Department of Computer Science and Engineering

DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING,

SMIT, MAJITAR

REVISED SYLLABUS FOR B. TECH (CSE) COURSE CURRICULUM

APPLICABLE FOR 2019-20 BATCH FROM 2ND YEAR
APPLICABLE FOR 2020-21 BATCH FROM 1ST YEAR AND SUBSEQUENT BATCHES.

Total Credits:

$22.5 + 22.5 + 23 + 22 + 20 + 12 = 122$

PROGRAM EDUCATIONAL OBJECTIVES FOR B. TECH

COMPUTER SCIENCE AND ENGINEERING DEGREE COURSE

The AICTE-approved B. Tech. Computer Science and Engineering degree course at SMIT/SMU provides the education and training necessary to design, implement, test, and hone skill sets as per the requirement of the changing trends of industries. The curriculum elaborates on all aspects of computer systems from Logic Design, Computer Organization & Architecture, Data Structures, Operating System concepts, Networking, Higher-Level Language Skills, Object Oriented Programming Concepts, Database Management System, Software Engineering, including electives ranging from mobile computing to data analytics and their applications.

The Computer Science and Engineering graduates are prepared for employment in a wide spectrum of high-technology industries and also to inculcate them to become successful professionals. The curriculum lays solid foundation in Computer Science enabling the graduates to work with engineers from other disciplines. Graduates are sufficiently prepared to continue life-long learning and equip themselves for higher qualifications and research activities worldwide.

The Program Educational Objectives of Computer Engineering program are:

- Engineering Knowledge: Our graduates will be capable of applying their engineering knowledge to succeed in whichever field they want to pursue keeping abreast of the ever-changing technology.
- Entrepreneurship: Our graduates should be able to set up various entrepreneurship ventures which in turn facilitate employability.
- Research Upliftment: Our graduates will apply the best practices of computation based on mathematics and science to address customized projects and ensure productivity in research.
- Societal and Ethical Responsibility: Our graduates will showcase a sense of societal and ethical responsibility in their professional endeavors and should be able to make an informed choice for the furtherance of the society.
- Cognitive Communication: Our graduates should be able to exhibit impromptu and impeccable communication skills with the potential of working as a team with cognitive empathy.

Department of Computer Science and Engineering

B.TECH. COURSE STRUCTURE – SEMESTER WISE

2ND YEAR- THIRD SEMESTER

Course No.	Course Code	Course Title	Total Number of Contact Hours				Credits
			Lecture (L)	Tutorial (T)	Practical (P)	Total Hours	
C210	MA 1308	Discrete Mathematics	2	1	0	3	3
C201	CS 1302	Data Structures	2	1	0	3	3
C203	CS 1304	Digital Circuits and Logic Design	2	1	0	3	3
C204	CS 1306	Computer Organization and Architecture	2	1	0	3	3
C205	CS 1307	Intellectual Property Rights and Software Ethics	2	1	0	3	3
C211	CS 1308	Object Oriented Concepts & Programming using C++	2	1	0	3	3
C206	CS 1361	Data Structures Lab	0	0	3	3	1.5
C207	CS 1363	Digital Circuits and Logic Design Lab	0	0	3	3	1.5
C212	CS 1365	Object Oriented Concepts & Programming using C++ Lab	0	0	3	3	1.5
--	BP 1391/BP 1392	Constitution of India/ Indian Traditional Knowledge	2	-	-	-	-
		TOTAL	12	06	09	27	22.5

2ND YEAR- FOURTH SEMESTER

Course No.	Course Code	Course Title	Total Number of Contact Hours				Credits
			Lecture (L)	Tutorial (T)	Practical (P)	Total Hours	
C230	MA 1408	Numerical Methods, Complex and Fourier Analysis	2	1	0	3	3
C220	CS 1403	Database Management Systems	2	1	0	3	3
C221	CS 1405	Design and Analysis of Algorithms	2	1	0	3	3
C222	CS 1406	Advanced Computer Organization & Architecture	2	1	0	3	3
	CS 14**	Open Elective-I #	2	1	0	3	3
	CS 14**	Programme Elective-I #	2	1	0	3	3
C225	CS 1462	Database Management Systems Lab	0	0	3	3	1.5
C226	CS 1464	Advanced Programming Lab	0	0	3	3	1.5
C227	CS 1465	Algorithm Lab	0	0	3	3	1.5
		TOTAL	12	06	09	27	22.5

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LIST OF ELECTIVES FOR 4TH SEMESTER

Open Elective I				Programme Elective I			
Course No.	**COURSE CODE**	**COURSE TITLE**	**CREDIT**	**Course No.**	**COURSE CODE**	**COURSE TITLE**	**CREDIT**
C231	CS 1437/CS 1422	Enterprise Resource Planning	3	C238	CS 1423/CS 1432	PC Hardware and Peripherals	3
C229	CS 1438/ CS 1431	Microprocessors and Peripheral Devices	3	C228	CS 1434/CS 1421	Java Programming	3
C223	CS 1439/EC 1424/CS 1407	Commu nication Techniq ues	3	C234	CS 1435	Python Programming	3
C232	CS 1440/CS1425	Internet, Technology and Society	3	C235	***CS 1436/CS 1642***	***Fundamentals of Web Technologies***	***3***
---------- --				C237	CS 1442	User Interface/User Experience (UI/UX) Design	3
				C357	***CS 1539***	***Biology***	***3***

* In addition to above upto one audit course (Optional) can be taken from online courses.
# Online courses as decided by the department can be taken as Programme Elective I.

