0	4-0-0	4	100	80	-	20	3	
MCSL-3112	System Software	C	4-0-0	4-0-0	4	100	80	-	20	3	
MCSL-3113	Advanced Web Technologies	C	4-0-0	4-0-0	4	100	80	-	20	3	
MCSL-3114	Design and Analysis of Algorithms	C	4-0-0	4-0-0	4	100	80	-	20	3	
MCSL-3115	Software Testing	C	4-0-0	4-0-0	4	100	80	-	20	3	
MCSP-3116	Lab on Advanced Web Technologies	C	0-0-6	0-0-3	3	100	-	80	20	3	
	** Student can opt any one of the following Interdisciplinary courses	IDE			4	100	80		20	3	
	Total				23	600					

**\*\* List of Interdisciplinary Courses**

Option 1 - Effective Communication Skills (IDEC-3101)

Option 2 – Basics of Music (Vocal) (IDEM-3362)

Option 3 - Human Rights and Constitutional Duties (IDEH-3313)

Option 4 - Indian Heritage: Contribution to the world (IDEW-3275)

**Note:**

**C – Compulsory, IDE-Interdisciplinary optional Courses**

**\*\*Grade points of these courses will not be included in the SGPA/CGPA of Semester/ Programme.**

**NOTE: The ID Course opted in Semester I, can't be opted in Semester III**

# Kanya Maha Vidyalaya, Jalandhar (Autonomous)

SCHEME AND CURRICULUM OF EXAMINATIONS OF TWO YEAR DEGREE PROGRAMME

## Master of Science (Computer Science)

Credit Based Continuous Evaluation Grading System (CBCEGS)

(Session 2023-24)

### Master of Science (Computer Science) Semester – IV

Course Code	Course Title	Course Type	Hours per week	Credit		Marks			Examination Time (in Hours)	
			L-T-P	L-T-P	Total	Total	Ext.			CA
							L	P		
MCSL-4111	Advanced Software Engineering	C	3-1-0	3-1-0	4	100	80	-	20	3
MCSL-4112	Microprocessor and Its Applications	C	3-1-0	3-1-0	4	100	80	-	20	3
MCSL-4113	Foundation of Statistical Computing	C	4-0-0	4-0-0	4	100	80	-	20	3
MCSP-4114	Lab on Foundation of Statistical Computing	C	0-0-6	0-0-3	3	100	-	80	20	3
MCSD-4115	Dissertation	C	0-0-12	0-0-6	6	200	-	160	40	6
	Total				21	600				

**Note:**

**C - Compulsory**

Master of Science (Computer Science) Semester – I

**(Session 2023-24)**

**COURSE CODE: MCSL-1111**  
**ADVANCED DATA STRUCTURES**

**Course Outcomes:**

After passing this course the student will be able to:

CO1: Design, analyze and implement algorithms and check their performances against specified parameters.

CO2: Comprehend and implement operations on heaps and queue.

CO3: Understand the necessary mathematical abstraction to solve different data structure problems.

CO4: Implement various searching, sorting and hashing algorithms.

Master of Science (Computer Science) Semester – I

(Session 2023-24)  
**COURSE CODE: MCSL - 1111**  
**ADVANCED DATA STRUCTURES**

**L-T-P: 3-1-0**

**Max. Marks: 100**

**Credits: 4**

**Examination Time: 3 Hours**

**Theory: 80**

**CA: 20**

**Instructions for Paper Setter -**

Eight questions of equal marks (16 marks each) are to set, two in each of the four sections (A-D). Questions of Sections A-D should be set from Units I-IV of the syllabus respectively. Questions may be divided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each section. The fifth question may be attempted from any section.

**UNIT-I**

Review of algorithm analysis, Binary search trees, balanced binary search trees (red-black trees), Btrees, AVL Trees, 2-3 trees, 2-3-4 trees.

**UNIT-II**

Binary heaps, heap operations, implementation and applications. Priority queue operations, and double-ended, priority queues.

**UNIT-III**

Binomial heaps, Fibonacci heaps. Data structures for disjoint sets.

Amortized analysis, string matching, and graph algorithms.

**UNIT-IV**

External data structures - external storage, external files, external sorting searching indexing files, external hashing.

**References / Textbooks:**

1. Alfred V. Aho, Jeffrey D. Ullman, John E. Hopcroft, Data Structures and Algorithms, Addison Wesley, 1985.
2. Dinesh P. Mehta, Sartaj Sahni, Handbook of Data Structures and Applications, Chapman & Hall/CRC, 2018.



3. Jean-Paul Tremblay, Paul Sorenson, An Introduction to Data Structures with Applications, McGraw Hill Education, 2017.
4. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein, Introduction to Algorithms, MIT Press, 2009.
5. Peter Brass, Advanced Data Structure, Cambridge University Press, 2008.

Note: The latest editions of the books should be followed.

Master of Science (Computer Science) Semester – I  
(Session 2023-24)  
**COURSE CODE: MCSL-1112**  
**ADVANCED COMPUTER ARCHITECTURE**

**Course Outcomes:**

After passing this course the student will be able to:

CO1: Comprehend paradigms and various kind of classifications of computing.

CO2: Gain knowledge of parallel computing models.

CO3: comprehend various architectural classifications of computers on the basis of data processing schemes.

CO4: Analyse pipelined architecture against parameters like throughput, speedup, efficiency, etc.

Master of Science (Computer Science) Semester – I  
(Session 2023-24)  
**COURSE CODE: MCSL-1112**  
**ADVANCED COMPUTER ARCHITECTURE**

**L-T-P: 3-1-0**

**Max. Marks: 100**

**Credits: 4**

**Examination Time: 3 Hours**

**Theory: 80**

**CA: 20**

**Instructions for Paper Setter -**

Eight questions of equal marks (16 marks each) are to set, two in each of the four sections (A-D). Questions of Sections A-D should be set from Units I-IV of the syllabus respectively. Questions may be divided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each section. The fifth question may be attempted from any section.

**UNIT-I**

**Paradigms of Computing:** Synchronous – Vector/Array, SIMD, Systolic

**Asynchronous** – MIMD, reduction Paradigm, Hardware taxonomy: Flynn’s classification, Software taxonomy: Kung’s taxonomy, SPMD.

**UNIT-II**

Parallel Computing Models

**Parallelism in Uniprocessor Systems:** Trends in parallel processing, Basic Uniprocessor Architecture, Parallel Processing Mechanism.

**UNIT-III**

**Parallel Computer Structures:** Pipeline Computers, Array Computers, Multiprocessor Systems

**Architectural Classification Schemes:** Multiplicity of Instruction-Data Streams, Serial versus Parallel Processing, Parallelism versus Pipelining.

**UNIT-IV**

**Pipelining:** An overlapped Parallelism, Principles of Linear Pipelining, Classification of Pipeline Processors, General Pipelines and Reservation Tables.

**Principles of Designing Pipelined Processors:** Instruction Prefetch and Branch Handling, Data Buffering and Busing Structure, Internal Forwarding and Register tagging, Hazard Detection and Resolution.

**References / Textbooks:**

1. Kai Hwang, Faye A. Briggs, Computer Architecture and Parallel Processing, McGraw-Hill International Editions, 1985.
2. John D. Carpinelli, Computer Systems Organization & Architecture, Addison Wesley, 2001.
3. Kai Hwang, Advanced Computer Architecture: Parallelism, Scalability and Programmability, McGraw-Hill, International Edition, 1993.
4. T. J. Fountain, D Sima , Peter Kacsuk, Advanced Computer Architectures: A Design Space Approach, Addison-Wesley, 1997.

