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BOARD OF STUDIES

(Including Proceeding, Course Structure, Course Curriculum and Evaluation Scheme)

for

M. Tech.

in

Computer Science

(Effective from the Session: 2026-27)

Dean
Faculty of Engg. & Tech.
Future University
Bareilly

Faculty of Engg. & Tech.
Future University
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Dean
Faculty of Engg. & Tech.
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To
The Hon'ble Vice-Chancellor,
Future University, Bareilly

Date: 22/07/2026

Through: Dean, Faculty of Engineering & Technology

Subject: *Request for Permission to Conduct the Board of Studies (BOS) Meeting for M. Tech. (Computer Science & Engineering)*

Respected Sir,

With due respect, this is to seek your kind permission to convene a meeting of the Board of Studies (BOS) for the M. Tech. Programme in Computer Science & Engineering under the Faculty of Engineering & Technology.

The purpose of the meeting is to review and approve the proposed course structure, syllabus, and academic regulations for the M. Tech. (CSE) program in accordance with the UGC/AICTE guidelines.

It is proposed to conduct the BOS meeting on dated 25/07/2026 in Board Room, Future University, Bareilly.

Kind approval is requested to proceed with the necessary arrangements and to issue the formal notification for the same.

Thanking you for your kind consideration.

Yours sincerely,

Prof. (Dr.) Shashi Kumar Singh
Chairperson, Board of Studies (CSE)
Faculty of Engineering & Technology
Future University, Bareilly

Approved
23/7/26

Dean
Faculty of Engg. & Tech.
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Agenda

Faculty of Engineering & Technology

Meeting Agenda of Board of Studies (BoS)

Faculty of Computer Science and Engineering

Dated: 25/07/2026

S.No.	Point of discussion	Sub point
1	**Approval of Scheme and Syllabus of M. Tech. In Computer Science and Engineering Course (Batch 2025 onwards)**	Subject code & syllabus will be defined in M. Tech. course and will be adopted as per UGC guidelines.

1. To approve the minutes of the first BOS held on…..
2. To review and recommend the course structure and curriculum of M. Tech. in Computer Science and Engineering on the basis of the recommendations of the first BOS for the session 2026-27, taking into consideration NEP 2020 guidelines.
3. To discuss the total credits to be taken for the program based on the decision taken in the meeting of all the Deans,
4. To assess the comprehensive and continuous evaluation and assessment of the Scholar.
5. Any other item with the permission of the chair.

Prof. (Dr.) Shashi Kumar Singh
Dean-Faculty of Engineering & Technology
Future University, Bareilly

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To,
Dr. Kuljeet Singh,
Associate Professor
CHRIST (Deemed to be University), Delhi NCR, India

Date: 22/07/2026

Sub: Invitation as an expert in BOS of M. Tech. in Computer Science & Engineering.

Sir,

The Vice-Chancellor of Future University, Bareilly has approved a recommendation that you are appointed as an external expert member for the Board of Studies meeting for Computer Science & Engineering program of Faculty of Engineering & Technology, Future University, Bareilly. The proposed date of BOS meeting is 25/07/2026 from 10:00 AM onwards in the University Campus (Conference Room). Therefore, I am requesting you to kindly accept the invitation as the external expert in the above said meeting. The schedule of the BOS meeting is as follows:

Date: 25/07/2026

Time: 10:00 AM

Venue: Conference Room, Future University, Bareilly.

A line of acknowledgement as acceptance will be highly appreciable.

Thanks and Best Regards

Prof. (Dr.) Shashi Kumar Singh
Dean-Faculty of Engineering & Technology
Future University, Bareilly

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To,
Anurag Saxena,
Custom Software Engineering Senior Manager
Company – Accenture

Date: 22/07/2026

Sub: Invitation as an expert in BOS of M. Tech. in Computer Science & Engineering.

Sir,

The Vice-Chancellor of Future University, Bareilly has approved a recommendation that you be appointed as an external expert member for the Board of Studies meeting for Computer Science & Engineering program of Faculty of Engineering & Technology, Future University, Bareilly. The proposed date of BOS meeting is 25/07/2026 from 10:00 AM onwards in the University Campus (Conference Room). Therefore, I am requesting you to kindly accept the invitation as the external expert in the above said meeting. The schedule of the BOS meeting is as follows:

Date: 25/07/2026

Time: 10:00 AM

Venue: Conference Room, Future University, Bareilly.

A line of acknowledgement as acceptance will be highly appreciable.

Thanks and Best Regards

Prof. (Dr.) Shashi Kumar Singh
Dean-Faculty of Engineering & Technology
Future University, Bareilly

Dean
Faculty of Engg. & Tech.
Future University
Bareilly

FUB/2025-26/R.O./BoS/30

Date: 24/07/2026

OFFICE ORDER

(Faculty of Engineering & Technology)

The proposed composition of the Board of Studies is as follows:

S. No.	Designation	Name	Role in BoS
1	Head of Department	Dr. Shivangi Ghildiyal	Chairman
2	One Outside Expert (Nominated by the Vice Chancellor)	Dr. Kuljeet Singh	Member
3	One Industry Expert (Nominated by the Vice Chancellor)	Mr. Anurag Saxena	Member
4	Three members of the faculty, one each from the categories of Professor, Associate Professor and Assistant Professor of the Department	1. Dr. Shashi Kumar Singh	Member
5		2. Dr. Sachin Raj Saxena	Member
6		3. Mr. Dharmendra Kumar	Member
7	Two Students (Nominated by the Dean on the recommendation of the Head of the Department)	Mr. Harshit Yadav	Member
8		Ms. Sneha Singh	Member

Registrar
Future University, Bareilly

Copy to:

1. Hon'ble Vice-Chancellor – for kind information.
2. All Members concerned.
3. Dean/Head, Faculty of Engineering & Technology.
4. Controller of Examinations.
5. Director, IQAC.

Dean
Faculty of Engg. & Tech.
Future University
Bareilly

FUB/2025-26/R.O./BoS/31

Date: 24/07/2026

OFFICE ORDER

(Faculty of Engineering & Technology)

The proposed composition of the Faculty Board is as follows:

S. No.	Designation	Name	Role in BoF
1	Dean	Dr. Shashi Kumar Singh	Chairman
2	Special Invitee	Prof. (Dr.) K. K. Pande	Special Invitee
3	Heads of the Departments	Dr. Shivangi Ghildiyal	Member
4	Professors/Associate Professor of the Departments	1. Dr. Hemant Yadav 2. Dr. Sachin Raj Saxena	Member
5	Two Outside Experts (Nominated by Vice Chancellor)	Dr. Kuljeet Singh	External Member
6		Mr. Anurag Saxena	External Member

Registrar
Future University, Bareilly

Copy to:

1. Hon'ble Vice-Chancellor – for kind information.
2. All Members concerned.
3. Dean/Head, Faculty of Engineering & Technology.
4. Controller of Examinations.
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BOARD OF STUDIES

M. TECH. (CS)

Name of Faculty: Faculty of Engineering & Technology

S. No	Particulars	Amount	Pack	Total
1	Remuneration	5000 (including TA for Local) (otherwise 5000 + 1500)	01	6500
Academic Expert:		Dr.Kuljeet Singh Associate Professor CHRIST (Deemed to be University), Delhi NCR, India kuljeet.singh@christuniversity.in, contact No. 8803694182		
			Grand Total	6500

M. Tech. BOS Chairperson

Dean
Faculty of Engg. & Tech.
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Bareilly

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BOARD OF STUDIES
M. TECH. (CS)
Name of Faculty: Faculty of Engineering & Technology

S. No	Particulars	Amount	Pack	Total
1	Remuneration	5000 (including TA for Local) (otherwise 5000 + TA)	01	5000
Industry Expert:		Name - Anurag Saxena Designation - Custom Software Engineering Senior Manager Company Name - Accenture Email - saxena.anurag30@gmail.com		
2	Lunch	1000		1000
			Grand Total	6000

B. Tech. BOS Chairperson

Dean
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			Company Name - Accenture Email - saxena.anurag30@gmail.com

The following are the details of the discussions held:

1. The proposed syllabus for M. Tech. (CS) in Computer Science and Engineering on the basis of the recommendations of the first BOS for the session 2026-27 and for all semesters was discussed and suggestions were given by the experts which were incorporated in the various placed.
2. The total credits to be taken for the program based on the decision taken in the meeting of all the Deans.
3. After discussion it was agreed that all evaluations will be on 100 with 30 internal continuous evaluation and 70 end semester evaluation.
4. Any other item with the permission of the chair:
   - Theory and practical will have code as per the UGC suggestion
   - Tutorial are not needed in practical subjects and should be removed
   - It was suggested that the University should follow the NCRF structure in all programs offered.
   - Practical credit shall be as per UGC norms.
   - UGC guidelines suggests for other Region language, and is not mentioning foreign languages as in the syllabus. College can reconsider the same.

The members appreciated the efforts of the faculty members in formulating the syllabus for 2026-27 academic batch. HOD Computer Science and Engineering informed the members that the syllabus for the year 2026-27 may need some corrections based on inputs from experts of the subject. BOS empowered the Dean Computer Science and Engineering to finalize the syllabus in consultation with subject experts and seek approval of the Academic Council when it meets next. Also the modifications be informed the Board of Studies when it meets next.

The meeting ended with a Vote of thanks to the external members who spared their valuable time and for the suggestions.