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3rd YEAR- 5TH SEMESTER							
Course No.	Course Code	Course Title	Total Number of Contact Hours				Credits
			Lecture (L)	Tutorial (T)	Practical (P)	Total Hours	
C312	MA 1502	Probability, Statistics and Stochastic Processes	2	1	0	3	3
C301	CS 1502	Operating Systems	2	1	0	3	3
C305	CS 1508	Computer Networks – I	2	1	0	3	3
C313	CS 1509	Software Engineering	2	1	0	3	3
	CS 15**	Programme Elective-II#	2	1	0	3	3
	CS 15**	Programme Elective-III#	2	1	0	3	3
C307	CS 1561	Operating Systems Lab	0	0	3	3	1.5
C308	CS 1566	Software Engineering and Object Oriented Analysis Lab	0	0	3	3	1.5
C309	CS 1567	Scripting Language Lab	0	0	3	3	1.5
--	CS 1581	Industrial Training- I	-	-	40	40	0.5
TOTAL			12	06	49	67	22.5

3rd YEAR-6TH SEMESTER							
Course No.	Course Code	Course Title	Total Number of Contact Hours				Credits
			Lecture (L)	Tutorial (T)	Practical (P)	Total Hours	
C331	CS 1604	Formal Languages and Automata Theory	3	1	0	4	4
C333	CS 1606	Computer Networks-II	3	1	0	4	4
	CS 16**	Programme Elective – IV#	2	1	0	3	3
	CS 16**	Programme Elective – V#	2	1	0	3	3
	CS 16**	Programme Elective – VI#	2	1	0	3	3
C336	CS 1663	Computer Networks Lab	0	0	3	3	1.5
C352	CS 1666	Parallel Programming Lab	0	0	3	3	1.5
C407	CS 1671	Mini Project	-	-	16(weeks)	16(weeks)	2
TOTAL			12	05	06+16(weeks)	53+16(weeks)	22

* In addition to above upto one audit course (Optional) can be taken from online courses.

Online courses as decided by the department can be taken as Programme Elective II or III (only one) in 5th semester and Programme Elective IV or V (only one) in 6th semester.

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LIST OF ELECTIVES FOR 5TH SEMESTER

Programme Elective II and III

Course No.	COURSE CODE	COURSE TITLE	CREDIT
C355	CS 1531	Information Transmission and Coding Theory	3
C310	CS 1532	Advanced Java Programming	3
C356	CS 1533	System Programming	3
C304	CS 1534/CS 1507	Discrete Structure	3
C314	***CS 1535/CS 1636***	***Graph Theory***	***3***
C311	***CS 1536/CS 1638***	***System Simulation and Modeling***	***3***
C315	***CS 1537***	***Advanced Web Technologies***	***3***
C316	CS 1538/CS 1601	Object Oriented Analysis and Design Using UML	3
C357	***CS 1539***	***Biology***	***3***
C340	***CS 1540/CS 1632***	***Bioinformatics***	***3***
C341	***CS 1541/CS 1633***	***Digital Image Processing***	***3***
C358	***CS 1542/CS 1635***	***Embedded Systems***	***3***
C359	CS 1543	Low Power Circuits and Systems	3
C360	CS 1544	Information Retrieval	3
C319	CS 1546/CS 1404	Computer Graphics	3
C444	***CS 1752***	***Advanced Algorithms***	***3***
C344	***CS 1759/CS 1644***	***Artificial Intelligence***	***3***
C318	***CS 1545***	***Artificial Neural Networks***	***3***
C235	***CS 1436/CS 1642***	***Fundamentals of Web Technologies***	***3***
C431	***CS 1669***	***Design Thinking***	***3***
C432	***CS 1670***	***Haskell Programming***	***3***

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LIST OF ELECTIVES FOR 6TH SEMESTER