Note: The latest editions of the books should be followed.

Master of Science (Computer Science) Semester – I  
(Session 2023-24)  
**COURSE CODE: MCSL-1113**  
**NETWORK SECURITY PRACTICES**

**Course Outcomes:**

After passing course the student will be able to:

CO1: Understand basics of cryptography, network security, services, mechanisms and defining various terms as vulnerability, threat and attack.

CO2: Comprehend the application of various private and public cryptography techniques.

CO3: Have understanding of data integrity, authentication, digital signatures and hash functions.

CO4: Understand various network security concepts as IPSec, Web security, PGP, Email security.

Master of Science (Computer Science) Semester – I  
(Session 2023-24)  
**COURSE CODE: MCSL-1113**  
**NETWORK SECURITY PRACTICES**

**L-T-P: 3-1-0**

**Max. Marks: 100**

**Credits: 4**

**Examination Time: 3 Hours**

**Theory: 80**

**CA: 20**

**Instructions for Paper Setter -**

Eight questions of equal marks (16 marks each) are to set, two in each of the four sections (A-D). Questions of Sections A-D should be set from Units I-IV of the syllabus respectively. Questions may be divided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each section. The fifth question may be attempted from any section.

**UNIT -I**

**Introduction:** Overview, Security attacks (Interruption, Interception, Modification and Fabrication) and services (confidentiality, authentication, integrity, non-repudiation, access control and availability), types of attacks, model for network security, CAINA Properties.

**Classical and Modern Cryptography Techniques:** Conventional encryption model, classical encryption techniques, Simplified DES, Principles of Block ciphers, DES and its strength.

**UNIT -II**

**Classical and Modern Cryptography Techniques:** Triple DES, Blowfish, CAST – 128, linear and differential cryptanalysis, steganography.

**Confidentiality:** Traffic confidentiality and random number generation.

**Public Key Encryption Methods:** Principles, RSA Algorithm, Diffie– Hellman key exchange, Elliptic curve cryptography.

**UNIT -III**

**Hash functions:** Applications of Hash Functions, Two Simple Hash Functions, Requirements and Security, SHA.

**Message Authentication Codes:** Requirements, Functions, Requirements of Message Authentication codes, Security of MACs, MACs based on HMAC, MACs based on Block Ciphers: DAA and CMAC.

**Digital Signatures:** Basics, Digital signature standard.

## UNIT -IV

**Key Management and Distribution:** Symmetric Key Distribution using Symmetric Encryption, Symmetric Key Distribution using Asymmetric Encryption, X.509 Certificates, Distribution of Public Keys, PKI.

**Other Securities:**

**Transport Level Security:** Web Security Considerations.

**Electronic Mail security:** Pretty Good Privacy.

**IP Security:** IP Security Overview and Policy, ESP, Combining security Associations.

### References / Textbooks:

1. William Stallings, Cryptography and Network Security: Principles and Practice, Pearson Education, 2017.
2. William Stallings, Network Security Essentials: Applications and Standards, Pearson Education, 2014.
3. Atul Kahate, Cryptography and Network Security, Tata McGraw-Hill Publishing Company Limited, 2013.
4. Bruce Schneier, Applied Cryptography: Protocols, Algorithms and Source Code in C, Wiley Publications, 2007.
5. V. K. Pachghare, Cryptography and Information Security Paperback, PHI Publications, 2015.
6. Behrouz A. Forouzan, Cryptography & Network Security, McGraw-Hill, 2008.

Note: The latest editions of the books should be followed.

Master of Science (Computer Science) Semester – I  
(Session 2023-24)

**COURSE CODE: MCSL - 1114**

**DISCRETE STRUCTURES**

**Course Outcomes:**

After passing course the student will be able to:

CO1: Understand and construct simple mathematical proofs of important principles like Pigeonhole principle, Inclusion-Exclusion Principle.

CO2: Comprehend advanced data structures like Graphs and Trees along with their associated operations.

CO3: Apply skills to solve problems on elementary counting techniques, factorials and recurrence relations.

CO4: Comprehend various combinatorial structures and Boolean Algebra.



Master of Science (Computer Science) Semester – I

(Session 2023-24)

**COURSE CODE: MCSL-1114**

**DISCRETE STRUCTURES**

**L-T-P: 3-1-0**

**Credits: 4**

**Examination Time: 3 Hours**

**Max. Marks: 100**

**Theory: 80**

**CA: 20**

**Instructions for Paper Setter -**

Eight questions of equal marks (16 marks each) are to set, two in each of the four sections (A-D). Questions of Sections A-D should be set from Units I-IV of the syllabus respectively. Questions may be divided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each section. The fifth question may be attempted from any section.

**UNIT-I**

**Sets and Functions:**

Sets, Relations, Functions, Pigeonhole principle, Inclusion – Exclusion Principle, Equivalence and Partial orderings, Elementary counting techniques, relation of partial order partitions, binary relations.

**UNIT-II**

**Graph Theory:**

Definition, Walks, Paths, Directed and Undirected graphs, connected graphs, regular and bipartite graphs, Eulerian chains and cycles. Hamiltonian chains and cycles, planar graphs, Trees and rooted tree, Spanning trees, Chromatic number Connectivity and other graphical parameter application.

**UNIT-III**

**Combinatorial Mathematics:**

Basic counting principles Permutations and combinations, Recurrence relations, generating Function, Application.

**UNIT-IV**

**Rings and Boolean algebra:** Rings Subrings morphism of rings ideals and quotient rings. Euclidean domains Integral domains and fields Boolean Algebra direct product morphisms Application of Boolean algebra in logic circuits and switching functions.

**References / Textbooks:**

1. Ehrig, H., Mahr, B., Fundamentals of Algebraic Specification I, EATCS Monographs on Theory. Comp. Sc. Vol. 6 spinger, Berlin 1985.
2. Gersting J., Mathematical Structures for Computer Science, W.H. Freeman, New York, 1987.

3. Gibons, A., Algorithmic Graph theory, Cambridge University Press, 1985.
4. Knuth, D.E., The art of Computer Programming Vol. I: Fundamental Algorithms, Reading, Mas, Adison Wesley 1973.
5. Kolman B., Busby R., Discrete Mathematical Structures for Computer Science, Prentice Hall Englewod Cliffs, 1984.
6. Sahni, S., Concepts in Discrete Mathematics Fridley MN., Camelot Publ. Comp., 1981.
7. Schmidt G.,Strohlein T., Relations Graphs Program, EATS Monograph on Theor.Comp.Sc.Vol.29, Berlin Spinger 1993.
8. Wheler W., Universal Algebra for Computer Scientist, EATCS Monographs on Theor.Comp.Sc.Vol.25 Spinger-Verlag, Berlin 1992.

Note: The latest editions of the books should be followed.

Master of Science (Computer Science) Semester – I  
(Session 2023-24)

**COURSE CODE: MCSL-1115**  
**ARTIFICIAL INTELLIGENCE**

**Course Outcomes:**

After passing course the student will be able to:

CO1: Understand various search strategies used in AI for finding solution to a problem.

CO2: Gain knowledge of propositional and predicate logic.