Prof. (Dr.) Shashi Kumar Singh
Dean-Faculty of Engineering & Technology
Future University, Bareilly

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Corrections Implemented

Attendance Sheet

Date: 25/07/2026

(Faculty of Engineering & Technology)

The proposed composition of the Board of Studies is as follows:

S. No.	Designation	Name	Role in BoS	Signature
1	Head of Department	Dr. Shivangi Ghildiyal	Chairman	
2	One Outside Expert (Nominated by the Vice Chancellor)	Dr. Kuljeet Singh	Member	
3	One Industry Expert (Nominated by the Vice Chancellor)	Mr. Anurag Saxena	Member	
4	Three members of the faculty, one each from the categories of Professor, Associate Professor and Assistant Professor of the Department	1. Dr. Shashi Kumar Singh	Member	
5		2. Dr. Sachin Raj Saxena	Member	
6		3. Mr. Dharmendra Kumar	Member	
7	Two Students (Nominated by the Dean on the recommendation of the Head of the Department)	Mr. Harshit Yadav	Member	
8		Ms. Sneha Singh	Member	

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Faculty of Engineering and Technology

Curriculum and Syllabus
(Applicable to students admitted during (2026-27)

M. Tech – Computer Science and Engineering
(2026 Batch)

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Semester-I						
S. No	**Course Code**	**Course Name**	**L**	**T**	**P**	**C**
1	MCS5101	Advanced Database Management systems	4	0	0	4
2	MCS5103	Design and Analysis of Algorithms	4	0	0	4
3	MCS5105	Statistical Modeling for Computer Sciences	3	0	0	3
4	MCS5107	Advanced Computer Architecture	3	0	0	3
5	MCS5109	Data Communication and Computer Networks	3	0	0	3
6	MCS5171	Statistical Modeling for Computer Sciences Lab	0	0	2	1
7	MCS5113	MOOC I	0	0	0	3
8		Elective I	3	0	0	3
Total						**24**

Semester-II						
S. No	**Course Code**	**Course Name**	**L**	**T**	**P**	**C**
1	MCS5202	Cryptography and Cryptanalysis	4	0	0	4
2	MCS5204	Mobile Ad-Hoc Networks	3	0	0	3
3	MCS5206	Artificial Intelligence	4	0	0	4
4	MCS5208	Theory of Computation	3	0	0	3
5	MCS5210	Advanced Graph Theory	3	0	0	3
6	MCS5276	Artificial Intelligence Lab	0	0	2	1
7	MCS5214	MOOC II	0	0	0	3
8		Elective II	3	0	0	3
Total						**24**

Semester-III						
S. No	**Course Code**	**Course Name**	**L**	**T**	**P**	**C**
1		Elective III	3	0	0	3
2		Elective IV	2	0	0	2
3	MCS5315	MOOC III	0	0	0	3
4	MCS5371	Dissertation I	0	0	0	16
Total						**24**

	Semester-IV					
S. No	**Course Code**	**Course Name**	**L**	**T**	**P**	**C**
1	MCS5472	Dissertation - II	0	0	0	20
2	MCS5416	MOOC IV	0	0	0	4
		Total				**24**

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List of Electives					
Course Code	**Course Name**	**L**	**T**	**P**	**C**
ELECTIVE I					
MCS5515	Wireless Sensor Networks	3	0	0	3
MCS5517	Software and Service Oriented Architecture	3	0	0	3
MCS5519	Pattern Recognition	3	0	0	3
MCS5521	Quantum Computing	3	0	0	3
ELECTIVE II					
MCS5516	Spatial Database Management and Geographic Information Systems	3	0	0	3
MCS5518	Cognitive Systems	3	0	0	3
MCS5520	High Performance Computing	3	0	0	3
MCS5522	GPU Programming	3	0	0	3
ELECTIVE III					
MCS5603	Multimedia Systems	3	0	0	3
MCS5605	Digital Forensics	3	0	0	3
MCS5607	Data Mining and Warehousing	3	0	0	3
MCS5609	Advanced Distributed Systems	3	0	0	3
ELECTIVE IV					
MCS5611	Cyber Security and Law	2	0	0	2
MCS5613	Advanced Operating Systems	2	0	0	2
MCS5615	Software Engineering Methodologies	2	0	0	2
MCS5617	Information Systems	2	0	0	2

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MCS501	Advanced Database Management Systems	L-T-P: 4-0-0	Credits: 4

Course Objectives:

CO1	Define parallel and distributed databases and its applications.
CO2	Show applications of Object Oriented database.
CO3	Explain basic concepts, principles of intelligent databases.
CO4	Utilize the advanced topics of data warehousing and mining.
CO5	Extend knowledge in research topics of databases.

Unit 1

Review of Relational Data Model and Relational Database Constraints: Relational model concepts; Relational model constraints and relational database schemas; update operations, anomalies, dealing with constraint violations, Types and violations. Overview of Object-Oriented Concepts–Objects, Basic properties. Advantages, examples, Abstract data types, Encapsulation, class hierarchies, polymorphism, examples.

Unit 2

Object and Object-Relational Databases: Overview of OOP; Complex objects; Identity, structure etc. Object model of ODMG, Object definition Language ODL; Object Query Language OQL; Conceptual design of Object database. Overview of object relational features of SQL; Object-relational features of Oracle; Implementation and related issues for extended type systems; syntax and demo examples, relational model. Overview of C++ language binding.

Unit 3

Parallel and Distributed Databases: Architectures for parallel databases; Parallel query evaluation; parallelizing individual operations; Parallel query optimizations; Introduction to Distributed databases; Distributed DBMS architectures; Storing data in a Distributed DBMS; Distributed catalog management; Distributed Query processing; Updating distributed data; Distributed transactions; Distributed Concurrency control and Recovery.

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Unit 4

DataWarehousing, Decision Support and DataMining: Introduction to decision support; OLAP, multidimensional model; Window queries in SQL; Finding answers quickly; Implementation techniques for OLAP; Data Warehousing; Views and Decision support, View materialization, Maintaining materialized views. Introduction to Data Mining; Counting co-occurrences; Mining for rules; Tree-structured rules; ROC and CMC Curves; Clustering; Similarity search over sequences; Incremental mining and data streams; Additional data mining tasks.

Unit 5

Enhanced Data Models for Some Advanced Applications: Active database concepts and triggers; Temporal, Spatial, and Deductive Databases–Basic concepts.More Recent Applications: Mobile databases; Multimedia databases; Geographical Information Systems; Genome data management.

Course Outcomes:

CO1	Describe how database management systems function internally.
CO2	Interpret and comparatively criticize database systems architectures.
CO3	Implement major components of a database management system and analyze their performance.
CO4	Analyze and compare the fundamental query evaluation and concurrency control algorithms.
CO5	Identify trade-offs among database systems techniques and contrast distributed / parallel techniques.

TextBooks:

1. Elmasri and Navathe: Fundamentals of Database Systems, PearsonEducation,2013.
2. Raghu Ramakrishna and Johannes Gehrke: Database Management Systems, 3rdEdition, McGraw-Hill, 2013.

Reference Books:

1. Data base Management Systems, Raghu Ramakrishnan, Johannes Gehrke, TMH, 3rd Edition, 2003.
2. Data base System Concepts, A.Silberschatz, H.F. Korth, S.Sudarshan, McGraw hill, VI edition, 2006.
3. Fundamentals of Database Systems 5th edition. RamezElmasri, Shamkant B.Navathe, Pearson Education, 2008.
4. Introduction to Database Systems, C.J.Date,Pearson Education.
5. Database Management System Oracle SQL and PL/SQL, P.K.Das Gupta, PHI

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MCS503	Design And Analysis Of Algorithms	L-T-P: 4-0-0	Credits: 4

Course Objectives:

CO1	Analyze the asymptotic performance of algorithms.
CO2	Write rigorous correctness proofs for algorithms.
CO3	Demonstrate a familiarity with major algorithms and data structures.
CO4	Apply important algorithmic design paradigms and methods of analysis.
CO5	Synthesize efficient algorithms in common engineering design situations.

Unit 1

Role of algorithms in computing: Performance analysis of algorithm and Recurrences- Time and Space complexity, Asymptotic Notation, Recurrence Relation, Basic introduction to algorithmic paradigms like Dynamic Programming, Divide and Conquer, Backtracking, Greedy Algorithms and branch and bound etc.

Unit 2

Elementary review of basic and advanced data structures: like Hash Tables, Binary Search Trees, Red-Black Trees, AVL Tree, Fibonacci Heap, Splay Tree. Sorting in Polynomial Time: Insertion Sort, Selection Sort and Quick Sort; Sorting in Linear Time: Radix Sort and Bucket Sort.

Unit 3

Graph Algorithms: BFS, DFS, Shortest Path, Maximum Flow,Minimum Spanning Tree- Prim's and Kruskal Algorithm. Greedy Algorithms: Huffman coding, Fractional Knapsack problem, priority queue heap sort.

Unit 4

Dynamic Programming: Elements of dynamic programming, Matrix- chain multiplication, longest common subsequence, Floyd's all pair shortest path algorithm. Branch and Bound: Job assignment problem and Travelling Sales man problem.

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Unit 5

Algorithms: Randomized Algorithms, Native Algorithms, Rabin Karp Algorithm, Complete and Approximate Algorithms-Polynomial time, Polynomial-time verification ,NP-completeness and reducibility, NP-complete and approximation problems, Vertex-cover Problem, Formula satisfiability, 3 CNF Statisfiability.

Course Outcomes:

CO1	Argue the correctness of algorithms using inductive proofs and invariants.
CO2	Analyse worst-case running times of algorithms using asymptotic analysis.
CO3	Explain the major graph algorithms and their analyses.
CO4	Describe the dynamic-programming paradigm and explain when an algorithmic design situation calls for it.
CO5	Analyse randomized algorithms. Employ indicator random variables and linearity of expectation to perform the analyses. Recite analyses of algorithms that employ this method of analysis.

Text Books:

1. Design and Analysis of Algorithms, October 2018; Publisher: ARS Publications, Chennai.
2. Design and Analysis of Algorithms, Cambridge University Press, April 2019.

Reference Books:

1. Design and Analysis of Algorithms, An Indian Adaptation Paperback – 1 July 2021 by Michael T. Goodrich , Roberto Tamassia .
2. Design & Analysis of Algorithm Gph Book: Mcs-031 Paperback – 1 January 2007 by Roy S .

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MCS505	Statistical Modeling for Computer Sciences	L-T-P: 3-0-0	Credits: 3

Course Objectives:

CO1	Understanding Statistical Concepts
CO2	Applying Statistical Methods
CO3	Data Analysis and Modeling
CO4	Critical Thinking and Problem Solving
CO5	Software and Computational Skills

Unit 1

Introduction: Measures of central tendency, Moments, Moment generating function (MGF) , Skewness, Kurtosis, Curve Fitting , Method of least squares, Fitting of straight lines, Fitting of second degree parabola, Exponential curves ,Correlation and Rank correlation, Regression Analysis: Regression lines of y on x and x on y, regression coefficients, properties of regressions coefficients and non linear regression.

Unit 2

Probability and Dist: Introduction, Addition and multiplication law of probability, Conditional probability, Baye's theorem, Random variables (Discrete and Continuous Random variable) Probability mass function and Probability density function, Expectation and variance, Discrete and Continuous Probability distribution: Binomial, Poission and Normal distributions.

Unit 3

Sampling, Testing of Hypothesis and Statistical Quality Control: Introduction , Sampling Theory (Small and Large) , Hypothesis, Null hypothesis, Alternative hypothesis, Testing a Hypothesis, Level of significance, Confidence limits, Test of significance of difference of means, T-test, F-test and Chi-square test, One way Analysis of Variance (ANOVA).Statistical Quality Control (SQC) , Control Charts , Control Charts for variables (X and R Charts), Control Charts for Variables (p, np and C charts).

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Unit 4

Random samples, sampling distributions of estimators, and Maximum Likelihood.

Unit 5

Statistical inference, Introduction to multivariate statistical models: classification problems, principal component analysis, The problem of over fitting model assessment.