Programme Elective IV, V and VI

Course No.	COURSE CODE	COURSE TITLE	CREDIT
C342	CS 1634	Data Warehousing and Data Mining	3
C362	CS 1637	Software Quality Management	3
C363	CS 1639	Real Time Systems	3
C343	*CS 1641*	*Social Network Analysis*	*3*
C364	CS 1643	VLSI Design	3
C345	CS 1645/CS 1605	Unix Internals and Shell Programming	3
C353	CS 1646	Speech and Natural Language Processing	3
C365	CS 1648	Signals and Networks	3
C346	*CS 1650*	*Agile Methodology*	*3*
C347	CS 1651	Latest Trends in Computer Science	3
C348	*CS 1653*	*Neural Networks and Deep Learning*	*3*
C366	CS 1654/CS 1623	Remote Sensing	3
C349	*CS 1655/CS 1624*	*Autonomous Mobile Robotics and Computational Intelligence*	*3*
C339	CS 1656/CS 1625	Geographical Information System	3
C354	CS 1657	Soft Skills and Interpersonal Communication	3
C367	CS 1658	Human Resource Development and Organizational Behavior	3
C416	*CS 1741*	*Machine Learning*	*3*
C444	*CS 1752*	*Advanced Algorithms*	*3*
C344	*CS 1759/CS 1644*	*Artificial Intelligence*	*3*
C351	*CS 1659*	*Ethical Hacking*	*3*
C431	*CS 1745*	*High Performance Computing*	*3*
C432	*CS 1746*	*Human Computer Interaction*	*3*
C415	*CS 1756*	*R Programming*	*3*
C419	*CS 1757*	*Internet of Things*	*3*
C421	*CS 1760*	*Block Chain Coding*	*3*
C412	*CS 1730*	*Augmented Reality*	*3*
C417	*CS 1742*	*Data Analytics*	*3*
C411	*CS 1723*	*Big Data*	*3*
C413	*CS 1732*	*Cloud Computing*	*3*
C318	*CS 1545*	*Artificial Neural Networks*	*3*
C350	*CS 1631*	*Deep Learning*	*3*
C368	*CS 1720 /CS1626*	*Intellectual Property Rights*	*3*
C402	CS 1660/CS 1702	Soft Computing	3
C314	*CS 1535/CS 1636*	*Graph Theory*	*3*
C315	*CS 1537*	*Advanced Web Technologies*	*3*
C431	*CS 1669*	*Design Thinking*	*3*
C432	*CS 1670*	*Haskell Programming*	*3*

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4th YEAR-7TH SEMESTER							
Course No.	Course Code	Course Title	Total Number of Contact Hours				Credits
			Lecture (L)	Tutorial (T)	Practical (P)	Total Hours	
C403	CS 1703	Compiler Design	3	1	0	4	4
C404	BA 1710	Industrial Engineering Management	2	1	0	3	3
	CS 17**	Programme Elective-VII#	2	1	0	3	3
	CS 17**	Programme Elective VIII#	2	1	0	3	3
	CS 17**	Open Elective-II*	2	1	0	3	3
C406	CS 1762	Compiler Design Lab	0	0	3	3	1.5
C422	CS 1763	Intelligent System Lab	0	0	3	3	1.5
--	CS 1781	Industrial Training- II	-	-	60	60	1
TOTAL			11	05	66	62	20

4th YEAR-8TH SEMESTER							
Course No.	Course Code	Course Title	Total Number of Contact Hours				Credits
			Lecture (L)	Tutorial (T)	Practical (P)	Total Hours	
C430	CS 1875	Major Project	-	-	-	16(weeks)	12
TOTAL			-	-	-	16(weeks)	12

* In addition to above upto one audit course(Optional) can be taken from online courses.
# Online courses as decided by the department can be taken as Programme Elective VI or VII of 7th semester.

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LIST OF ELECTIVES FOR 7TH SEMESTER

Programme Elective VII and VIII

Course No.	COURSE CODE	COURSE TITLE	CREDIT
	CS 1730	***Augmented Reality***	***3***
C412	CS 1731	Ad-Hoc Wireless Networks	3
C413	CS 1732	Cloud Computing	3
C414	CS 1733	Cryptography and Network Security	3
C434	CS 1734	Distributed Database System	3
C435	CS 1739	Wireless Sensor Networks	3
C416	***CS 1741***	***Machine Learning***	***3***
C417	***CS 1742***	***Data Analytics***	***3***
C437	CS 1744	Mobile Computing	3
C431	***CS 1745***	***High Performance Computing***	***3***
C432	***CS 1746***	***Human Computer Interaction***	***3***
C438	CS 1747	Computational Number Theory	3
C436	CS 1748	Advanced Operating Systems	3
C441	CS 1749	Fault Tolerant Computing	3
C442	CS 1750	Multi-agent Intelligent Systems	3
C443	CS 1751	Parallel and Distributed Algorithms	3
C444	***CS 1752***	***Advanced Algorithms***	***3***
C445	CS 1753	Computational Geometry	3
C439	MA 1754	Queuing Theory and Modeling	3
C440	CS 1755	Quantum Computing	3
C415	***CS 1756***	***R Programming***	***3***
C419	***CS 1757***	***Internet of Things***	***3***
C639	***CS 1640 /CS 1758***	***Computer Vision***	***3***
C421	***CS 1760***	***Block Chain Coding***	***3***
C344	***CS 1759/CS1644***	***Artificial Intelligence***	***3***
C349	***CS 1655/CS 1624***	***Autonomous Mobile Robotics and Computational Intelligence***	***3***
C343	***CS 1641***	***Social Network Analysis***	***3***
C346	***CS 1650***	***Agile Methodology***	***3***
C351	***CS 1659***	***Ethical Hacking***	***3***
C428	CS 1743	Cyber Security	3
C429	CS 1754	Future Internet Architecture	3
C350	***CS 1631***	***Deep Learning***	***3***

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Open Elective II			
Course No.	**COURSE CODE**	**COURSE TITLE**	**CREDIT**
C423	CS 1728 /CS1701	Distributed Systems	3
C409	CS 1721 /CS1407	Principle of Programming Languages	3
C411	***CS 1723***	***Big Data***	***3***
C422	CS 1724/CS 1736	Optimization Technique	3
C425	CS 1725	Indian Music System	3
C426	CS 1726	History of Science	3
C427	CS 1727	Introduction to Art and Aesthetics	3
C424	CS 1729	Engineering Research Methodology	3
C368	***CS 1720 /CS1626***	***Intellectual Property Rights***	***3***