CO3: Represent planning in AI in different scenarios.

CO4: Understand basics of fuzzy logic, learning in AI and neural network.

Master of Science (Computer Science) Semester – I

(Session 2023-24)

**COURSE CODE: MCSL-1115**  
**ARTIFICIAL INTELLIGENCE**

**L-T-P: 4-0-0**

**Max. Marks: 100**

**Credits: 4**

**Examination Time: 3 Hours**

**Theory: 80**

**CA: 20**

**Instructions for Paper Setter -**

Eight questions of equal marks (16 marks each) are to set, two in each of the four sections (A-D). Questions of Sections A-D should be set from Units I-IV of the syllabus respectively. Questions may be divided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each section. The fifth question may be attempted from any section.

**UNIT-I**

**Introduction-** What is intelligence, Foundations of Artificial Intelligence (AI), History of AI Problem Solving- Formulating problems, problem types, states and operators, state space, search strategies.

**Uninformed Search Strategies** – BFS, DFS, UCS, Depth Limited Search, Iterative Deepening Search, Bi-directional Search. **Informed Search Strategies-** Best first search, A\* algorithm, heuristic functions, Iterative deepening A\*(IDA), small memory A\*(SMA\*).

**UNIT-II**

**Game playing** - Perfect decision game, Imperfect decision game, Evaluation function, Alpha-Beta Pruning.

**Reasoning-** Representation, Inference, Propositional Logic, Predicate Logic (First Order Logic), logical reasoning, forward chaining, backward chaining.

**UNIT-III**

**Planning-** Basic representation of plans, partial order planning, planning in the blocks world, Hierarchical planning, Conditional planning, representation of resource constraints, measures, temporal constraints.

**Uncertainty** - Basic probability, Baye's rule, Belief networks, Default reasoning, Fuzzy sets and Fuzzy logic.

## UNIT-IV

**Inductive Learning** - decision trees, rule based learning, current-best-hypothesis search, least commitment search, neural networks, reinforcement learning, genetic algorithms, Other learning methods - Neural Networks, Re-enforcement learning, Genetic algorithms, Communication among agents.

### References / Textbooks:

1. Stuart J. Russell, Peter Norvig, Artificial Intelligence: A Modern Approach, Pearson India Education Services Pvt. Ltd., 2015.
2. Kevin Knight, Elaine Rich, B. Nair, Artificial Intelligence, McGraw Hill, 2008.
3. George F. Luger, Artificial Intelligence, Pearson Education, 2001.
4. Nils J. Nilsson, Artificial Intelligence: A New Synthesis, Morgan Kauffman, 2002.

Note: The latest editions of the books should be followed.

Master of Science (Computer Science) Semester – I  
(Session 2023-24)  
**COURSE CODE: MCSP - 1116**  
**LAB ON ADVANCED DATA STRUCTURES**

**L-T-P: 0-0-2**

**Credits: 2**

**Examination Time: 3 Hours**

**Max. Marks: 50**

**Practical: 40**

**CA:10**

Programs based on Advanced Data Structures.

Master of Science (Computer Science) Semester – II

**(Session 2023-24)**

**COURSE CODE: MCSL-2111**

**THEORY OF COMPUTATION**

**Course Outcomes:**

After passing this course the student will be able to:

CO1: Comprehend various grammars in Chomsky hierarchy and their closure properties.

CO2: Define production rules for Context Free Grammar (CFG), Convert CFG into Chomsky and Greibach Normal Form.

CO3: Apply Pumping Lemma to find to identify membership of a language.

CO4: Construct computing machines like Finite Automata, Pushdown Automata, Turing machine, etc.

Master of Science (Computer Science) Semester – II  
(Session 2023-24)

**COURSE CODE: MCSL-2111**  
**THEORY OF COMPUTATION**

**L-T-P: 3-1-0**

**Credits: 4**

**Examination Time: 3 Hours**

**Max. Marks: 100**

**Theory: 80**

**CA: 20**

**Instructions for Paper Setter -**

Eight questions of equal marks (16 marks each) are to set, two in each of the four sections (A-D). Questions of Sections A-D should be set from Units I-IV of the syllabus respectively. Questions may be divided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each section. The fifth question may be attempted from any section.

**UNIT-I**

Chomsky Hierarchy, regular expressions, Operations on Regular Sets, Regular grammars, Linear Grammar, equivalence of Regular Grammars, properties of regular languages, pumping lemma, Closure properties.

**UNIT-II**

Finite Automata – DFA, transition graphs, non-deterministic FA, equivalence of DFA and NFA, Minimization of NFA,  $\epsilon$ -NFA and its conversion into NFA, Mealy and Moore Machines.

Context Free Languages – Leftmost and rightmost derivation, parsing and ambiguity, Chomsky normal form, Greibach Normal form.

**UNIT-III**

Pushdown Automata – NDPDA, DPDA, context free languages and PDA, comparison of deterministic and non-deterministic versions, closure properties, pumping lemma for CFL

Context Sensitive Languages, Variations, Linear Bounded Automata, Closure Properties, The Kuroda Normal Form, One sided Context Sensitive Grammars.

**UNIT-IV**

Turing Machines, variations, halting problem, Post Correspondence Problem (PCP)



Properties of LL(k) and LR(k) grammars, Decidability, Recursive and Recursively Enumerable Languages, Closure properties.

**References / Textbooks:**

1. K.L.P. Mishra and N. Chandrasekaran, "Theory of Computer Science, Third Edition", PHI Learning Private Limited, 2011.
2. John E. Hopcroft, Rajeev Motwani, Jeffrey D. Ullman, "Introduction to Automata Theory", Languages and Computation, Pearson Education.
3. M. Sipser, "Introduction to the Theory of Computation", Second Edition, Cengage Learning.
4. K. V. N. Sunitha , N. Kalyani, "Formal Languages and Automata Theory", McGraw-Hill, 2010.
5. Stephen Wolfram, "Theory and Applications of Cellular Automata", World Scientific, 1986.
6. G.E. Revesz, "Introduction to Formal Languages", Dover Publications, 1991.
7. M. A. Harrison, "Introduction to Formal Language Theory", Addison-Wesley, 1978.
8. R.K. Shukla," Theory of Computation", Cengage Learning.
9. Peter Linz, An Introduction to Formal Languages and Automata, Third Edition, Narosa Publishers, 1998.

Master of Science (Computer Science) Semester – II  
(Session 2023-24)

**COURSE CODE: MCSL-2112**

**IMAGE PROCESSING**

**Course Outcomes:**

After passing this course the student will be able to:

CO1: Identify current applications in the field of digital image processing along with its basics.

CO2: Comprehend fundamental concepts of Digital Image Processing like human visual system model, image signal representation, imaging system specification

CO3: Identify basic image processing operations.

CO4: Comprehend various colour models and colour image processing techniques.

Master of Science (Computer Science) Semester – II  
(Session 2023-24)

**COURSE CODE: MCSL-2112**

**IMAGE PROCESSING**

**L-T-P: 3-1-0**

**Credits: 4**

**Examination Time: 3 Hours**

**Max. Marks: 100**

**Theory: 80**

**CA: 20**

**Instructions for Paper Setter -**

Eight questions of equal marks (16 marks each) are to set, two in each of the four sections (A-D). Questions of Sections A-D should be set from Units I-IV of the syllabus respectively. Questions may be divided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each section. The fifth question may be attempted from any section.