Course Outcomes:

CO1	Apply Statistical Concepts
CO2	Data Analysis and Interpretation
CO3	Model Building and Evaluation
CO4	Problem-Solving
CO5	Software Proficiency

TextBooks:

1. Erwin Kreyszig, Advanced Engineering Mathematics, 9thEdition, John Wiley & Sons, 2006.
2. P. G. Hoel, S. C. Port and C. J. Stone, Introduction to Probability Theory, Universal Book Stall, 2003(Reprint).
3. S. Ross: A First Course in Probability, 6th Ed., Pearson Education India, 2002.
4. W. Feller, An Introduction to Probability Theory and its Applications, Vol. 1, 3rd Edition, Wiley, 1968.

Reference Books:

1. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 35th Edition, 2000.
2. T.Veerarajan : Engineering Mathematics (for semester III), Tata McGraw-Hill, New Delhi.
3. R.K. Jain and S.R.K. Iyenger: Advance Engineering Mathematics; Narosa Publishing House, New Delhi.
4. J.N. Kapur: Mathematical Statistics; S. Chand & Sons CompanyLimited, New Delhi.
5. D.N.Elhance,V. Elhance& B.M. Aggarwal: Fundamentals of Statistics; KitabMahalDistributers, New Delhi.

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MCS507	Advanced Computer Architecture	L-T-P: 3-0-0	Credits: 3

Course Objectives:

CO1	Understanding Advanced Design Principles
CO2	Analyzing Performance
CO3	Parallelism Concepts
CO4	Memory Systems and Buses
CO5	Performance Enhancement Techniques

Unit 1

Parallel Computer Models: The state of computing, classification of Parallel Computers, Multiprocessors and Multicomputer, Multivector and SIMD Computers. Program and network properties: Conditions of Parallelism, Data and resource Dependences, Hardware and Software Parallelism, Program partitioning and scheduling, Grain Size and latency, Program flow mechanisms, Control flow Vs. Data flow, Data flow Architecture, Demand driven mechanisms, Comparisons of flow mechanisms.

Unit 2

System Interconnect Architecture: Network properties and routing, Static interconnection Networks, Dynamic interconnection Networks, Multiprocessor system Interconnects, Hierarchical bus systems, Crossbar switch and multiport memory, Multistage and combining network. Advanced Processors: Advanced processor technology, Instruction-set Architectures, CISC Scalar Processors, RISC Scalar Processors, Superscalar Processors, VLIW Architectures, Vector and Symbolic processors.

Unit 3

Pipelining: Linear pipeline processor, non-linear pipeline processor, Instruction pipeline design, Mechanisms for instruction pipelining, Dynamic instruction scheduling, Branch Handling techniques, Branch prediction, Arithmetic Pipeline design, Computer arithmetic principles, Static Arithmetic pipeline,Multifunctional arithmetic pipelines.

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Unit 4

Memory Hierarchy Design: Cache basics and cache performance, reducing miss rate and miss penalty, multilevel cache hierarchies, main memory organizations, design of memory hierarchies.

Unit 5

Multiprocessor Architectures: Symmetric shared memory architecture, distributed shared memory architectures, models of memory consistency, Cache coherence protocols (MSI, MESI, and MOESI), scalable cache coherence, overview of directory based approaches, design challenges of directory protocols, memory based directory protocols, and cache based directory protocols, protocol design tradeoffs, and synchronization.
Enterprise Memory Subsystem Architecture: Enterprise RAS Feature set, Machine check, hot add / remove, domain partitioning, memory mirroring / migration, patrol scrubbing, Fault tolerant system.

Course Outcomes:

CO1	Demonstrate Understanding of Parallel Processing Concepts
CO2	Evaluate Different Architectures
CO3	Analyze Instruction-Level Parallelism Techniques
CO4	Understand Memory and I/O Architectures
CO5	Identify Performance and Scalability Issues

Text Books:

1. Kai Hwang,"AdvancedArchitecture",TMH , 2000.
2. D. A. Patterson and J. L.Hennessey,"Computer Organization and design", Morgan Kaufmann, 2nd Edition, 2002.

Reference Books:

1.J.P.Hayes,"Computer Architecture and Organization", MGH, 1998.

2. V.Rajaranam&C.S.R.Murthy,"Parallel Computer", PHI, 2002.

3. Kai Hwang and Zu, "Scalable Parallel Computer Architecture",MGH, 2001.

4. M.J Flynn, "Computer Architecture, Pipelined and Parallel Processor Design", Narosa Publishing, 1998.

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MCS509	Data Communication and Computer Networks	L-T-P: 3-0-0	Credits: 3

Course Objectives:

CO1	Understanding Fundamentals Concepts.
CO2	Analyzing Network Performance.
CO3	Designing and Implementing Networks.
CO4	Discuss the nature, uses and implications of Internet techniques.
CO5	Overview of Security Issues.

Unit 1

Fundamentals of Data Communication and Computer Network: Process of data communication and its components: Transmitter, Receiver, Medium, Message, Protocol, Bandwidth, Data Transmission Rate, Baud Rate and Bits per second, Modes of Communication (Simplex, Half Duplex, Full Duplex), Analog signal and Digital signal, Classification of Networks: LAN, WAN, MAN.

Unit 2

Transmission Media and Switching: Communication Media- Guided Transmission Media, Twisted-Pair Cable, Coaxial Cable, Fiber-Optic Cable, Unguided Transmission Media-Radio Waves, Microwaves, Infrared, Satellite, Line-Of-Sight Transmission, Point-to-Point, Broadcast, Multiplexing: Frequency- Division Multiplexing, Time-Division Multiplexing, Switching.

Unit 3

Error Detection and Corrections: Types of Errors, Forward Error Correction Versus Retransmission, Framing, Error Detectionand Error Correction:ARQ,Hamming Code,Wireless LAN IEEE 802.11 Standard Architecture,Bluetooth Architecture:Piconet,Scatternet,Mobile Generations: 3G, 4G and 5G.

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Unit 4

Network Communication Models:OSI Model,Layered Architecture,TCP/IP Layers and their functions, Protocols,Addressing, IP Address, IPv4 Addressing, Subnetting, IPv6 Addressing Schemes and basic structure.

Unit 5

Network Topologies and Network Devices: Network computing model,Topologies,Network connecting devices,Switch, Router, Repeater,Bridge,Gateways and Modem.

Course Outcomes:

CO1	Analyze the functioning of Data Communication and Computer Network.
CO2	Select relevant Transmission Media and Switching Techniques as per need.
CO3	Analyze the Transmission Errors with respect to IEEE Standards.
CO4	Configure different TCP/IP Services.
CO5	Implement relevant Network Topology using Networking devices.

Text Books:

1. Data Communications and Networks- 2nd Edition- AchyutSGodbole-and AtulKahate Tata McGraw –Hill.
2. Data Communication and Networking- 5th Edition – B A Forouzan- Tata McGraw-Hill.

Reference Books:

1. Data Communications and Networks – James Irvine and David Harley- Publishers : Wiley India.
2. Computer Networks – 4th Edition – Andrew S Tanenbaum – Pearson – Prentice Hall.
3. Computer Network and Internets – Douglas E. Cormer – Pearson.

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MCS511	Statistical Modeling for Computer Sciences Lab	L-T-P: 0-0-2	Credits: 1

Course Objectives:

CO1	Probability and Statistics
CO2	Random Variables
CO3	Descriptive Statistics
CO4	Hypothesis Testing
CO5	Regression Analysis

Experiments :

1. Data Exploration and Cleaning:

- Load and explore datasets (e.g., using R or Python).
- Handle missing values, outliers, and inconsistencies.
- Perform descriptive statistics and data visualization.
- Implement data preprocessing techniques.

2. Descriptive Statistics and Visualization:

- Calculate and interpret measures of central tendency, dispersion, and skewness.
- Create various plots (histograms, scatter plots, box plots) to visualize data patterns.
- Use data visualization tools (e.g., Seaborn, Matplotlib) to create informative visuals.

3. Probability Distributions:

- Implement and analyze different probability distributions (e.g., normal, binomial, Poisson).
- Generate random samples from specified distributions.
- Calculate probabilities and cumulative probabilities.

4. Statistical Inference:

- Perform hypothesis testing (e.g., t-tests, chi-square tests).
- Estimate confidence intervals for population parameters.
- Analyze relationships between variables (e.g., correlation analysis).

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5. Regression Analysis:

- Fit simple and multiple linear regression models.
- Interpret regression coefficients and p-values.
- Evaluate model performance using metrics like R-squared.
- Perform logistic regression for binary classification.

6. Clustering:

- Implement clustering algorithms (e.g., k-means, hierarchical clustering).
- Evaluate the quality of clusters using metrics like silhouette score.
- Analyze cluster profiles and interpret results.

7. Classification:

- Implement classification algorithms (e.g., logistic regression, decision trees, support vector machines).
- Evaluate model performance using metrics like accuracy, precision, recall, and F1-score.
- Interpret model predictions and feature importance.

8. Time Series Analysis:

- Analyze time series data (e.g., using ARIMA models).
- Forecast future values based on historical data.
- Interpret time series analysis results.

9. Advanced Statistical Modeling:

- Explore techniques like Bayesian modeling, generalized linear models, or other advanced statistical techniques.
- Implement and analyze models using appropriate software (e.g., Stan, JAGS).

10. Data Visualization and Reporting:

- Create dashboards and reports to communicate statistical findings.
- Use tools like Tableau or Power BI to create interactive visualizations.
- Present statistical findings effectively using clear and concise language.

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MCS502	Cryptography and Cryptanalysis	L-T-P: 3-0-0	Credits: 3

Course Objectives:

CO1	Understanding fundamental concepts
CO2	Analyzing cryptographic algorithms
CO3	Understanding cryptanalysis
CO4	Applying cryptographic principles
CO5	Understanding information security goals

Unit 1

Overview of Cryptography: Introduction, Information security and cryptography, Basic terminology and concepts, Symmetric key encryption , Digital signatures, Public-key cryptography, Hash functions, Protocols and mechanisms, Key establishment, management, and certification, Pseudorandom numbers and sequences, Classes of attacks and security models.

Unit 2

Mathematical Background Probability theory , Information theory, Complexity theory, Number theory, Abstract algebra, Finite fields, The integer factorization problem, The RSA problem, The Diffie-Hellman problem, Composite moduli.

Unit 3

A quick introduction to groups, rings, integral domain and fields (including: Lagrange theorem, Structure of cyclic and abelian groups, isomorphism theorems).

Unit 4

Fields, Characteristic of a field, prime fields, Arithmetic of polynomials over fields. Field extensions, Galois group of a field extensions, Fixed field and Galois extensions. Minimum polynomial, Construction of fields with the help of an irreducible polynomial. Splitting field of a polynomial, Separable polynomial and Separable extensions. Construction of finite fields and their structure. Enumeration of irreducible polynomials over finite fields. Fundamental theorem of Galois Theory.