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Minor Specialization for 2019-2020 batch onwards: B.Tech (Cyber Security)

Year	Semester	Subject Code	Subject Name	Credit
II	4th	CS1841	1) Signal and Networks	3
III	5th	CS1851	1) Ethical Hacking and Data Privacy	3
		CS1882	2) Seminar / Project work using Python	2
	6th	CS1861	1) Cryptography and Network Security	3
		CS1862	2) Specialisation Elective-I: 12weeks duration – a) Intrusion Detection and Prevention System OR b) Block Chain	3
IV	7th OR 8th	CS1871	1) Distributed Computing	3
		CS18XX	2) Specialisation Elective-II: 12weeks duration on- a) Web Application Security OR b) Forensic of Cyber Security	3
		CS1881	In case Specialisation Elective-II not opted, then - One Publication in the field of Cyber Security in International Conference / Journal (Scopus / SCI)	
			Total	**20**

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Minor Specialization for 2019-2020 batch onwards: B.Tech (Artificial Intelligence)

Year	Semester	Subject Code	Subject Name	Credit
II	4th	CS1842	1) Introduction to Machine Learning	3
III	5th	CS1852	1) Artificial Intelligence	3
		CS1882	2) Seminar / Project work using Python	2
	6th	CS1863	1) Block Chain	3
		CS1864	2) Specialisation Elective-I: 12weeks duration – a) Artificial Neural Networks OR b) Mobile Robotics	3
IV	7th OR 8th	CS1872	1) Soft Computing	3
		CS18XX	2) Specialisation Elective-II: 12weeks duration on- a) Speech & Natural Language Processing OR b) Digital Image Processing	3
		CS1881	In case Specialisation Elective-II: 12weeks duration is not opted, then - One Publication in the field of Artificial Intelligence in International Conference / Journal (Scopus / SCI)	
			Total	**20**

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Minor Specialization for 2019-2020 batch onwards: B.Tech (Internet of Things)

Year	Semester	Subject Code	Subject Name	Credit
II	4th	CS1843	1) Introduction to IoT & Microprocessor	3
III	5th	CS1853	1) Information Theory	3
		CS1882	2) Seminar / Project work using Python	2
	6th	CS1865	1) Cloud Architecture & Deployment	3
		CS1866	2) Specialisation Elective-I: 12weeks duration – a) Wireless Sensor Networks OR b) IoT Standards OR c) IoT for Industries	3
IV	7th OR 8th	CS1873	1) IoT Security	3
		CS18XX	2) Specialisation Elective-II: 12weeks duration on- a) Embedded Systems OR b) Smarter Cities	3
		CS1881	In case Specialisation Elective-II is not opted, then - One Publication in the field of IoT in International Conference / Journal (Scopus / SCI)	
			Total	**20**

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Minor Specialization for 2019-2020 batch onwards: B.Tech (Data Science)

Year	Semester	Subject Code	Subject Name	Credit
II	4th	CS1844	1) Probability & Statistics for Data Analytics	3
III	5th	CS1854	1) Artificial Intelligence	3
		CS1882	2) Seminar / Project work using Python Or R-Programming	2
	6th	CS1867	1) Big Data Analytics	3
		CS1868	2) Specialisation Elective-I: 12weeks duration – a) Data Privacy & Security OR b) Bioinformatics OR c) IoT	3
IV	7th OR 8th	CS1874	1) Information Retrieval	3
		CS18XX	2) Specialisation Elective-II: 12weeks duration on - a) Optimization Technique OR b) Data forensic OR c) Medical Image Processing	3
		CS1881	In case Specialisation Elective-II is not opted, then - One Publication in the field of Data Science in International Conference / Journal (Scopus / SCI)	
			Total	**20**

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Member, Dept of CSE

Mrs. Minakshi Roy
Member, Dept of CSE

Mr. Ashis Pradhan
Member, Dept of CSE

Ms. Nitisha Pradhan
Member, Dept of CSE

Department of Computer Science and Engineering

Revised Promotion Criteria for 2017- 18 Admitted Batch

Programme	Promotion from/To	Revised Minimum	Revised Total
B.Tech	I Year to II year	25	44
	II Year to II I year	60	89
	III Year to IV year	100	134
	Final Year	166	166

Lateral Entry

Programme	Promotion from/To	Revised Minimum	Revised Total
B.Tech	II Year to II I year	27	45
	III Year to IV year	60	90
	Final Year	122	122

Revised Promotion Criteria for 2018- 19 Admitted Batch

Programme	Promotion from/To	Revised Minimum	Revised Total
B.Tech	I Year to II year	23	38
	II Year to II I year	55	83
	III Year to IV year	95	128
	Final Year	160	160

Lateral Entry

Programme	Promotion from/To	Revised Minimum	Revised Total
B.Tech	II Year to II I year	27	45
	III Year to IV year	60	90
	Final Year	122	122

Department of Computer Science and Engineering

Promotion Criteria for 2019- 20 Admitted Batch

Programme	Promotion from/To	Revised Minimum	Revised Total
B.Tech	I Year to II year	23	38
	II Year to II I year	55	83
	III Year to IV year	95	128
	Final Year	160	160

Lateral Entry

Programme	Promotion from/To	Revised Minimum	Revised Total
B.Tech	II Year to II I year	27	45
	III Year to IV year	60	90
	Final Year	122	122

Total Credits (From 2nd year to final year): 22.5 + 22.5 + 23 + 22 + 20 + 12 = 122

Department of Computer Science and Engineering

C210 **MA 1308** **(2L + 1 T hrs/week)**

DISCRETE MATHEMATICS

Questions to be set having equal weightage/marks from each unit: SIX
TWO from UNIT I, TWO from UNIT II, and TWO from both UNIT I and UNIT II combined.
Questions to be answered: FIVE
Compulsory TWO Questions from UNIT I and UNIT II, and ANY ONE from the combination Question.