**UNIT-I**

**Background:** Introduction to electronic systems for image transmission and storage, computer processing and recognition of pictorial data, overview of practical applications.

**UNIT-II**

**Fundamentals:** Mathematical and perceptual preliminaries, human visual system model, image signal representation, imaging system specification building image quality, role of computers, image data formats.

**UNIT-III**

**Image Processing Techniques:** Image enhancement, image restoration, image data compression and statistical pattern recognition.

**Applications of Image Processing:** Picture data archival, machine vision, medical image processing.

**UNIT-IV**

**Techniques of Colour Image Processing:** Colour image signal representation, colour system transformations, extension of processing techniques to colour domain.

**References / Textbooks:**

1. Pratt, W.K. Digital Image Processing, John Wiley, N.Y./1978.
2. Rosenfield, A and Kak, A.C., Picture processing, Academic Press N.Y., 1982.

3. Jain, A.K., Fundamentals of Digital Image Processing, Englewood Cliffs, Prentice Hall, 1989.
4. Chris Soloman, Stuart Gibson, Fundamentals of Digital Image Processing: A Practical Approach using MatLab, John Wiley and Sons, 2007.
5. Gonzalez and Woods, Digital Image Processing, Addison Wesley, 2000.
6. Jayaraman S, Veerakumar T, Esakkirajan S, Digital Image Processing, Tata McGraw Hill Education (2017), 1<sup>st</sup> Edition

Master of Science (Computer Science) Semester – II  
(Session 2023-24)  
**COURSE CODE: MCSL-2113**  
**ADVANCED PROGRAMMING CONCEPTS**

**Course Outcomes:**

After passing this course the student will be able to:

CO1: Comprehend fundamentals of Java programming.

CO2: Apply OOPs concepts to model real world problems for its simplified implementation.

CO3: Identify the utilization of Applets and multithreading.

CO4: Work with Graphical User Interface through Swings and Event handling.

Master of Science (Computer Science) Semester – II  
(Session 2023-24)  
**COURSE CODE: MCSL-2113**  
**ADVANCED PROGRAMMING CONCEPTS**

**L-T-P: 4-0-0**

**Max. Marks: 100**

**Credits: 4**

**Examination Time: 3 Hours**

**Theory: 80**

**CA: 20**

**Instructions for Paper Setter -**

Eight questions of equal marks (16 marks each) are to set, two in each of the four sections (A-D). Questions of Sections A-D should be set from Units I-IV of the syllabus respectively. Questions may be divided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each section. The fifth question may be attempted from any section.

**UNIT-I**

**Introduction to Advanced Programming using Java Fundamentals:** Features, Objects Oriented Basis, Character Set, Operators, Data Types, Control Structures

**UNIT-II**

Classes, Inheritance, Polymorphism, Packages & Interfaces, Exception Handling

**UNIT-III**

**Multithreading:** Java Thread model, Thread Priorities, Synchronization, Interthread communication.

**Applet:** Applet basics, Applet architecture, Applet: Display, Repaint, Parameter Passing

**UNIT-IV**

**Swings:** Window Fundamentals, Working with JFrame Windows, Graphics, Controls, Color and Fonts.

**Events Handling:** The Delegation Event Model, Event Classes, Event Listener Interfaces.

**References / Textbooks:**

1. Herbet Schildt & Naughton, Complete Reference: Java, Tata Mc Graw Hill Education, 5th Edition, 2006.
2. Jane Jawoske, Java Unleashed, SAM5, Tech Me dia 2006.

3. Java 8 Programming Black Book, D.T. Editorial Services, 2015.
4. E Balagurusamy, Programming with Java – A Primer, McGraw Hill Education, 2017.
5. Kathy Sierra and Bert Bates, Head First Java, O'Reilly Publications, 2<sup>nd</sup> Edition.
6. Herbert Schildt, Java – A Beginner's Guide, Oracle Press, 7<sup>th</sup> Edition.

Master of Science (Computer Science) Semester – II  
(Session 2023-24)

**COURSE CODE: MCSL – 2114**

**CLOUD COMPUTING**

**Course Outcomes:**

After passing this course the student will be able to:

CO1: Articulate the main concepts, key technologies, strengths and limitations of Cloud computing.

CO2: Identify the architecture and infrastructure of various Cloud services and deployment models.

CO3: Identify the application of programming and security model in cloud computing.

CO4: Comprehend various advance topics in the field of cloud computing.



Master of Science (Computer Science) Semester – II  
(Session 2023-24)

**COURSE CODE: MCSL – 2114**  
**CLOUD COMPUTING**

**L-T-P: 4-0-0**

**Credits: 4**

**Examination Time: 3 Hours**

**Max. Marks: 100**

**Theory: 80**

**CA: 20**

**Instructions for Paper Setter -**

Eight questions of equal marks (16 marks each) are to set, two in each of the four sections (A-D). Questions of Sections A-D should be set from Units I-IV of the syllabus respectively. Questions may be divided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each section. The fifth question may be attempted from any section.

**UNIT-I**

**Introduction:** Definition, Vision, Reference Model, Benefits, Limitations, Terminology, Open Challenges.

**Virtualization:** Definition, Type of Virtualization, Benefits, Limitations, Virtualization and Cloud, Virtual Appliance.

**UNIT-II**

**Cloud Computing Architecture:** Service Models, Deployment Models, Cloud Entities, Cloud Clients, Service Level Agreement (SLA) and Quality of Service (QoS) in Cloud Computing.

**UNIT-III**

**Programming Models in Cloud:** Thread Programming, Task Programming and Map–Reduce Programming.

**Cloud Security:** Infrastructure Security, Data Security, Identity and Access Management, Privacy Management, Security as a Service on Cloud.

**UNIT-IV**

**Advance Topic in Cloud:** Energy Efficiency in cloud, Market Oriented Cloud Computing, Big– Data Analytics, Federated Cloud Computing.

**Reference / Textbooks:**

1. Rajkumar Buyya, Christian Vecchiola and Thamarai Selvi, Mastering Cloud Computing: Foundation and Application Programming, Tata McGraw Hill, ISBN-13: 978-1-25-902995-0, New Delhi, India, Feb 2013.
2. Tim Mather, Subra Kumaraswamy, Shahed Latif, Cloud Security and Privacy, O'Reilly, ISBN-13: 978-8-18-404815-5.
3. Barrie Sosinsky, Cloud Computing Bible, Wiley India Pvt. Ltd., ISBN-13: 978-8-12-652980-3, New Delhi, India, 2011.
4. Dr. Saurabh Kumar, Cloud Computing: Insights into New-Era Infrastructure, Wiley India Pvt. Ltd, ISBN-13: 978-8-12-652883-7, New Delhi, India, 2011.
5. Fern Halper, Hurwitz, Robin Bloor, Marcia Kaufman, Cloud Computing for Dummies, Wiley India Pvt. Ltd, ISBN-13: 978-0-47-059742-2, New Delhi, India, 2011.

Master of Science (Computer Science) Semester – II

**(Session 2023-24)**

**COURSE CODE: MCSL-2115**

**DISTRIBUTED DATABASE SYSTEMS**

**Course Outcomes:**

After passing this course the student will be able to:

CO1: Comprehend different kind of distributed databases, data fragmentation and involved transparencies.

CO2: Translate global queries into fragment queries by following different equivalence transformation rules for queries.