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Unit 5

Cyclotomic extensions, Geometric constructions and Galois theory of Equations (Statement only of Abel Ruffini), Solving Cubic and Bi-quadratic polynomials using radicals.

Key Establishment Protocols : Introduction, Key transport based on symmetric encryption, Key agreement based on symmetric techniques, Key transport based on public-key encryption, Key agreement based on asymmetric techniques, Secret sharing, Key Management Techniques, Techniques for distributing public keys, Techniques for controlling key usage, Key management involving multiple domains.

Course Outcomes:

CO1	Ability to design and analyze cryptographic algorithms
CO2	Ability to evaluate the security of cryptographic systems
CO3	Understanding of cryptographic protocols
CO4	Practical skills in applying cryptography
CO5	Understanding of the limitations of cryptographic algorithms

TextBooks:

1. Alfred J. Menezes, Paul C. van Oorschot and Scott A. Vanstone, "Handbook of Applied Cryptography" CRC Press.

2. Cryptography and Network Security: Principles and Practice (ISBN 0131873164), 4/e, by William Stallings.

Reference Books:

1. B. Schneier, "Applied Cryptography: Protocols, Algorithms, and Source Code in C", 2nd Edition, John Wiley & Sons, 1995.

2. Matt Bishop, Computer Security: Art and Science, Addison-Wesley, 2002.

3 MihirBellare and Phillip Rogaway, "Introduction to Modern Cryptography".

4. Field and Galois Theory, By Patrick Morandi GTM.

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MCS504	MOBILE AD-HOC NETWORKS	L-T-P: 3-0-0	Credits: 3

Course Objectives:

CO1	Understand MANET fundamentals.
CO2	Understand Medium Access Protocols.
CO3	Understand Network Protocols.
CO4	Understand security aspects and their design challenges.
CO5	Understand Cross Layer Design.

Unit 1

INTRODUCTION: Introduction to mobile ad-hoc networks (MANETs) – definition, characteristics features, applications. Characteristics of wireless channel, ad-hoc mobility models: indoor and outdoor models.

Unit 2

MEDIUM ACCESS PROTOCOLS: MAC Protocols: Design issues, goals and classification. Contention based protocols – with reservation, scheduling algorithms, protocols using directional antennas. IEEE standards: 802.11a, 802.11b, 802.11g, 802.15. HIPERLAN.

Unit 3

NETWORK PROTOCOLS: Routing Protocols: Design issues, goals and classification. Proactive Vs reactive routing, unicast routing algorithms, Multicast routing algorithms, hybrid routing algorithm, energy aware routing algorithm, hierarchical routing, QoS aware routing.

Unit 4

END – END DELIVERY AND SECURITY: Transport Layer: Issues in designing – Transport layer classification, adhoc transport protocols. Security issues in adhoc networks: issues and challenges, network security attacks, secure routing protocols.

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Unit 5

CROSS LAYER DESIGN: Cross layer Design: Need for cross layer design, cross layer optimization, parameter optimization techniques, cross layer cautionary perspective. Integration of ad-hoc with Mobile IP networks.

Course Outcomes:

CO1	Identify different issues in MANETs and sensor networks.
CO2	Analyze protocols developed for ad-hoc and sensor networks.
CO3	Identify and address security threats in ad-hoc.
CO4	Establish a sensor network environment for various applications.
CO5	Apply their knowledge to design and manage MANETs and sensor networks.

Text Books:

1. C. Siva Ram Murthy and B. S. Manoj, Ad hoc Wireless Networks Architecture and Protocols, 2nd edition, Pearson Edition, 2007.
2. Charles E. Perkins, Ad hoc Networking, Addison – Wesley, 2000.

Reference Books:

1. Stefano Basagni, Marco Conti, Silvia Giordano and Ivan stojmenovic, Mobile ad-hoc Networking, Wiley-IEEE press, 2004.
2. Mohammad Ilyas, The handbook of ad-hoc wireless networks, CRC press, 2002.
3. T. Camp, J. Boleng, and V. Davies " A Survey of Mobility Models for Ad-hoc.

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MCS506	Artificial Intelligence	L-T-P: 4-0-0	Credits: 4

Course Objectives:

CO1	Foundational Understanding.
CO2	Practical Application and Implementation
CO3	Ethical and Social Implications.
CO4	Developing Skills and Abilities.
CO5	Specific Skills and Knowledge.

Unit 1

Introduction: AI problems, foundation of AI and history of AI intelligent agents: Agents and Environments, the concept of rationality, the nature of environments, structure of agents, problem solving agents, problem formulation.

Unit 2

Searching: Searching for solutions, uniformed search strategies – Breadth first search, depth first Search. Search with partial information (Heuristic search) Greedy best first search, A* search Game Playing: Adversial search, Games, minimax, algorithm, optimal decisions in multiplayer games, Alpha-Beta pruning, Evaluation functions, cutting of search.

Unit 3

Knowledge Representation: Using Predicate logic, representing facts in logic, functions and predicates, Conversion to clause form, Resolution in propositional logic, Resolution in predicate logic, Unification. Representing Knowledge Using Rules: Procedural Versus Declarative knowledge, Logic Programming, Forward versus Backward Reasoning.

Unit 4

Learning: What is learning, Rote learning, Learning by Taking Advice, Learning in Problem-solving, Learning from example: induction, Explanation-based learning. Connectionist Models: Hopfield Networks, Learning in Neural Networks, Applications of Neural Networks, Recurrent Networks. Connectionist AI and Symbolic AI.

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Unit 5

Expert System: Representing and using Domain Knowledge, Reasoning with knowledge, Expert System Shells, Support for explanation examples, Knowledge acquisition-examples.

Course Outcomes:

CO1	Understand the informed and uniformed problem types.
CO2	Apply search strategies to solve them.
CO3	Design and evaluate intelligent expert models.
CO4	Demonstrate and enrich knowledge to select and apply AI tools.
CO5	Examine the issues involved in knowledge bases,reasoning systems and planning.

Text Books:

1. Artificial Intelligence – A Modern Approach. Second Edition, Stuart Russel, Peter Norvig, PHI/ Pearson Education.
2. Artificial Intelligence, Kevin Knight, Elaine Rich, B. Shivashankar Nair, 3rd Edition,2008.

Reference Books:

1. Artificial Neural Networks B. YagnaNarayana, PHI.
2. Artificial Intelligence, 2nd Edition, E.Rich and K.Knight (TMH).

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MCS508	Theory Of Computation	L-T-P: 3-0-0	Credits: 3

Course Objectives:

CO1	To give an overview of the theoretical foundations of computer science from the perspective of formal languages.
CO2	To illustrate finite state machines to solve problems in computing.
CO3	To explain the hierarchy of problems arising in the computer sciences.
CO4	To familiarize Regular grammars, context frees grammar.
CO5	To describe REL.

Unit 1

FINITE AUTOMATA (FA): Introduction, Deterministic Finite Automata (DFA) -Formal definition, simpler notations (state transition diagram, transition table), language of a DFA. Nondeterministic Finite Automata (NFA)- Definition of NFA, language of an NFA, Equivalence of Deterministic and Nondeterministic Finite Automata, Applications of Finite Automata, Finite Automata with Epsilon Transitions, Eliminating Epsilon transitions, Minimization of Deterministic Finite Automata, Finite automata with output (Moore and Mealy machines) and Inter conversion.

Unit 2

REGULAR EXPRESSIONS (RE): Introduction, Identities of Regular Expressions, Finite Automata and Regular Expressions- Converting from DFA's to Regular Expressions, Converting Regular Expressions to Automata, applications of Regular Expressions. REGULAR GRAMMARS: Definition, regular grammars and FA, FA for regular grammar, Regular grammar for FA. Proving languages to be non-regular -Pumping lemma, applications, Closure properties of regular languages.

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Unit 3

CONTEXT FREES GRAMMER (CFG): Derivation Trees, Sentential Forms, Rightmost and Leftmost derivations of Strings. Ambiguity in CFG's, Minimization of CFG's, CNF, GNF, Pumping Lemma for CFL's, Enumeration of Properties of CFL (Proof's omitted).

Unit 4

PUSHDOWN AUTOMATA: Definition, Model, Acceptance of CFL, Acceptance by Final State and Acceptance by Empty stack and its Equivalence, Equivalence of CFG and PDA. TURING MACHINES (TM): Formal definition and behaviour, Languages of a TM, TM as accepters, Department of Computer Science and Engineering MLR Institute of Technology- UG - Autonomous-Regulations & Syllabus – MLR - 17 Page | 68 and TM as a computer of integer functions, Types of TMs.

Unit 5

RECURSIVE AND RECURSIVELY ENUMERABLE LANGUAGES (REL): Properties of recursive and recursively enumerable languages, Universal Turing machine, The Halting problem, Undecidable problems about TMs. Context sensitive language and linear bounded automata (LBA), Chomsky hierarchy, Decidability, Post's correspondence problem (PCP), undecidability of PCP.

Course Outcomes:

CO1	To use basic concepts of formal languages of finite automata techniques.
CO2	To Design Finite Automata's for different Regular Expressions and Languages
CO3	To Construct context free grammar for various languages.
CO4	To solve various problems of applying normal form techniques, push down automata and Turing Machines.
CO5	To participate in GATE, PGECET and other competitive examinations.

Text Books:

1. John E. Hopcroft, Rajeev Motwani, Jeffrey D. Ullman (2007), Introduction to Automata Theory Languages and Computation, 3rd edition, Pearson Education, India.

Reference Books:

1. K. L. P Mishra, N. Chandrashekaran (2003), Theory of Computer Science-Automata Languages and Computation, 2nd edition, Prentice Hall of India, India.

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MCS510	Advanced Graph Theory	L-T-P: 3-0-0	Credits: 3

Course Objectives:

CO1	Developing a strong understanding of fundamental graph theory concepts.
CO2	Learning advanced graph algorithms and techniques.
CO3	Understanding Proof techniques in graph theory.
CO4	Exploring the applications of graph theory in various fields.
CO5	Applying graph theory to solve real world problems.

Unit 1

Introduction to Graphs and its applications, Basics of Paths, Cycles and Trails,Connection,BipartiteGraphs,Eulerian Circuits, Vertex Degrees and Counting, Degree-Sum formula,the Chinese Postman Problem and Graphic Sequences.

Unit 2

Trees and Distance, Properties of trees, Spanning Trees and Enumeration, Matrix-Tree Computation, Cayley's Formula, Prufer Code.

Unit 3

Matching and Covers, Hall's Condition, Min-Max Theorem, Independent Sets, Covers and Maximum Bipartite Matching, Augmenting Path Algorithm, Weighted Bipartite Matching, Hungarian Algorithm.