Course Objective: The objective of this course is familiarize on numerous counting techniques and abstract structures which appear frequently in many areas such as Algorithm analysis , data structures , database management system. Discrete mathematics plays a crucial role in enabling students of computer science to tackle these problems. Graph theory has tremendous application in Computer Networks, Switching. Group theory has enormous applications coding theory and related areas.

Course Outcome: On successful completion of this course, students should be able to:
1. Apply concepts of Group theory to the model real-world problems.
2. Analyze the use of graphs in Engineering applications.
3. Extend the concepts of Predicate Calculus in computer science like design of computing machines, artificial intelligence, definition of data structures for programming languages etc.
4. Evaluate problems related to mathematical logic and pigeonhole principle.
5. Solve problems using Permutation and Combination, Recursion and generating functions.

Pre-requisites: Differential & Integral calculus, Permutations and combinations.

UNIT I

Set theory, Group Theory and Graphs [18 Hrs]

Set theory: Principle of inclusion and exclusion, Relations, and functions, Techniques of Proofs, Pigeonhole Principle; Partial ordering, lattice and algebraic systems, principle of duality, basic properties of algebraic systems defined by lattices, distributive and complemented lattices.

Group Theory: Groups, subgroups, permutation group with simple examples. Cosets, normal subgroup, Burnside's theorem (statement only) and its simple applications, codes and group codes.

Graphs, Digraphs, Walk, Path, Cycles, Connectedness, Tree, Computer representation of relation, relation digraph, and graphs, transitive closer and Warshall's Algorithm.

UNIT II

Elementary configurations and Predicate calculus [18 Hrs]

Elementary configurations: - Permutations and Combinations, Generating functions, Partitions and Compositions, Lexicographical and Fike's orderings of permutations. Algorithms for Lexicographical, Reverse Lexicographical and Fike's ordering of permutation.

Predicate calculus: Connectives , Well formed formula (WFF), , Quantification, examples and properties of WFF into Causal form. Resolution and refutation, answer extraction and simple examples.

Text books :

I. Jean-Paul Tremblay and Manohar, R: Discrete Mathematical Structures with application to Computer Science, McGraw Hill.
2. C.L. Liu: Elements of discrete mathematics, McGraw Hill.
3. Narasingh Deo :Graph theory with applications to Computer Science , PHI.

References :

1. B. Kolman, R.C. Busby & S. Ross.: Discrete Mathematical Structures, Pearson
2. Principles of Artificial Intelligence; N. J. Nielson,
3. E. S. Page & L.B. Wilson: An Introduction to Computational Combinatorics, Cambridge University.

Signature.....
Date.....

Department of Computer Science and Engineering

C201 **CS 1302** **(2L + 1 T hrs/week)**

DATA STRUCTURES

Questions to be set having equal weightage/marks from each unit: SIX
TWO from UNIT I, TWO from UNIT II, and TWO from both UNIT I and UNIT II combined.
Questions to be answered: FIVE
Compulsory TWO Questions from UNIT I and UNIT II, and ANY ONE from the combination Question

Objective: This course emphasizes on the organization of information, the implementation of linear data structures such as linked lists, stacks, queues, and non-linear data structures such as trees, and graphs. This course also explores recursion principles, the close relationship between data structures and algorithms and the analysis of algorithm complexity.

Pre-requisites: Programming concepts and 'C' language.

Course Outcome: On successful completion of this course, students should be able to:

1. Describe the working of data structures like array, stack, queue, linked list, tree and graph
2. Explain common applications for array, stack, queue, linked list, tree and graph
3. Solve a given problem using appropriate data structures and algorithm
4. Discuss about the working of the principal algorithms for sorting, searching, and hashing
5. Correlate the performance of a program with respect to the choice of data structure & algorithm

UNIT – I

Introduction [3 Hrs]
Definition, Algorithmic analysis: 'Oh' notation.

Contiguous data structures [4 Hrs]
Representation of multidimensional arrays, Highly structured sparse matrices using dimensioned arrays, **String representation and manipulation.**

Stacks [5 Hrs]
Definition, Operations on stacks, Implementation using array. Application of Stacks: Evaluation of arithmetic expressions. Recursion: Use of recursive techniques in enumeration problems and back tracking algorithms, Recursion removal using stacks.

Queues [5 Hrs]
Definition, Operations on queue, Implementation of queues, Circular queues, Applications.