CO3: Comprehend query optimization along with management of distributed transaction and recovery mechanisms.

CO4: Identify deadlock situations along with application of concurrency control and reliability mechanisms to prevent deadlocks.

Master of Science (Computer Science) Semester – II  
(Session 2023-24)

**COURSE CODE: MCSL-2115**

**DISTRIBUTED DATABASE SYSTEMS**

**L-T-P: 3-1-0**

**Max. Marks: 100**

**Credits: 4**

**Examination Time: 3 Hours**

**Theory: 80**

**CA: 20**

**Instructions for Paper Setter -**

Eight questions of equal marks (16 marks each) are to set, two in each of the four sections (A-D). Questions of Sections A-D should be set from Units I-IV of the syllabus respectively. Questions may be divided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each section. The fifth question may be attempted from any section.

**UNIT-I**

Introduction to distributed databases, comparison of distributed and centralized systems, DDBMS, global relations, fragment and physical image, types of schemas, methods of fragmentation of a relation, levels of transparency in a distributed system, integrity constraints.

**UNIT-II**

Representation of database operation in form of a query, operation in form of a query, operations on a query, unary and binary tree in a query, converting a global query into fragment query, join and union operations involving a query, aggregate functions, and parametric queries.

**UNIT-III**

Introduction to query optimization, estimation of profiles of algebraic operations, optimization graphs, reduction of relation using semi-join and join operation.

Properties and goals of transaction management, distributed transactions, recovery mechanism in case of transaction failures, log based recovery, check pointing, and communication and site failures in case of a transaction and methods to handle them, serializability and timestamp in distributed databases.

**UNIT-IV**

Introduction to distributed deadlocks, local and global wait for graphs, deadlock detection using centralized and hierarchical controllers, prevention of deadlocks, 2 and 3 phase locking and commitment protocols, reliability in commitment and locking protocols, reliability and concurrency control, reliability and removal of inconsistency.

Distributed database administration, authorization and protection in distributed databases, distributed database design, heterogeneous database system.

## References / Textbooks:

1. Stefano Ceri and Guiseppe Pelagatti, Distributed Databases Principles and Systems, McGraw-Hill International Editions, 2004.
2. David Bell, Jame Grimson, Distributed Database Systems, Addison-Wesley, 1992.
3. M. Tamer Ozsü, Patrick Valduriez, Principles of Distributed Database Systems, Prentice Hall, 2002, 2<sup>nd</sup> Edition.
4. Romez Elmasri, Shamkant B. Navathe, 'Fundamentals of Database Systems' Pearson Education, 2005.
5. Silberschatz, Korth, Sudershan, Database System Concept, 4th Ed. McGraw Hill, 2006.
6. Connolly & Begg "Database Systems – A practical approach to Design, Implementation and Management, 3rd Ed. Pearson Education, 2005.

Master of Science (Computer Science) Semester – II  
(Session 2023-24)  
COURSE CODE: MCSP-2116  
**LAB ON ADVANCED PROGRAMMING CONCEPTS**

**L-T-P: 0-0-2**

**Credits: 2**

**Examination Time: 3 Hours**

**Max. Marks: 50**

**Practical: 40**

**CA:10**

Implementations based on advanced programming concepts.

Master of Science (Computer Science) Semester – III  
(Session 2023-24)  
**COURSE CODE: MCSL- 3111**  
**DATA MINING AND DATA WAREHOUSING**

**Course Outcomes:**

After passing this course the student will be able to:

CO1: Understand the basic concepts, need of data mining and procedure for data pre-processing.

CO2: Analyse architecture of data warehouse.

CO3: Comprehend various data mining and clustering techniques.

CO4: Identify various applications areas, trends and challenges of data mining.

Master of Science (Computer Science) Semester – III  
(Session 2023-24)  
**COURSE CODE: MCSL- 3111**  
**DATA MINING AND DATA WAREHOUSING**

**L-T-P: 4-0-0**

**Max. Marks: 100**

**Credits: 4**

**Examination Time: 3 Hours**

**Theory: 80**

**CA:20**

**Instructions for Paper Setter -**

Eight questions of equal marks (16 marks each) are to set, two in each of the four sections (A-D). Questions of Sections A-D should be set from Units I-IV of the syllabus respectively. Questions may be divided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each section. The fifth question may be attempted from any section.

**UNIT I**

**Data Mining:** Introduction, Need of Data mining, Data mining Process, difference between DM & ML.

**Data Pre-processing:** Pre-processing the data, Data cleaning, data integration, data transformation, data reduction.

**UNIT II**

**Data Warehousing:** Concepts of Data Warehousing, difference between operational database systems and data warehousing, Need of a separate data warehouse.

From data Warehouse to Data Mining- OLAP and OLAM, Three Tier Data Warehouse Architecture.

**UNIT III**

**Integration of Data Mining with DB/DW systems:** DM Implementation Process, Knowledge discovery in database.

**Data Mining Techniques:** Classification, Clustering, Regression, Association Rules.

**Clustering:** Applications, Requirements, Clustering Methods.



## UNIT IV

**Applications, Trends and Challenges:** Introduction to DMQL, Applications of Data Mining, Challenges in implementation of data mining, trends in Data Mining. Basic knowledge about useful data mining tools.

### **References / Textbooks:**

1. Jiawei Han, Micheline Kamber, Jian Pei, Data Mining: Concepts and Techniques, Morgan Kaufmann, 2012.
2. Alex Berson, Stephen J. Smith, Data Warehousing, Data Mining and OLAP, Tata McGraw 2008.
3. Silberschatz, Korth, Sudershan, Database System Concepts, McGraw Hill, 2002.
4. Thomas M. Connolly, Carolyn E. Begg, Database Systems: A Practical Approach to Design, Implementation and Management, Addison-Wesley, 2002.
5. Pang-Ning Tan, Michael Steinbach, Vipin Kumar, Introduction to Data Mining, Pearson Addison Wesley, 2006.
6. Prateek Bhatia, Data Mining and Data Warehousing: Principles and Practical Techniques, Cambridge University Press, 2019.

Note: The latest editions of the books should be followed.

Master of Science (Computer Science) Semester – III

(Session 2023-24)

**COURSE CODE: MCSL-3112**

**SYSTEM SOFTWARE**

**Course Outcomes:**

After passing this course the student will be able to:

CO1: Study and analyse various components of system software like translators, loaders, interpreters, compilers, assemblers etc.

CO2: Apply macros for making the assembly level program modular.

CO3: Analyse the working of different phases of compiler.

CO4: Comprehend different system software like OS, DBMS, text editors etc.

Master of Science (Computer Science) Semester – III

(Session 2023-24)

**COURSE CODE: MCSL-3112**

**SYSTEM SOFTWARE**

**L-T-P: 4-0-0**

**Max. Marks: 100**

**Credits: 4**

**Examination Time: 3 Hours**

**Theory: 80**

**CA:20**

**Instructions for Paper Setter -**

Eight questions of equal marks (16 marks each) are to set, two in each of the four sections (A-D). Questions of Sections A-D should be set from Units I-IV of the syllabus respectively. Questions may be divided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each section. The fifth question may be attempted from any section.

**UNIT I**

**Introduction to System Software:** Evolution of System Software, components of system software, Translators, loaders, interpreters, compiler, assemblers.