Unit 4

Vertex Coloring and Upper Bounds, Brook's Theorem and Color-Critical Graphs, Counting Proper Colorings.

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Unit 5

Planner Graphs, Characterization of Planner Graphs,Kuratowski's Theorem,Wagner's Theorem.Line Graphs and Edge Coloring,Hamiltonian Graph,Traveling Salesman Problem and NP-Completeness,Dominating Sets.

Course Outcomes:

CO1	Understanding fundamental concepts.
CO2	Applying Graph Theory to problems.
CO3	Understanding Matching.
CO4	Analyzing Graph Structures.
CO5	Connecting to Real-world applications.

Text Books:

1. "Introduction to Graph Theory" by Douglas B West.
2. "Graph Theory" by Frank Harary.
3. "Graph Theory with Applications to Engineering and Computer Science" by NarsinghDeo.
4. "Handbook of Graph Theory" by Jonathan L Gross and Jay Yellen.

Reference Books:

1. "Graph Theory with Algorithms and its Applications: In Applied Science and Technology" by SantanuSaha Ray.
2. "The Fascinating World of Graph Theory" by Dr Ping Zhang Gary.
3. "Graph Theory for Programmers" by Evstigneev Kasyanov Vladimir.

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MCS512	Parallel Computing	L-T-P: 2-0-0	Credits: 2

Course Objectives:

CO1	Understanding Parallel Architectures.
CO2	Mastering Parallel Programming Models.
CO3	Developing Parallel Algorithms.
CO4	Performance Analysis and Optimization.
CO5	Understanding Performance Metrics.

Unit 1

Parallel Computer Architecture: Trends, Convergence of Parallel Architecture, Fundamental Design Issues.

Unit 2

Parallel Computers and Computation: Parallelism and Computing, Trends in Applications, Trends in Computer Design, Trends in Networking, Parallel Machine Model, The Multi-Computer, Other Machine Models, A Parallel Programming Model, Tasks and Channels, Other Programming Models.

Unit 3

Designing Parallel Algorithms: Methodical Design,Partitioning,Domain Decomposition, Partitioning Design Checklist,Communication,Local Communication, Global Communication, Distributing Communication and Computation.

Unit 4

Interconnection Network Design: Basic definitions,Performance,Organizational Structure, Interconnection Topologies,Evaluating Design Trade-Offs in Network Topology,Routing,Switch Design, Flow control.

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Unit 5

Case Studies: Atmosphere Model, Floorplan Optimization, Computational Chemistry.

Course Outcomes:

CO1	Describe different parallel architectures.
CO2	Develop efficient parallel algorithms.
CO3	Analyze and measure the performance of parallel computing.
CO4	Develop programming proficiency.
CO5	Understanding memory hierarchy and cost performance.

TextBooks:

1. A. Grama, G. Karypis, V. Kumar, A. Gupta, "Introduction to parallel computing", 2nd Edition,Addison-Wesley,2004.
2. Joseph Ja'Ja', "An introduction to parallel algorithms", 1st Edition, Addison-Wesley, 1992

References:

1. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein, "Introduction to Algorithms",3rdEdition,PHI,Learning,2010.
2. Frank Thomson Leighton, "Introduction to Parallel Algorithms and Architectures: Arrays, Trees and Hypercubes", 1st Edition, Morgan Kaufmann Publishers, 1991.
3. Michael T. Heath, AbhiramRanade, Robert S. Schreiber, "Algorithms for Parallel Processing",1stEdition,Springer,1998.
4. Karl Heinz Hoffmann, A. Meyer, "Parallel Algorithms and Cluster Computing: Implementations, Algorithms and Applications", Illustrated Edition, Springer, 2006.

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MCS515	Wireless Sensor Networks	L–T–P: 3–0–0	Credits: 3

Course Objectives:

CO1	To Understand the basic WSN technology and supporting protocols, with emphasis placed on standardization basic sensor systems and provide a survey of sensor technology.
CO2	Understand the medium access control protocols and address physical layer issues.
CO3	Learn key routing protocols for sensor networks and main design issues.
CO4	Learn transport layer protocols for sensor networks, and design requirements.
CO5	To recognize social needs and contribute effectively through self-learning.

Unit I

Introduction and overview: Wireless Sensor Networks (WSN), Commercial and Scientific Applications of WSN, Category of Applications of WSN, Challenges for WSN, Enabling Technologies for WSN.

Unit II

Single node Architecture: Hardware Components, Energy Consumption of Sensor nodes, Operating Systems and Execution Environments, Examples of Sensor Nodes, Network Architecture: WSN Scenarios, Optimization Goals and figures of Merits, Design principles for WSNs, Service Interfaces for WSNs, Gateway Concepts.

Unit III

Physical Layer: Wireless Channel and Communication Fundamentals, Physical Layer & Transceiver Design Considerations in WSN, MAC Protocols: Fundamentals, MAC Protocols for WSNs, IEEE802.15.4 MAC Protocol, Routing Protocols: Gossip and agent based unicast protocols, Energy Efficient Unicast, Broadcast and Multicast, Geographic Routing, Transport Control Protocols: Traditional Protocols, Design Issues, Examples of Transport Protocols, Performance of Transport Control Protocols.

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Unit IV

Sensor Tasking and Control: Information-Based Sensor Tasking, Joint Routing Information Aggregation, Sensor Network Databases: Challenges, Query Interfaces, In-Network Aggregation, Data Centric Storage, Data Indices and Range queries, Distributed Hierarchical Aggregation, Temporal Data.

Unit V

Operating Systems for Sensor Networks: Introduction, Design Issues, Examples of Operating Systems, Node Level Simulators, Performance and Traffic Management Issues: WSN Design Issues, Performance Modelling of WSNs, Emerging Applications and Future Research Directions. Vision transformers and diffusion models (overview), Challenges: occlusion, illumination, dataset bias, fairness in vision.

Course Outcomes:

CO1	Introduction to wireless networks, architectures and technologies.
CO2	Wireless sensor network platforms: Hardware and Software.
CO3	Communication architecture and protocols for WSN (MAC, Link, Routing).
CO4	Energy management.
CO5	Sensor data acquisition, processing and handling.

Textbooks:

•KazemSohraby,DanielMinoli,TaiebZnati, "Wireless Sensor Networks: Technology, Protocols, and Applications", John wiley& Sons.

•Holger Karl, Andreas Willig, "Protocols and architectures for wireless sensor networks", John wiley& Sons.

References:

• Feng Zhao, Leonidas Guibas, "Wireless Sensor Networks; An Information Processing Approach", Elsevier.

• C. S. Raghavendra, Krishna M. Shivalingam, TaiebZnati, "Wireless sensor networks", Springer Verlag.

• H. Edgar, Jr. Callaway, "Wireless Sensor networks, Architectures and Protocols", CRC Press.

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MCS517	Software and Service Oriented Architecture	L-T-P: 3-0-0	Credits: 3

Course Objectives:

CO1	Understanding SOA Fundamentals.
CO2	SOA Technologies.
CO3	SOA Design and Implementation.
CO4	SOA Management and Monitoring.
CO5	SOA Application.

Unit 1

SOA BASICS :Software Architecture – Types of IT Architecture – SOA – Evolution – Key components – perspective of SOA – Enterprise-wide SOA – Architecture – Enterprise Applications – Solution Architecture for enterprise application – Software platforms for enterprise Applications – Patterns for SOA – SOA programming models.

Unit 2

SOA ANALYSIS AND DESIGN: Service-oriented Analysis and Design – Design of Activity, Data, Client and business process services – Technologies of SOA – SOAP – WSDL – JAX – WS – XML WS for .NET – Service integration with ESB – Scenario – Business case for SOA – stakeholder OBJECTIVES – benefits of SPA – Cost Savings.

Unit 3

SOA GOVERNANCE:SOA implementation and Governance – strategy – SOA development – SOA governance – trends in SOA – event-driven architecture – software s a service – SOA technologies – proof-of-concept – process orchestration – SOA best practices.

Unit 4

SOA IMPLEMENTATION:SOA based integration – integrating existing application – development of web services – Integration - SOA using REST – RESTful services – RESTful services with and without JWS – Role of WSDL,SOAP and Java/XML mapping in SOA – JAXB Data binding.

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Unit 5

APPLICATION INTEGRATION:JAX –WS 2.0 client side/server side development – Packaging and Deployment of SOA component – SOA shopper case study –WSDL centric java WS with SOA-J – related software – integration through service composition (BPEL) – case study - current trends.

Course Outcomes:

CO1	Apply SOA Principles
CO2	Utilize SOA Technologies
CO3	Design SOA-based Systems
CO4	Manage SOA Environments
CO5	Analyze and Evaluate SOA Solutions

TextBooks:

1.RonSchmelzer et al. — XML and Web Servicesl, Pearson Education, 2002

2.ThomasErl, —Service OrientedArchitecture: Concepts, Technology, and Designl, Pearson Education, 2005.

Reference Books:

1.Frank P.Coyle,—XML,WebServicesandtheData Revolutionl,PearsonEducation,2002.

2.EricNewcomer,GregLomow,—UnderstandingSOAwithWebServicesl,Pearson Education,2005.

3.Sandeep Chatterjee and JamesWebber,—DevelopingEnterpriseWeb Services: An Architect's Guidel, Prentice Hall,2004.

4.JamesMcGovern,SameerTyagi, Michael E.Stevens, Sunil Mathew, lJava Web. Services Architecturel, Morgan Kaufmann Publishers, 2003.

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MCS519	Pattern Recognition	L–T–P: 3–0–0	Credits: 3

Course Objectives:

CO1	The student will be able to understand the mathematical formulation of patterns.
CO2	To study the various linear models.
CO3	Understand the basic classifiers.
CO4	Can able to distinguish different models.
CO5	To recognize social needs and contribute effectively through patterns.

Unit I

Introduction to Pattern recognition: Mathematical Formulation and Basic Functional Equation, Reduction of Dimensionality, Experiments in Pattern Classification, Backward Procedure for Both Feature Ordering- and Pattern Classification, Suboptimal Sequential Pattern Recognition, Nonparametric Design of Sequential Pattern Classifiers, Analysis of Optimal Performance and a Multiclass Generalization.

Unit II

Linear Models: Linear Basis Function Models -Maximum likelihood and least squares, Geometry of least squares , Sequential learning, Regularized least squares, Multiple outputs , The Bias-Variance Decomposition, Bayesian Linear Regression -Parameter distribution, Predictive, Equivalent, Bayesian Model Comparison, Probabilistic Generative Models- Continuous inputs, Maximum likelihood solution, Discrete features, Exponential family, Probabilistic Discriminative Models -Fixed basis functions, Logistic regression, Iterative reweighted least squares, Multiclass logistic regression, Probit regression, Canonical link functions.