Non-contiguous Data Structures [3 Hrs]
Linear linked list: Insertion, Traversal and deletion operations on singly linked list. Various types of linked list: Doubly linked list, Circular lists, Use of header node in circular lists, Generalized (recursive) list, Application of linear list, **Representation and manipulation of sets, Strings and graphs.**

UNIT- II

Trees [6 Hrs]
Definition of a tree and various terminologies used in tree, Binary tree, Recursive and non-recursive tree traversal algorithms, Representation of n-ary trees using binary trees, Application of trees, Expression trees. Search trees: Definition, Insertion, Deletion and reversal, Height balanced search trees (using AVL trees illustrative example) and weight balanced search trees.

Graphs [4 Hrs]
Terminology and representations: Introduction, Definition and terminology, Graph representations, Traversals, Connected components and spanning trees, Shortest path problem, Dijkstra's algorithm.

Sorting and searching [10 Hrs]

Sorting: Insertion, 2-way merge, Heap sort and quick sort, Comparison of different sorts, **Radix sort. Searching: Linear, Binary search, Comparison of different methods**. Hashing technique: Hash tables, Different hashing functions, Overflow handling, Methods for collision handling, Theoretical evaluation.

Text Books:

1. Ellis Horowitz and Sartaj Sahni, "Fundamentals of Data Structures", Galgotia.
2. Samanta, D., "Classic Data Structures", PHI.

Reference Books:

1. Alfred V. Aho, John E. Hopcroft, Jeffrey D. Ullman, "Data Structures and Algorithms", Pearson
2. E.M. Reingold and W.J. Hansen, "Data Structures", CBS.
3. A. S. Tanenbaum, Y. Langsam, M.J. Augenstein, "Data Structures using C", Pearson.
4. M. A. Weiss, "Data Structure and Algorithm Analysis in C", Pearson.

Department of Computer Science and Engineering

C203 **CS 1304** **(2L + 1 T hrs/week)**

DIGITAL CIRCUITS AND LOGIC DESIGN

Questions to be set having equal weightage/marks from each unit: SIX
TWO from UNIT I, TWO from UNIT II, and TWO from both UNIT I and UNIT II combined.
Questions to be answered: FIVE
Compulsory TWO Questions from UNIT I and UNIT II, and ANY ONE from the combination Question

Objective: It provides an in-depth coverage of digital circuits and logic design, starting from elementary 2-valued logic to expression minimization and circuit design techniques. This also includes the working principles of digital logic circuits and implementing them using logic gates, interfacing of logic families with TTL/ECL/MOS/CMOS etc.

Pre-requisites: Basic Electronics and Engineering Physics

Course Outcomes: On successful completion of this module, students should be able to
1. Relate and implement Boolean algebra in Digital Logic Circuits
2. Design combinational logic circuits
3. Design sequential logic circuits
4. Interpret various logic families
5. Explain the working of multivibrator circuits

UNIT – I

Logic gates and simplification of Boolean functions [6 Hrs]
Introduction to basic logic gates (AND, OR, NOT, NOR, NAND), The K-map method, SOP and POS simplifications, NAND and NOR implementations. Don't care conditions, Quine-McCluskey tabulation method (5-variable, decimal notation), **Determination and selection of prime implicants, MEV – techniques.**

Combinational logic [4 Hrs]
Design Procedure, Design of adders, Subtractor and code converters, Analysis procedure, Multi-level NAND and NOR circuits, Ex-OR and equivalence functions.

Combinational logic, MSI and LSI [4 Hrs]
Application of typical TTL IC components like binary parallel adder (74283), Carry look ahead adder, BCD adder (8283), Comparator (7485), Decoders (74138, 7442), Encoder (74148), Multiplexer (74157),parity generator.

Memory devices [6 Hrs]
Memory terminologies: **RAM, ROM, Word, Capacity, Address, Access Time, Cycle time, Magnetic core memory**, Semiconductor memory (S-RAM and D-RAM): Structures and operations, Read/Write cycles, Refreshing. Magnetic tape storage, Magnetic disk storage, Winchester disk and floppy disk, ROM and its architecture, **Types of ROM: PROM, EPROM, EEPROM, ROM applications, Linear selection and coincident selection.**

UNIT – II

Sequential logic [8 Hrs]
NAND/NOR gate latch, Clocked signals and clocked flip flops (S-R, J-K and D), J-K master-slave flip-flop,Edge triggering, Level Triggering , Ripple (Asynchronous) counters (mod 2N and mod<2N), IC asynchronous counters (7490, 7493), Asynchronous down counter, Cascading of counters, **Pre-settable counter (74193)**, Analysis of clocked sequential circuits, Design of clocked sequential circuits, State table and state transition diagram, sequential circuits design methodology.State reduction, State assignment, Flip-flop excitation tables, Design of synchronous counters,

Classification of sequential Circuits-Moore and Mealy Shift registers, **Universal shift register (74194)**, Ring counter, Johnson counter.

Integrated circuit logic families [6 Hrs]

IC Terminologies –I/O conditions, Fan in fan out, Propagation delay, Noise immunity, Circuits and characteristics of TTL, ECL, MOS (P-MOS, N-MOS), CMOS, **Interfacing of logic families to one another (TTL to CMOS, CMOS to TTL, TTL to ECL, and ECL to TTL).**

Multivibrators and timing circuits [6 Hrs]

Multivibrators- Bistable, Astable and monostable: Design of astable, Monostable, and bistablemultivibrators using transistors, Design of astable and monostablemultivibrators using logic gates, **Schmitt trigger circuit using IC 7413, Design of astablemultivibrator using IC 7413**.