**UNIT II**

**Assemblers:** Overview of assembly process, design of one pass and two assemblers.  
**Macroprocessors:** Macro definition and expansion, concatenation of macro parameters, generations of unique labels, conditional macro expansion, Recursive macro expansion.

**UNIT III**

**Compilers:** Phases of compilation process, logical analysis, parsing, storage management optimisation. Incremental compilers, cross compilers, P code compilers.

**UNIT IV**

**Loaders and Linkage Editors:** Basic loader functions. Relocation, program linking, linkage, editors, dynamic linking bootstrap loaders.

**Other System Software:** Operating system, DBMS, text editors, Interactive debugging systems.

**References / Textbooks:**

1. Leland L. Beck, System Software: An introduction to System Programming, Addison Wesley, 1997.
2. D.M. Dhamdhere, Introduction to System Software, Tata McGraw Hill, 1986.

3. D.M. Dhamdhare, System Software and Operating Systems, Tata McGraw Hill Education, 1992.
4. Madrich, Stuart, Operating Systems, McGraw Hill, 1974.
5. Stern Nancy, Assembler Language Programming for IBM and IBM compatible computers, John Wiley, 1991.

Note: The latest editions of the books should be followed.

Master of Science (Computer Science) Semester – III  
(Session 2023-24)

**COURSE CODE: MCSL-3113**  
**ADVANCED WEB TECHNOLOGIES**

**Course Outcomes:**

After passing this course the student will be able to:

CO1: Apply standard, form and validation controls.

CO2: Create master page and database connection.

CO3: comprehend different graphical layouts of website.

CO4: Work on other core issues of website like cookies, caching and dependencies.

Master of Science (Computer Science) Semester – III  
(Session 2023-24)

**COURSE CODE: MCSL-3113**  
**ADVANCED WEB TECHNOLOGIES**

**L-T-P: 4-0-0**

**Max. Marks: 100**

**Credits: 4**

**Examination Time: 3 Hours**

**Theory: 80**

**CA:20**

**Instructions for Paper Setter -**

Eight questions of equal marks (16 marks each) are to set, two in each of the four sections (A-D). Questions of Sections A-D should be set from Units I-IV of the syllabus respectively. Questions may be divided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each section. The fifth question may be attempted from any section.

**UNIT-I**

**Standard Controls:** Display information, Accepting user input, Submitting form data, Displaying images, Using the panel control, Using the hyperlink control.

**Validation Controls:** Using the required field validator control, using the range validator control using the compare validator control, using the regular expression validator control, Using the custom validator control, Using the validation summary controls.

**UNIT-II**

**Rich Controls:** Accepting file uploads, Displaying a calendar, Displaying advertisement, Displaying different page views, Displaying a wizard.

**Designing Website with Master Pages:** Creating master pages, Modifying master page content, Loading master page dynamically.

**SQL Data Source Control:** Creating database connections, Executing database commands, Using ASP.NET parameters with the SQL data source controls, Programmatically executing SQL data source commands, Caching database data with the SQL data Source controls.

**UNIT-III**

**List Controls:** Dropdown list control, Radio button list controls, list box controls, bulleted list controls, custom list controls.

**Grid View Controls:** Grid view control fundamentals, Using field with the grid view control, Working with grid view control events extending the grid view control.

## UNIT-IV

**Building Data Access Components with ADO.NET:** Connected the data access, Disconnected data access, Executing a synchronous database commands, Building data base objects with the .NET framework.

**Maintaining Application State:** Using browser cookies, Using session state, Using profiles.

**Caching Application Pages and Data:** page output caching, partial page caching, data source caching, data caching, SQL cache dependences.

### **References / Textbooks:**

1. Stephen Walther, ASP.NET 3.5, Pearson Education, 2005.
2. Matthew MacDonald, ASP.NET: The Complete Reference, McGraw-Hill/Osborne, 2002.
3. Imar Spaanjaars, Beginning ASP.NET 3.5, John Wiley & Sons, 2008.
4. Scott Millett, Professional ASP.NET Design Patterns, Wiley, 2010.
5. Glenn Johnson, Programming Microsoft® ADO.NET 2.0 Applications: Advanced Topics, WP Publishers & Distributors Pvt Limited, 2005.

Note: The latest editions of the books should be followed.

Master of Science (Computer Science) Semester – III

**(Session 2023-24)**

**COURSE CODE: MCSL-3114**

**DESIGN AND ANALYSIS OF ALGORITHMS**

**Course Outcomes:**

After passing this course the student will be able to:

CO1: Analyse performance and complexity of various algorithms.

CO2: Comprehend greedy approach along with its application in various problems.

CO3: Comprehend dynamic programming approach along with its application in various problems.

CO4: Implement backtracking, search and traversal techniques.



Master of Science (Computer Science) Semester – III  
(Session 2023-24)  
**COURSE CODE: MCSL-3114**  
**DESIGN AND ANALYSIS OF ALGORITHMS**

**L-T-P: 4-0-0**

**Max. Marks: 100**

**Credits: 4**

**Examination Time: 3 Hours**

**Theory: 80**

**CA:20**

**Instructions for Paper Setter -**

Eight questions of equal marks (16 marks each) are to set, two in each of the four sections (A-D). Questions of Sections A-D should be set from Units I-IV of the syllabus respectively. Questions may be divided into parts(not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each section. The fifth question may be attempted from any section

**UNIT-I**

**Introduction:** Concept of Algorithm, Algorithm Specification, Performance Analysis (Time and Space Complexities), Asymptotic Notations.

**Divide and Conquer:** General Method, Binary Search, Finding the Maximum and Minimum, Quick Sort, Selection.

**UNIT-II**

**Greedy Method:** General Method, Knapsack Problem, Minimum Cost Spanning Trees (Prim's Algorithm, Kruskal's Algorithm) and Single-Source Shortest Path.

**UNIT-III**

**Dynamic Programming:** General Single Method, Multistage Graphs, All Pairs Shortest Paths, Single-Source Shortest Paths, Optimal Binary Search Tress, 0/1 Knapsack and Travelling Salesman Problem.

**UNIT-IV**

**Backtracking:** General Method, 4-Queens Problem, Graph Coloring and Hamiltonian Cycles.

**Search and Traversal Technique:** Techniques for Binary Trees, Techniques for Graphs.

**References / Textbooks:**

1. V. Aho, J.E. Hopcroft, J.D. Ullman, Design and Analysis of Algorithms, Addison Wesley, 1976.
2. Horowitz, S. Sahni, Fundamentals of Computer Algorithms, Galgotia Publishers, 1984.
3. K. Mehlhorn, Data Structures and Algorithms, Vols. 1 and 2, Springer Verlag, 1984.

4. Purdom, Jr. and C. A. Brown, The Analysis of Algorithms, Holt Rinechart and Winston, 1985.
5. D. E. Kunth, The Art of Computer Programming, Vols. I and 3, Addison Wesley, 1975.
6. AnanyLevitin, Introduction to the Design & Analysis of Algorithms, Addison, Wesley, 2002.

Note: The latest editions of the books should be followed.

Master of Science (Computer Science) Semester – III

(Session 2023-24)

**COURSE CODE: MCSL-3115**

**SOFTWARE TESTING**

**Course Outcome:**

After passing this course the student will be able to:

CO1: Comprehend fundamental concepts in software testing.

CO2: Analyse various software testing techniques.

CO3: Comprehend object-oriented software testing methods.