Unit III

Kernel Methods: Constructing Kernels, Radial Basis Function Networks - Nadaraya-Watson model, Gaussian Processes -Linear regression revisited, Gaussian processes for regression, Learning the hyper parameters, Automatic relevance determination, Gaussian processes for classification, Laplace approximation, Connection to neural networks, Sparse Kernel Machines- Maximum Margin Classifiers, Overlapping class distributions, Relation to logistic regression, Multiclass SVMs, SVMs for regression, Computational learning theory, Relevance Vector Machines- RVM for regression, Analysis of sparsity, RVM for classification.

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Unit IV

Graphical Models: Bayesian Networks, Example: Polynomial regression, Generative models, Discrete variables, Linear-Gaussian models, Conditional Independence- Three example graphs, D-separation, Markov Random Fields- Conditional independence properties, Factorization properties, Illustration: Image de-noising, Relation to directed graphs, Inference in Graphical Models- Inference on a chain, Trees, Factor graphs, The sum-product algorithm, The max-sum algorithm, Exact inference in general graphs, Loopy belief propagation, Learning the graph structure.

Unit V

Mixture Models and EM algorithm: K-means Clustering-Image segmentation and compression, Mixtures of Gaussians-Maximum likelihood, EM for Gaussian mixtures, An Alternative View of EM- Gaussian mixtures revisited, Relation to K-means, Mixtures of Bernoulli distributions, EM for Bayesian linear regression, The EM Algorithm in General, Combining Models- Tree-based Models, Conditional Mixture Models- Mixtures of linear regression models, Mixtures of logistic models, Mixtures of experts.

Course Outcomes:

CO1	Learn the basics of pattern classes and functionality.
CO2	Construct the various linear models.
CO3	Understand the importance kernel methods.
CO4	Learn the Graphical models.
CO5	Learn the Markov and Mixed models.

Textbooks:

1. Sequential methods in Pattern Recognition and Machine Learning-K.S.Fu, Academic Press, volume no.52.
2. Pattern Recognition and Machine Learning- C. Bishop-Springer, 2006.

References:

1. Pattern Classification- Richard o. Duda, Peter E. hart, David G. Stork, John Wiley& Sons, 2nd Ed.,2001.

2. The elements of Statistical Learning- Trevor Hastie, Robert Tibshirani, Jerome H. Friedman,Springer, 2nd Ed., 2009.

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MCS521	Quantum Computing	L-T-P: 3-0-0	Credits: 3

Course Objectives:

CO1	To introduce the fundamentals of quantum computing.
CO2	The problem-solving approach using finite dimensional mathematics.
CO3	Quantum Algorithms.
CO4	Quantum Information and Entanglement.
CO5	Quantum Cryptography:Quantum Computing Architecture.

Unit 1

Introduction to Essential Linear Algebra: Some Basic Algebra, Matrix Math, Vectors and Vector Spaces, Set Theory. Complex Numbers: Definition of Complex Numbers, Algebra of Complex Numbers, Complex Numbers Graphically, Vector Representations of Complex Numbers, Pauli Matrice, Transcendental Numbers.

Unit 2

Basic Physics for Quantum Computing: The Journey to Quantum, Quantum Physics Essentials, Basic Atomic Structure, Hilbert Spaces, Uncertainty, Quantum States, Entanglement Basic Quantum Theory: Further with Quantum Mechanics, Quantum Decoherence, Quantum Electrodynamics, Quantum Chromodynamics, Feynman Diagram Quantum Entanglement and QKD, QuantumEntanglement, Interpretation, QKE.

Unit 3

Quantum Architecture: Further with Qubits, Quantum Gates, More with Gates, QuantumCircuits, The D- Wave Quantum Architecture. Quantum Hardware: Qubits, How Many Qubits Are Needed? Addressing Decoherence, Topological Quantum Computing, Quantum Essentials.

Unit 4

Quantum Algorithms: What Is an Algorithm? Deutsch's Algorithm, Deutsch-Jozsa Algorithm, Bernstein Vazirani Algorithm, Simon's Algorithm, Shor's Algorithm, Grover's Algorithm.

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Unit 5

Current Asymmetric Algorithms: RSA, Diffie-Hellman, Elliptic Curve The Impact of Quantum Computing on Cryptography: Asymmetric Cryptography, Specific Algorithms, Specific Applications

Course Outcomes:

CO1	Understand basics of quantum computing.
CO2	Understand physical implementation of Qubit.
CO3	Understand Quantum algorithms and their implementation.
CO4	Understand The Impact of Quantum Computing on Cryptography.
CO5	Understand current Quantum applications.

TextBooks:

1 Nielsen M. A., Quantum Computation and Quantum Information, Cambridge University Press.

2 Dr. Chuck Easttom, Quantum Computing Fundamentals, Pearson.

Reference Books:

1. Quantum Computing for Computer Scientists by Noson S. Yanofsky and Mirco A. Mannucci.

2. Benenti G., Casati G. and Strini G., Principles of Quantum Computation and Information, Vol.Basic Concepts, Vol.

3. Basic Tools and Special Topics, World Scientific. Pittenger A. O., An Introduction to Quantum Computing Algorithms.

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MCS516	Spatial Database Management and Geographic Information Systems	L–T–P: 3–0–0	Credits: 3

Course Objectives:

CO1	Fundamentals of GIS and Spatial Data
CO2	Spatial Database Management
CO3	GIS Analysis and Applications
CO4	To acquire knowledge of Database System Architecture
CO5	To have an exposure to Database Creation and management

Unit I

Thematic maps: Introduction to different types of maps-choropleth maps, Heat maps, proportional symbol maps, dot density maps, animated time-series maps.

Unit II

Technology of Map Production: Standard procedure- data preparation-data model creation, cartographic design, map layout, quality control.

Unit III

The Concept of Database: Introduction to Database, characteristics of database, Database design, Entities and attributes, database models, Relationships, Designing for data integrity, Database normalization and Denormalization.

Unit IV

Database System Architecture: Database system- Architecture, Centralized and Client–Server Architectures, Server System Architectures, Parallel Systems, Distributed Systems, Network Types.

Unit V

Spatial Data Models & Non-Spatial Data Models : Basic Concepts about Spatial Information, Spatial vs. Non-spatial data ,Spatial data models – Raster and Vector ,Raster and Vector data representation; Data Conversions ,Comparison between Raster and Vector Data ,Concepts of DBMS in Context of GIS, Hierarchical, Network, and Relational Models.

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Course Outcomes:

CO1	Various types of thematic maps
CO2	Production of map's
CO3	Database creation & Redundancy
CO4	Various types of database systems
CO5	Creation and management of database

Textbooks:

1. Yeung, Albert K. W., and G. Brent Hall. 2007. Spatial Database Systems: Design, Implementation and Project Management.

2. Lee, Jae-Gil and Minseo Kang. 2015. "Geospatial Big Data: Challenges and Opportunities." Big Data Research.

3. Burrough, P.A.,1986: Principles of Geographical Information Systems in Land Resources Assessment, Clarendon Press, Oxford.

References:

1. Cauvin,Colette; Francisco Escobar and Aziz Serradj, Thematic Mapping and Transformations.ISTE Ltd.,Willey.

2. Denegre,J.1994. Thematic Mapping From Satellite Imagery:A Guide Book. Elsevier Science Ltd.

3. Elmasri, Ramez and Navathe, Shamkant B., 2011. Fundamentals of Database Systems. AddisonWesley.

4. Silberschatz, Abraham;Henry F. Korth and S. Sudarshan, 2006 Database Systems Concepts. McGraw Hill.

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MCS518	Cognitive Systems	L–T–P: 3–0–0	Credits: 3

Course Objectives:

CO1	Gaining a solid foundation in the principles and methodologies of cognitive science, including its interdisciplinary nature.
CO2	Develop computational skills.
CO3	Foster interdisciplinary thinking.
CO4	Promote ethical awareness.
CO5	Cultivating an understanding of the ethical implications of cognitive technologies and their impact on society.

Unit I

Introduction to Cognition: Meaning cognitive processes, Development of cognitive psychology: Structuralism, Functionalism, Behaviorism, Memory Research, Gestalt Psychology, Emergence of cognitive psychology, Information Processing, Connectionism, Alternate approaches to cognitive psychology, Research Methods in Cognitive Psychology.

Unit II

Perceptual Processes: Object Recognition- theories of object recognition, Bottom-Up and Top-Down Processing, Face Perception, Change Blindness. Attention: Divided attention, Selective Attentkon, Visual attention and Auditory attention. Consciousness: Varieties, Subliminal Perception. Visual Perception "Perceptual Organizational Processes, Multisensory interaction and Integration – Synesthesia, Comparing the senses, Perception and Action.

Unit III

Memory: Working Memory: Research on Working Memory, Factors affecting the capacity of working Memory, Baddeley's Working Memory Approach. Long Term Memory: Encoding and Retrieval in Long Term Memory, Autobiographical Memory. MemoryStrategies: Practice, Mnemonics using Imagery, Mnemonics using organization, The Multimodal Approach, Improving Prospective Memory. Metacognition :Metamemory, TOT, Metacomprehension.

Unit IV

VUCA World Problem Solving – Types of problem, Understanding the problem, Problem Solving Approaches, Factors that influence Problem Solving.crativity.Reasoning – Inductive and Deductive Reasoning Decision Making – Heuristics in decision making – representativeness, availability and Anchoring and adjustment.The framing effect, Overconfidence in decisions, The Hindsight Bias.

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Unit V

Future Skills : Critical thinking, Adaptive thinking, Cognitive Load Management, Design thinking, Virtual Collaboration and Cultural Sensitivity.

Course Outcomes:

CO1	**Knowledge Acquisition**
CO2	**Critical Thinking and Problem Solving**
CO3	**Practical Application**
CO4	**Communication and Collaboration**
CO5	**Lifelong Learning**

Textbooks:

1.Matlin M.W. (2003) 'Cognition' 5th Edition, Wiley Publication.

2. Riegler, B.R., Reigler, G.L. (2008), Cognitive Psychology – Applying the Science of Mind. 2nd Edition, Pearson Education.

References:

1. Benjafield J G (2007). 'Cognition' 3rd Edition. Oxford University Press.

2. Goldstein B.E.(2008) 'Cognitive Psychology' 2nd Edition, Wadsworth.

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MCS520	High Performance Computing	L–T–P: 3–0–0	Credits: 3

Course Objectives:

CO1	Understanding HPC Architectures
CO2	Mastering Parallel Programming
CO3	Performance Analysis and Optimization
CO4	Applying HPC to Real-World Problems
CO5	Familiarization with Cloud HPC

Unit I

Parallel Programming & Computing – Introduction: Era of Computing, Parallel Computing, Multiprocessors and Multicomputer Architectures, Scalar VS Vector Processing, Multivector and Superscalar Machines, Pipelined Processors, SIMD Computers, Conditions of parallelism, Program flow mechanisms, Types of Parallelism – ILP, PLP, LLP, Program Partitioning and scheduling.