Text Books:

1. Morris Mano, "Digital Logic and Computer Design", PHI
2. Tocci and Widmer, "Digital Systems", PHI
3. Herbert Taub and Donald Schilling, "Digital Integrated Electronics", McGraw Hill.

Reference Books:

1. Thomas C Bartee, "Computer Architecture and Logic Design", McGraw Hill
2. Louis Nashelsky, "Introduction to Digital Technology", Prentice Hall
3. Fletcher, "An Engineering Approach to Digital Design", PHI Raj Kamal, "Digital Systems Principles and Design", Pearson Education.

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Date.....

Department of Computer Science and Engineering

C204 **CS 1306** **(2L + 1 T hrs/week)**

COMPUTER ORGANIZATION AND ARCHITECTURE

Questions to be set having equal weightage/marks from each unit: SIX
TWO from UNIT I, TWO from UNIT II, and TWO from both UNIT I and UNIT II combined.
Questions to be answered: FIVE
Compulsory TWO Questions from UNIT I and UNIT II, and ANY ONE from the combination Question

Objective: The main objectives of this course are to develop an understanding of the functional blocks of a computer and the inter-relation between them. It emphasizes on the design of the processing unit as well.

Pre-requisites: Digital Circuits & Logic Design, Computer System fundamentals.

Course Outcomes: On successful completion of this course, students should be able to:

1. Demonstrate competence in mapping relation between computer programming and computer organization and architecture.
2. Identify computer model requirements.
3. Analyze and evaluate the competence of a model.
4. Identify the evolution of Computer systems and the complexities in data processing.
5. Propose various microprocessor design alternatives to learn the concepts of parallel processing, pipelining and Interprocessor system performance

UNIT – I

Basic organization of the computer and Introduction to microprocessors [6 Hrs]
Basic organization of the computer and block level description of the functional units from program execution point of view, Fetch, Decode and Execute cycle. **Introduction to microprocessors, Evolution, a brief overview of more advanced processors (Pentium, Motorola and Zilog).**

Memory organization [6 Hrs]
A review of random and serial access memories, Basic concept of main memory: Static and dynamic memory, ROM, Error correction, Computer memory system overview, Memory hierarchy, Cache memory: Mapping functions, Replacement algorithms, Virtual memory, Logical to physical memory mapping, External memory: **Magnetic disk, RAID.**

Input/Output [4 Hrs]
External devices, I/O Modules, Programmed I/O, Interrupt driven I/O, DMA, I/O channels and processors.

The processing unit [4 Hrs]
Fundamental concepts: Fetching a word from memory, Storing a word in memory, Register transfers, Performing an arithmetic or logic operation Addressing modes, Instruction format: Three, Two, Oneand zero address instruction, **Control Unit:Hardwired control unit, Micro programmed control unit.**

UNIT- II

Arithmetic [7 Hrs]
Number representation, Fixed point addition and subtraction, Multiplication of fixed point numbers: Booth's multiplication, Integer division: Restoring and non-restoring.

Fundamentals of processor design [5 Hrs]
Instruction set processor design, Exploitation of instruction-level parallelism (ILP), Processor micro-architecture, Principles of processor performance, **Vector processing and array processing.**

Pipelined processor architecture [6 Hrs]
Fundamentals of pipelining, Flynn's classification of computers (SISD, SIMD, MISD, MIMD) Arithmetic pipeline design, Instruction pipeline design, Balancing pipeline stages, Stalls in pipeline, Methods for reduction of stalls in pipeline.

Reduced instruction set computers [2 Hrs]
Introduction, Reduced Instruction Set Architecture, **differences between RISC and CISC processors.**

Text Books:

1. V. C. Hamacher, Zaky, Vranesic, "Computer Organization", McGraw Hill
2. William Stallings, "Computer organization & Architecture – Designing for Performance", Pearson Education.
3. Gaonkar R.S.,"Microprocessor Architecture,Programming and Applications", 5th Ed., Penram International.

Reference Books:

1. D. A. Patterson and J. L. Hennessy, "Computer Organization and Design - The Hardware/Software Interface", Morgan Kaufmann.
2. J. P. Hayes, "Computer Architecture and Organization", McGraw Hill.
3. Morris Mano, "Computer System Architecture", Pearson
4. P. Pal Chaudhuri, "Computer Organization and Design", PHI

Department of Computer Science and Engineering

C205 **CS 1307** **(2L+1T hrs/week)**

INTELLECTUAL PROPERTY RIGHTS & SOFTWARE ETHICS

Questions to be set having equal weightage/marks from each unit: SIX
TWO from UNIT I, TWO from UNIT II, and TWO from both UNIT I and UNIT II combined.
Questions to be answered: FIVE
Compulsory TWO Questions from UNIT I and UNIT II, and ANY ONE from the combination Question

Objective:
To introduce the role and importance of Intellectual property rights in the field of information technology
To understand the concepts of patents, trademarks and copyrights.
To introduce the procedure for obtaining patents, trademarks and copyright.

Pre-requisites: NIL.