CO4: Perform test planning and debugging.

Master of Science (Computer Science) Semester – III

**(Session 2023-24)**  
**COURSE CODE: MCSL-3115**  
**SOFTWARE TESTING**

**L-T-P: 4-0-0**

**Max. Marks: 100**

**Credits: 4**

**Examination Time: 3 Hours**

**Theory: 80**

**CA:20**

**Instructions for Paper Setter -**

Eight questions of equal marks (16 marks each) are to set, two in each of the four sections (A-D). Questions of Sections A-D should be set from Units I-IV of the syllabus respectively. Questions may be divided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each section. The fifth question may be attempted from any section.

**UNIT - I**

Introduction to Software Testing, The Tester's Role in a Software Development Organization, Origins of Defects, Cost of defects, Fundamentals of Test Process, General Principles of Testing, Test Metrics, Role of Testing in SDLC, Comparing Software and Hardware Testing, Verification and Validation.

**UNIT - II**

Introduction to Test cases, test case design, types of testing, Structural versus Functional Technique Categories, Static versus Dynamic Testing, Control flow & Data flow testing, Random Testing, Requirements based testing, Black Box Testing, White Box Testing.

**UNIT - III**

Modeling of Software, Object Oriented Modeling based on UML, Requirements and Specifications with Use Case Diagrams; Object Oriented Testing Issues, OO Testing Methodologies, Analysis and Design Testing, UML Based, Class Testing, Integration Testing.

**UNIT - IV**

GUI testing, Validation testing, Regression testing, Scenario testing, Advances in Software Testing Methods. Test Organization, Test Planning, Test Strategies, Test Prioritization, Debugging. Software test automation – skill needed for automation – scope of automation.

**References / Textbooks:**

1. Paul Jorgensen, Software Testing: A Craftsman's Approach, Auerbach Publications, 2013.
2. Rex Black, Erik van Veenendaal, Dorothy Graham, Foundations of Software Testing: ISTQB Certification, Cengage Publications, 2015.
3. Glenford J. Myers, The Art of Software Testing, Wiley, 2004.

4. Paul Ammann, Jeff Offutt, Introduction to Software Testing, Cambridge University Press, 2016.
5. Srinivasan Desikan, Ramesh Gopaldaswamy, Software Testing: Principles and Practices, Pearson Publications, 2009.

Note: The latest editions of the books should be followed.

Master of Science (Computer Science) Semester – III  
(Session 2023-24)  
**COURSE CODE: MCSP- 3116**  
**LABON ADVANCED WEB TECHNOLOGIES**

**L-T-P: 0-0-3**

**Credits: 3**

**Examination Time: 3 Hours**

**Max. Marks: 100**

**Practical: 80**

**CA:20**

Programming Laboratory on Advanced Web Technologies.

Master of Science (Computer Science) Semester – IV  
(Session 2023-24)  
**COURSE CODE: MCSL-4111**  
**ADVANCED SOFTWARE ENGINEERING**

**Course Outcomes:**

After passing this course the student will be able to:

CO1: Comprehend Quality Assurance and Control through application of various quality models.

CO2: Comprehend software risk and configuration management.

CO3: Implement structural modelling of the software.

CO4: Implement behavioural modelling of the software.

Master of Science (Computer Science) Semester – IV  
(Session 2023-24)  
**COURSE CODE: MCSL-4111**  
**ADVANCED SOFTWARE ENGINEERING**

**L-T-P: 3-1-0**

**Credits: 4**

**Examination Time: 3 Hours**

**Max. Marks: 100**

**Theory: 80**

**CA:20**

**Instructions for Paper Setter -**

Eight questions of equal marks (16 marks each) are to set, two in each of the four sections (A-D). Questions of Sections A-D should be set from Units I-IV of the syllabus respectively. Questions may be divided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each section. The fifth question may be attempted from any section.

**UNIT I**

**Software Quality Assurance Concepts and Standards:** Quality Concepts, Quality Control, Quality Assurance, SQA Activities, Software Reviews, Formal Technical Reviews, Review Guidelines, Software Reliability, Software Safety, Quality Assurance Standards, ISO 9000, ISO 9001:2000, CMM, TQM, Six Sigma, SPICE, Software Quality Assurance Metrics.

**UNIT II**

**Risk Management and Change Management:** Software Risks, Risk Identification, Risk Projection, Risk Refinement, The RMMM Plan, Software Configuration Management, Baselines, Software Configuration Items, SCM Process: Version Control, Change Control, Configuration Audit.

**UNIT III**

**Introduction to UML:** Conceptual model of UML, building blocks of UML, Mechanisms in UML

**Basic Structural Modelling:** Classes, relationships, common mechanisms, class and object diagrams.

**Advanced structural Modelling:** Advanced classes, advanced relationships, Interfaces types and roles, packages, instances and object diagrams.

**UNIT IV**

**Basic behavioral modelling:** Interactions, use cases, Use Case Diagrams, Interaction Diagrams and activity diagrams.



**Advanced behavioural modelling:** Events and signals, state machines, process and threads, time and space, state chart diagrams.

**Diagrams:** Collaboration Diagrams and Sequence Diagrams. Component and Deployment Diagrams.

## References

1. Ian Sommerville, Software Engineering, Seventh Edition, Pearson Education.
2. R.S. Pressman, Software Engineering: A Practitioner's Approach, Sixth Edition, Tata McGraw-Hill.
3. William E. Perry, Effective Methods for Software Testing, Second Edition, John Wiley & Sons.
4. Paul C. Jorgensen, Software Testing: A Craftsman's Approach, Third Edition, Auerbach Publications, Taylor and Francis Group, 2010.
5. Yogesh Singh, Software Testing, Cambridge University Press.
6. K.K. Aggarwal, Yogesh Singh, Software Engineering, Second Edition, New Age International.
7. Pankaj Jalote, An Integrated Approach to Software Engineering, Second Edition, Narosa.
8. S. Limaye, Software Testing, McGraw-Hill.
9. Grandy Booch, James Rumbaugh, Ivar Jacobson. 'The Unified Modelling Language User Guide. Pearson Education 2002.
10. Meilir Page Jones, 'Fundamentals of Object Oriented Design in UML', Addison Wesley, 2000

Master of Science (Computer Science) Semester – IV  
(Session 2023-24)  
**COURSE CODE: MCSL-4112**  
**MICROPROCESSOR AND ITS APPLICATIONS**

**Course Outcomes:**

After passing this course the student will be able to:

CO1: Comprehend block structure of microprocessor along with its components.

CO2: Comprehend architecture of 8086 and 8088 microprocessors.

CO3: Articulate memory interface of 8086 and 8088 microprocessors.

CO4: Comprehend I/O interfacing along with interrupt service.

Master of Science (Computer Science) Semester – IV  
(Session 2023-24)  
**COURSE CODE: MCSL-4112**  
**MICROPROCESSOR AND ITS APPLICATIONS**

**L-T-P: 3-1-0**

**Max. Marks: 100**

**Credits: 4**

**Examination Time: 3 Hours**

**Theory: 80**

**CA:20**

**Instructions for Paper Setter -**

Eight questions of equal marks (16 marks each) are to set, two in each of the four sections (A-D). Questions of Sections A-D should be set from Units I-IV of the syllabus respectively. Questions may be divided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each section. The fifth question may be attempted from any section.