Unit II

Introduction to High Performance Computing: Era of Computing, Scalable Parallel Computer Architectures, towards low-cost computing, Network of Workstations project by Berkeley, Cluster Computing Architecture, Components, Cluster Middleware and SSI, Need of Resource Management and Scheduling, Programming Environments.

Unit III

Cluster Computing: Clustering Models, Clustering Architectures, Clustering Architectures key factors, types of clusters, Mission critical Vs Business Critical Applications, Fault Detection and Masking Algorithms, Check pointing, Heartbeats, Watchdog Timers, Fault recovery through Failover and Failback Concepts.

Unit IV

High Speed Networks & Message Passing: Introduction to High-Speed Networks, Lightweight Messaging Systems, Xpress Transport Protocol, Software RAID and Parallel File systems, Load Balancing Over Networks – Algorithms and Applications, Job Scheduling approaches and Resource Management in Cluster.

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Unit V

CUDA Programming:

Introduction to CUDA architecture for parallel processing, CUDA Parallelism Model, Foundations of Shared Memory, Introduction to CUDA-C, Parallel programming in CUDA-C, Thread Cooperation and Execution Efficiency, Constants memory and events, memory management, CUDA C on multiple GPUs, Hashing and Natural Parallelism, Scheduling and Work Distribution, Atomics, Barriers and Progress, Transactional Memory.

Course Outcomes:

CO1	Ability to Analyze and Design
CO2	Proficiency in Coding
CO3	Performance Evaluation
CO4	Debugging Skills
CO5	Independent Learning

Textbooks:

1. Rajkumar, High Performance Cluster Computing: Architectures and Systems, Vol. 1 Pearson Education.

2. Georg Hager and Gerhard Wellein, Introduction to High Performance Computing for Scientists and Engineers, CRC Press.

References:

1 Kai Hwang, Advanced Computer Architecture: Parallelism, Scalability, Programmability, McGraw Hill International Editions.

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MCS522	GPU Programming	L–T–P: 3–0–0	Credits: 3

Course Objectives:

CO1	Understanding GPU Architecture
CO2	Parallel Programming Concepts
CO3	Mastering Programming Models
CO4	Developing GPU Accelerated Applications
CO5	Optimizing Performance

Unit I

Introduction: Graphics software/hardware organization. Physical simulation quick overview.

Unit II

Basics of 3D Computer Graphics: Coordinates, vectors, lines, planes, intercepts, transforms, etc. Primitives and scene representation.

Unit III

GPU Organization and Shader Programming : Hardware abstraction for 3D graphics by the Vulkan and OpenGL APIs. Rendering pipeline, programmable shaders, and OpenGL Shading Language. Shader programming for graphical and non-graphical computations.

Unit IV

GPU Physical Simulation and CUDA or OpenCL Programming Physical simulation techniques.

Unit V

CUDA, Compute Shader, or OpenCL programming for physical simulation.

Course Outcomes:

CO1	Ability to Analyze and Design
CO2	Proficiency in Coding
CO3	Performance Evaluation
CO4	Debugging Skills
CO5	Independent Learning

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Textbooks:

1. Programming Massively Parallel Processors: A Hands-on Approach, 4th Edition, 2022, by Hwu, Kirk, and El Hajj.

References:

1. Professional CUDA C Programming by John Cheng, Max Grossman, Ty McKercher.

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MCS603	Multimedia Systems	L–T–P: 3–0–0	Credits: 3

Course Objectives:

CO1	Introduce fundamental concepts
CO2	Explore multimedia processing and rendering
CO3	Examine quality of service (QoS)
CO4	Analyze multimedia transmission
CO5	Develop multimedia applications

Unit I

Multimedia System Overview: Introduction to Multimedia System, Multimedia Files: Image and sound file formats, features of software to read and write such files, Basics of digital audio, Basics of digital imaging ,Multimedia compression technologies and standards - VCD, DVD - MPEG-1/2/4/21.

Unit II

Compression and Decompression Techniques: Types of Compression, Binary Image Compression Schemes, Color, gray scale, still-video image compression, Discrete Cosine Transform, Video Image compression, MPEG Coding methodology, Audio Compression, Data and File format standards- RTF, TIFF,RIFF, MIDI, JPEG, AVI, JPEG, TWAIN Architecture.

Unit III

Multimedia Input and Output Technology: Key Technology Issues, Pen Input, Video and Image Display Systems, Print Output Technologies, Image Scanners, Digital Voice and Audio, Video Images and Animation, Full Motion Video.

Unit IV

Storage and Retrieval Technologies: Magnetic Media Technology, RAID-Level-0 To 5, Optical Media, WORM optical drives, Hierarchical Storage Management, Cache Management for storage systems.

Unit V

Multimedia Application Design: Typesof Multimedia systems - Virtual Reality Design - Components of Multimedia system - Distributed Application Design Issues - Multimedia Authoring and User Interface - Hypermedia Messaging - Distributed Multimedia Systems.

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Course Outcomes:

CO1	Students should be able to differentiate between various multimedia components and technologies.
CO2	Students should be able to design and create multimedia projects, including using tools for image editing, animation, and video production.
CO3	Apply multimedia principles.
CO4	Understand multimedia technologies.
CO5	Students should be able to develop quality multimedia software titles.

Textbooks:

1. Andleigh PK and Thakrar K, "Multimedia Systems", Addison Wesley Longman, 1999.

2. Fred Halsall, "Multimedia Communications", Addison Wesley, 2000.

3. Ralf Steinmetz, KlaraNahrstedt, "Multimedia, computing, communications and applications", Prentice Hall, 1995.

References:

1. Tay Vaughan, "Multimedia making It work" , TMH 5th Edition 2001.

2. Weixel, Fulton, Barksdale.Morse, "Multimedia Basics" ,Easwar Press 2004.

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MCS605	Digital Forensics	L–T–P: 3–0–0	Credits: 3

Course Objectives:

CO1	Provides an in-depth study of the rapidly changing and fascinating field of computer forensics.
CO2	Combines both the technical expertise and the knowledge required to investigate, detect and prevent digital crimes.
CO3	Knowledge on digital forensics legislations, digital crime, forensics processes and procedures, data acquisition and validation, e-discovery tools.
CO4	E-evidence collection and preservation, investigating operating systems.
CO5	Define file systems, network forensics, art of steganography and mobile device forensics.

Unit I

Digital Forensics Science, Computer Crime : Digital Forensics Science: Forensics science, computer forensics, and digital forensics. Computer Crime: Criminalistics as it relates to the investigative process, analysis of cyber criminalistics area, holistic approach to cyber-forensics.

Unit II

Cyber Crime Scene Analysis: Discuss the various court orders etc., methods to search and seizure electronic evidence, retrieved and un-retrieved communications, Discuss the importance of understanding what court documents would be required for a criminal investigation.

Unit III

Evidence Management & Presentation: Create and manage shared folders using operating system, importance of the forensic mindset, define the workload of law enforcement, Explain what the normal case would look like, Define who should be notified of a crime, parts of gathering evidence, Define and apply probable cause.

Unit IV

Computer Forensics: Prepare a case, Begin an investigation, Understand computer forensics workstations and software, Conduct an investigation, and complete a case, Critique a case, Network Forensics: open-source security tools for network forensic analysis, requirements for preservation of network data.

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Unit V

Mobile Forensics: mobile forensics techniques, mobile forensics tools. Legal Aspects of Digital Forensics: IT Act 2000, amendment of IT Act 2008. Recent trends in mobile forensic technique and methods to search and seizure electronic evidence.

Course Outcomes:

CO1	Understand relevant legislation and codes of ethics.
CO2	Computer forensics and digital detective and various processes, policies and procedures.
CO3	E-discovery, guidelines and standards, E-evidence, tools and environment.
CO4	Email and web forensics and network forensics.
CO5	**Mobile forensics.**

Textbooks:

1. John Sammons, the Basics of Digital Forensics, Elsevier

2. John Vacca, Computer Forensics: Computer Crime Scene Investigation, Laxmi Publications

References:

1. William Oettinger, Learn Computer Forensics: A beginner's guide to searching, analyzing, andsecuring digital evidence, Packt Publishing; 1st edition (30 April 2020), ISBN: 1838648178.

2. Thomas J. Holt, Adam M. Bossler, Kathryn C. Seigfried-Spellar, Cybercrime and DigitalForensics: An Introduction, Routledge.

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MCS607	Data Mining & Warehousing	L–T–P: 3–0–0	Credits: 3

Course Objectives:

CO1	Data Mining Fundamentals
CO2	Understanding Data Warehousing
CO3	Data Pre processing, Data Analysis and Visualization
CO4	Model Building and Evaluation
CO5	Understanding the practical applications of data warehousing and data mining in various domains, including business, healthcare, and scientific research.

Unit I

Introduction: Data mining - Functionalities - Classification - Introduction to Data Warehousing - Data Pre-processing: Pre-processing the Data - Data cleaning - Data Integration and Transformation - Data Reduction.

Unit II

Data Mining, Primitives, Languages and System Architecture: Data Mining - Primitives - Data Mining Query Language, Architecture of Data mining Systems. Concept Description, Characterization and Comparison: Concept Description, Data Generalization and Summarization, Analytical Characterization, Mining Class Comparison – Statistical Measures

Unit III

Mining Association Rules: Basic Concepts - Single Dimensional Boolean Association Rules from Transaction Databases, Multilevel Association Rules from transaction databases - Multi dimension Association Rules from Relational Database and Data Warehouses.

Unit IV

Classification and Prediction: Introduction - Issues - Decision Tree Induction - Bayesian Classification - Classification of Back Propagation. Classification based on Concepts from Association Rule Mining - Other Methods. Prediction - Introduction - Classifier

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Unit V

Data warehousing: Introduction - Operational data sources- data warehousing - Data warehousing design - Guidelines for data warehousing implementation - Data warehousing metadata - Online analytical processing (OLAP): Introduction - OLAP characteristics of OLAP system - Multidimensional view and data cube - Data cube implementation - Data cube operations OLAP implementation guidelines.

Course Outcomes:

CO1	Proficiency in Data Mining Techniques
CO2	Data Analysis and Interpretation
CO3	Tool Proficiency
CO4	Critical Thinking and Problem-Solving
CO5	Ability to Design and Implement Data Warehouses

Textbooks:

1. J.Han and M. Kamber, 2012, "Data Mining Concepts and Techniques", Harcourt India Pvt. Ltd, New Delhi .

2. Mohammed J. Zaki, Wagner Meira, Jr. "DataMining and Analysis Fundamental Concepts and Algorithms", Cambridge University Press, May 2014 .

References:

1 K.P. Soman , Shyam Diwakar, V.Ajay, 2006, "Insight into Data Mining Theory and Practice", Prentice Hall of India Pvt. Ltd, New Delhi.

2 G.K. Gupta, "Introduction to Data mining with case studies", 2nd Edition, PHI Private limited, New Delhi, 2011.

3 Arun K Pujari, "Data Mining Techniques", 10th impression, University Press, 2008

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MCS609	Advanced Distributed Systems	L–T–P: 3–0–0	Credits: 3

Course Objectives:

CO1	To understand fundamental concepts of distributed computing and its design.
CO2	Architectural Design
CO3	Fault Tolerance and Security
CO4	Develop practical skills in designing, implementing, and debugging distributed systems using relevant tools and technologies
CO5	Explore theoretical aspects like vector clocks, leader election algorithms, and the CAP theorem

Unit I

Introduction: Definition of Distributed Systems, Goals: Connecting Users and Resources, Transparency, Openness, Scalability, Hardware Concepts: Multiprocessors, Homogeneous Multicomputer systems, Heterogeneous Multicomputer systems, Software Concepts: Distributed Operating Systems, Network Operating Systems, Middleware, The client-server model: Clients and Servers, Application Layering, Client-Server Architectures.

Unit II

Communication: Layered Protocols, Lower-Level Protocols, Transport Protocols, Higher-level Protocols, Remote Procedure Call: Basic RPC Operation, Parameter Passing, Extended RPC Models, Remote Object Invocation: Distributed Objects, Binding a Client to an Object; Static verses Dynamic Remote Method Invocations, Parameter Passing, Message Oriented Communication: Persistence and synchronicity in Communication, Message-Oriented Transient Communication,Message-Oriented'Persistent Communication, Stream Oriented Communication: Support for Continuous Media, Streams and Quality of Service, Stream Synchronization.

Unit III

Process Threads: Introduction to Threads, Threads in Distributed Systems, Clients: user Interface-Client-Side Software for Distribution Transparency, Servers: General Design Issues, Object Servers, Software Agents: Software Agents in Distributed Systems, Agent Technology, Naming: Naming Entities: Names, Identifiers, and Address, Name Resolution, The Implementation of a Name System, Locating Mobile Entities: Naming verses Locating Entities, Simple Solutions, Home-Based Approaches, Hierarchical Approaches.

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Unit IV

Distributed Object Based Systems: CORBA: Overview of CORBA, Communication, Processes, Naming, Synchronization, Caching and Replication, Fault Tolerance, Security, Distributed COM: Overview of DCOM, Communication, Processes, Naming, Synchronization, Replication, Fault Tolerance, Security, GLOBE: Overview of GLOBE, Communication, Process, Naming, Synchronization, Replication, Fault Tolerance, Security, Comparison of CORBA, IDCOM. Globe: Philosophy, Communication, Processes, Naming, Synchronization, Caching and Replication Fault Tolerance, Security, MTN.

Unit V

Distributed Multimedia Systems: Introduction, Characteristics of Multimedia Data, Quality of Service Management: Quality of Service negotiation, Admission Control, Resource Management Resource Scheduling.

Course Outcomes:

CO1	Analytical Skills
CO2	Design Capabilities
CO3	Problem-Solving Abilities
CO4	Technology Proficiency
CO5	Research Capabilities

Textbooks:

1. Andrew S. Tanenbaum and Marteen Van Steen, Distributed Systems: Principles and Paradigms,Pearson Prentice Hall, 2 nd Edition, 2010.

References:

1. Colouris G., Dollimore Jean, Kindberg Tim, Distributed Systems Concepts and Design, 3 rd Edition Pearson Education, 5 th Edition, 2011.

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MCS611	Cyber Security and Law	L–T–P: 2–0–0	Credits: 2

Course Objectives:

CO1	Understanding the Cyber Threat Landscape
CO2	Implementing Security Measures
CO3	Analyzing Legal and Ethical Issues
CO4	Developing Security Policies and Procedures
CO5	Exploring Emerging Trends

Unit I

Introduction to cyber crime and cyber law, cyber space and information technology, Nature and scope of cyber crime, Jurisdiction of cyber crime.

Unit II

Important definitions under IT Act 2000, Cyber crime issues: unauthorized access, White collar crimes, viruses, malwares, worms, Trojans, logic bomb, Cyber stalking, voyeurism, obscenity in internet, Software piracy.

Unit III

IT Act 2000, offences under IT Act and IT (amendment) Act, 2008. CRPC overview, Case studies, Role of intermediaries, Electronic evidence, Cyber terrorism, espionage, warfare and protected system.

Unit IV

Overview of amended laws by the IT Act, 2000: The Indian Penal Code, 1860, The Indian EvidenceAct, 1872, The Banker's Book Evidence Act, 1891, The Reserve Bank of India Act, 1934, Cyber Theft and the Indian Telegraph Act, 1885. Relevant Case laws. Digital Signatures and certificate-legal issues.

Unit V

Intellectual Property rights: Introduction to IP, Copyright, Related Rights, Trademarks, Geographical Indications, Industrial Design, Patents, Licensing and transfer of technology, WIPO Treaties, Copyrights Act, Patents Act, Trademarks Act.

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Course Outcomes:

CO1	Risk Assessment and Mitigation
CO2	Security Implementation
CO3	Policy Development
CO4	Legal and Ethical Awareness
CO5	Career Preparedness

Textbooks:

1. Cyber Security, Cyber Crime and Cyber Forensics: Applications and Perspectives, RaghuSantanam, M. Sethumadhavan, Information Science Reference .
2. Pfleeger, Charles P. and Shari L. Pfleeger. Security in Computing, 4th Edition. Upper SaddleRiver,
   NJ: Prentice Hall.
3. Cybercrime: Security and Surveillance in the Information Age, Douglas Thomas; BrianLoader.
4. Computer Crime: A Crime-Fighters Handbook by David Icove.

References:

1. Crime in the Digital Age: Controlling Telecommunications and Cyberspace Illegalities, Peter N. Grabosky.
2. Cyberlaw – The Indian Perspective By Pavan Duggal, Saakshar Law Publications.

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MCS613	Advanced Operating System	L–T–P: 2–0–0	Credits: 2

Course Objectives:

CO1	To study the characteristics of OS for Multiprocessor and Multicomputer.
CO2	To learn the issues related to designing OS.
CO3	To learn the latest trends in building Mobile OS.
CO4	Developing Security Policies and Procedures
CO5	Exploring Emerging Trends

Unit I

Multiprocessor Operating Systems: System Architectures- Structures of OS – OS design issues – Process synchronization – Process Scheduling and Allocation- memory management.

Unit II

Distributed Operating Systems: System Architectures- Design issues – Communication models – clock synchronization – mutual exclusion – election algorithms- Distributed Deadlock detection

Unit III

Distributed scheduling - Distributed shared memory - Distributed File system – Multimedia file systems - File placement – Caching.

Unit IV

Database Operating Systems: Requirements of Database OS – Transaction process model – Synchronization primitives - Concurrency control algorithms.

Unit V

Mobile Operating Systems: ARM and Intel architectures - Power Management - Mobile OS Architectures - Underlying OS - Kernel structure and native level programming - Runtime issues- Approaches to power management.

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Course Outcomes:

CO1	Knowledge about advanced concepts in OS
CO2	Ability to develop OS for distributed systems
CO3	Ability to develop modules for mobile devices
CO4	Evaluation of storage management strategies
CO5	Problem-solving skills related to OS design

Textbooks:

1. M Singhal and NG Shivaratri , Advanced Concepts in Operating Systems, Tata McGraw Hill Inc, 2001.

References:

1. A S Tanenbaum, Distributed Operating Systems, Pearson Education Asia, 2001
2. Source Wikipedia, Mobile Operating Systems, General Books LLC, 2010

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MCS615	Software Engineering Methodologies	L–T–P: 2–0–0	Credits: 2

Course Objectives:

CO1	Understanding Software Development Processes
CO2	Requirements Engineering
CO3	Software Design Principles
CO4	Software Quality Assurance
CO5	Teamwork and Communication

Unit I

Introduction: Life cycle models, Requirement Analysis and specification, Formal requirements specification.

Unit II

Fundamental issues in software design: Goodness of design, cohesions, coupling. Function-oriented design: structured analysis and design.

Unit III

Overview of object –oriented concepts. Unified Modeling Language (UML). Unified design process. User interface design. Coding standards and guidelines. Code walkthrough and reviews.

Unit IV

Unit testing. Black box and white box testing. Integration and system testing. Software quality and reliability. SEI CMM and ISO 9001.

Unit V

PSP and Six Sigma. Clean room technique. Software maintenance issues and techniques. Software reuse. Client-Server software development.

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Course Outcomes:

CO1	Ability to Apply Methodologies
CO2	Design and Modeling Skills
CO3	Software Development Skills
CO4	Quality Assurance Practices
CO5	Professional and Ethical Practices

Textbooks:

1. Ian Sommeriele, "Software Engineering", Addison Wesley.
2. C.Easteal and G.Davis, Software Engineering Analysis and Design, Tata McGraw Hill.
3. Pressman, Software Engineering –A Practitioner's Approach.

References:

1.Richard Fairley, Software Engineering Concepts, Tata Mcgraw Hill.

2. Pankaj Jalote , An Integrated Approach to Software engineering, Narosa Publication.

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MCS617	Information Systems	L–T–P: 2–0–0	Credits: 2

Course Objectives:

CO1	Understanding the Role of IS
CO2	Developing Analytical Skills
CO3	Gaining Technical Proficiency
CO4	Understanding Business Context
CO5	Ethical and Global Awareness

Unit I

General Methodologies for Information Systems Design – Structured Approach, Object-Oriented Approach, Prototyping, Rational Unified Process, CASE Tools.

Unit II

Quality Assurance in Information Systems - SEI CMM and ISO 9001.

Unit III

Coding Methodologies – Standard Coding Techniques, Extreme Programming

Unit IV

Testing – Different Aspects of Testing, Unit and System Testing, Regression Testing.

Unit V

Information System Project Management and Process Metrics .Development of Typical information Systems – Finance and Accounting, Inventory Control, E-Commerce.

Course Outcomes:

CO1	Problem Solving
CO2	Data Analysis and Management
CO3	Systems Development
CO4	Communication and Collaboration
CO5	Ethical and Social Responsibility

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Textbooks:

1. "Information Systems: What Every Business Student Needs to Know" by Efrem Mallach, and "Textbook on Management Information Systems" by D.P. Nagpal.
2. Information Systems for Business and Beyond (David Turban and Carol V. Pollard).

References:

1. Information Systems ,Richard T. Watson (editor) University of Georgia.

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