**UNIT-I**

**Introduction:** Introduction to Microprocessor, General Architecture of Microcomputer System. Microprocessor Units, Input unit, Output unit, Memory unit and auxiliary storage unit.

**UNIT-II**

**Architecture of 8086/8088 Microprocessor:** Description of various pins, configuring the 8086/8088 microprocessor for minimum and maximum mode systems, Internal architecture of the 8086/8088 microprocessor, system clock, Bus cycle, Instruction execution sequence.

**UNIT-III**

**Memory Interface of 8086/8088 Microprocessor:** Address space and data organization, generating memory addresses hardware organization of memory address space, memory bus status code, memory control signals, read/write bus cycles, program and data storage memory, dynamic RAM system.

**UNIT-IV**

**Input/Output Interface of the 8086/8088 Microprocessor:** I/O interface, I/O address space and data transfer, I/O instructions, I/O bus cycles, Output ports, 8255A Programmable Peripheral Interface (PPI), Serial communication interface (USART and UART) – the RS-232 C interface.

Interrupt Interface of 8086/8088 Microprocessor, Types of Interrupt, Interrupt Vector Table (IVT).

## References / Textbooks:

1. Walter Triebel: The 8086 Microprocessor – Architecture, Software and Interfacing Techniques, PHI, Delhi.
2. GangwarTripathi, Microprocessor & its Applications, EXCEL Books (2010)
3. Douglas V. Hall: Microprocessors and Interfacing – Programming and Hardware, Tata McGraw Hill Publishing Company Ltd., New Delhi.
4. Ramesh Gaonkar, Microprocessor Architecture, Programming and Applications with 8085 6/e, Penram International Publishing (2013), 6<sup>th</sup> Edition
5. A Nagoorkani, 8086 Microprocessor & its Applications, McGraw Hill Education (2017), 2<sup>nd</sup> Edition
6. Singh Anokh and A.K. Chhabra, Fundamentals of Microprocessors and its Applications, S. Chand & Company (2010).
7. R. Theagarajan, Microprocessors and its applications, New Age Publishers (1997), 1<sup>st</sup> Edition

Master of Science (Computer Science) Semester – IV  
(Session 2023-24)  
**COURSE CODE: MCSL-4113**  
**FOUNDATION OF STATISTICAL COMPUTING**

**Course Outcomes:**

After passing this course the student will be able to:

CO1: Comprehend basics of Statistical Computing and managing data structures like vector, matrix, etc.

CO2: Create, operate and manage lists and data frames.

CO3: Apply control and I/O statements for generating outputs.

CO4: Simulate various descriptive and analytical algorithms using R language along with their visualization.

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**FOUNDATION OF STATISTICAL COMPUTING**

**L-T-P: 4-0-0**

**Max. Marks: 100**

**Credits: 4**

**Examination Time: 3 Hours**

**Theory: 80**

**CA:20**

**Instructions for Paper Setter -**

Eight questions of equal marks (16 marks each) are to set, two in each of the four sections (A-D). Questions of Sections A-D should be set from Units I-IV of the syllabus respectively. Questions may be divided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each section. The fifth question may be attempted from any section.

**UNIT - I**

**Statistical Computing:** Introduction, Role of Programming and Statistical Software. Data Statistics: Sampling, Cumulative statistics, Statistics for Data frames, matrix objects and lists.

**Introduction to R:** Introduction to R, Help functions in R, Vectors, Common Vector Operations, Using all and any function, subletting of vector. Creating matrices, Matrix operations, Applying Functions to Matrix Rows and Columns, Adding and deleting rows and columns.

**UNIT - II**

Lists, Creating lists, general list operations, Accessing list components and values, applying functions to lists, recursive lists

**Creating Data Frames:** Matrix-like operations in frames , Merging Data Frames, Applying functions to Data frames, Factors and Tables , factors and levels , Common functions used with factors , string operations

**UNIT - III**

**Input/ Ouput:** scan() , readline() Function, Printing to the Screen Reading and writing CSV and text file. Control statements: Loops, Looping Over Nonvector, Sets, if-else , writing user defined function, scope of the variable, R script file.

## UNIT - IV

**Graphics in R:** Graph Syntax ((title, xlabel, ylabel, pch, lty, col.), Simple graphics (Bar, Multiple Bar, Histogram, Pie, Box-Plot, Scatter plot, qqplot), Low-level and High-Level plot functions. Using Analytical Algorithms (KNN, K-means, Naive Bayes) for Predictive analysis and Modelling.

### References / Textbooks:

1. Andrie de Vries and Joris Meys, R Programming for Dummies, Wiley (2016), 2<sup>nd</sup> Edition.
2. Sandip Rakshit, R Programming for Beginners, McGraw Hill Education (2017), 1<sup>st</sup> Edition.
3. Sandip Rakshit, Statistics with R Programming, McGraw Hill Education (2018), 1<sup>st</sup> Edition.
4. Garrett Golemund, Hands on Programming with R, O'Reilly (2014), 1<sup>st</sup> Edition
5. Mark Gardener, Beginning R: The Statistical Programming Language, Wiley (2013)
6. Tilman M. Davies, The Book of R: A first Course in Programming and Statistics, No Strach Press (2016), 1<sup>st</sup> Edition

Master of Science (Computer Science) Semester – IV  
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**COURSE CODE: MCSP-4114**

**LAB ON FOUNDATION OF STATISTICAL COMPUTING**

**L-T-P: 0-0-3**

**Credits: 3**

**Max. Marks: 100**

**Examination Time: 3 Hours**

**Practical: 80**

**CA:20**

Lab on Foundation of Statistical Computing.



Master of Science (Computer Science) Semester – IV  
(Session 2023-24)  
**COURSE CODE: MCSD-4115**  
**DISSERTATION**

**Course Outcomes:**

After passing course the student will be able to:

CO1: Apply the tools and techniques learnt to frame problems and their corresponding solutions.

CO2: Develop skills necessary to structure, manage and execute projects.

CO3: Demonstrate the skills to work as a member and as a leader of cohesive unit.

CO4: Develop presentation skills.

CO5: Perform documentation related to development of the project.

Master of Science (Computer Science) Semester – IV

(Session 2023-24)

**COURSE CODE: MCSD-4115**

**DISSERTATION**

**L-T-P: 0-0-6**

**Max. Marks: 200**

**Credits: 6**

**Examination Time: 6 Hours**

**Practical: 160**

**CA:40**

**Research Aptitude:** Meaning, scope of research, types of research, formulation of research problem. Data collection methods - Primary and Secondary, Bibliography and references, Report writing.

**Instructions -**

1. Candidates have to submit one hard copy and two CDs/DVDs of documentation which shall be kept with the HoD in the college only. Further, supervisor/guide shall forward one copy of DVD /CD containing all the documentation files of the students (file name to be saved as Rollno\_of\_the\_student.pdf) to the COE Office. The Covering letter (duly signed by the guide and Head of the department) should contain the following information. Candidate name, Candidate Roll no, Project Title of the student and .pdf file name of her project documentation.
2. The assignment shall be evaluated by a board of three examiners (one (01) External examiner as approved by the BOS, one (01) internal examiner and HoD).
3. The dissertation is to be submitted as per the common ordinances for P.G. courses under semester system.
4. The students are to submit the dissertation by the end of the semester and must have published one research paper. The student should append the Plagiarism report (allowing upto 25%) while submitting the dissertation.