Courses Outcomes: On successful completion of this course, students should be able to:

1. Identify regulations, legislation and standards for Intellectual Property Rights
2. Describe the impact of Intellectual Property Rights on engineering and industrial practices vis a vis social, environmental and economic context.
3. Apply principles of Intellectual Property Rights to sustainable design and development.
4. Analyze ethical lapses and recognize ethical dilemmas.
5. Distinguish professional issues which arise in the intellectual property law context

UNIT - I

Introduction to Intellectual Property Rights [8 Hrs]

Intellectual Property, Introduction to IPR, History of IPR, Overview & Importance, Role of IPR in Research & Development, Legislations Covering IPRs in India, Different forms of IPR – Patents, Copyright, Trademark, Industrial Designs, Layout Designs of Integrated Circuits, Geographical Indications, **Trade Secrets, Plant Varieties**, Some important examples of IPR.

Patents [6 Hrs]

Introduction, Patent – A form of property, The Patent Law in India, Patent Document, Protectable Subject matter: Patent and kind of inventions protected by a patent , Inventions which are not patentable under the act, Patent of addition, Term of patents of addition. Why protect inventions by patents? Searching for patents, **Drafting of a patent**, Filing of a patent. **Rights Conferred to Patentee.**

Copyright [6 Hrs]

Introduction: Meaning of copyright, Characteristics of copyrights, Indian Copyright Law. Main features of Copyright Act 1957, Amendments to Copyright Act, Requirements of copyrights, Copyright are protection in form and not in idea, Authorship and ownership of copyright. Rights conferred by copyright, Term of copyright, Related rights, Distinction between related rights and copyright.

UNIT II

Trademarks [4 Hrs]

Meaning of Trademark, the Functions of a Trademark, Essentials of a Trademark, Trademark Law in India, Domain name and how does it relates to trademarks? Registration of Trademark. Rights conferred by registration of Trademark.

IPR in the field of Information Technology [4 Hrs]

Introduction, Information Technology Act - 2000, Offences and corresponding penalties – Section 65 to 71, Section 66A and restriction of free speech, National Cyber Security Policy – 2013, Some notable cases.

Computer Ethics [4 Hrs]

Definition of Ethics, Computer and Information Ethics, The Ten Commandments of computer ethics, Hacking, **Ethical hacking**, Plagiarism.

Open Source Software [8 Hrs]

Introduction to Free and Open Source Software (FOSS), Open Source vs. Closed Source, Free Software, Free Software vs. Open Source software, **Copyright vs. Copyleft**, Licenses: GNU General Public License(GPL), MIT License, BSD License, Mozilla Public License, Apache License. Creative Commons, Public Domain, Forking Open Source projects; **Violation of copyrights and remedies, Using Open Source projects in industry, Open Source Government, Open Source Hardware, Open source media.**

Text Books:

1. Dr. B. L. Wadhera, Law Relating to Intellectual Property, Universal Law Publishing Co. Ltd.

2. P. Narayanan; Law of Copyright and Industrial Designs; Eastern Law House, Delhi

Reference Books:

1. Ajit Parulekar and Sarita D' Souza, Indian Patents Law – Legal & Business Implications; Macmillan India Ltd. 2006

2. National Cyber Security Policy, 2013.

3. Information Technology Act – 2000.

Department of Computer Science and Engineering

C211 **CS 1308** **(2L + 1 T hrs/week)**

OBJECT ORIENTED CONCEPTS & PROGRAMMING USING C++

Questions to be set having equal weightage/marks from each unit: SIX
TWO from UNIT I, TWO from UNIT II, and TWO from both UNIT I and UNIT II combined.
Questions to be answered: FIVE
Compulsory TWO Questions from UNIT I and UNIT II, and ANY ONE from the combination Question.

Objective: This course introduces C++ as an Object Oriented Programming Language, building on existing knowledge of C and Java. The unit covers the C++language with a focus on its object-oriented features, and how these can be implemented as part of program designs and implementation. The students will also study and gain practical experience with the implementation issues related to object-oriented techniques, be able to build good quality software using object-oriented techniques, and understand the role of patterns in object-oriented design.

Pre-requisites: Computer Programming concepts

Course Outcomes: On successful completion of this course, students should be able to:

1. Describe the principles of Object Oriented Programming and C++ features that support OOP Paradigm.
2. Compare and differentiate between OOP and structured or procedural programming.
3. Explain programming constructs and features of C++ programming language.
4. Employ C++ constructs to write Object Oriented Programs to solve problems.
5. Adapt to bottom up approach of problem solving using classes and objects.

UNIT – I

Basic concepts of OOP [5 Hrs]
The Data types: Literal constant, Variables, Pointer types, String types, Constant qualifier, Reference types, The Boolean type, Enumeration types, Array types, Typedef names, Volatile qualifier, Class types, Expressions: Definition, **Operators: Arithmetic, Increment and decrement, Conditional, Size of operator,** New and delete, Comma,
The bitwise operator, Precedence, Type conversions, Statements: Selection, Iteration, Jump.

Procedural- based programming [4 Hrs]
Functions: Overview, Function prototype, Argument passing, Returning a value, Recursion, Inline functions, Linkage directives: Extern "C", Scope: Global objects and functions, Local objects, Dynamically allocated objects.

Object–based programming [5 Hrs]
Classes: Definition , Class object, Class member functions, Constructors and destructors, Friend function and classes, Static class members, Structures and unions, Bit field: A space saving member, Class scope, Nested classes, Structured programming and Object oriented programming paradigm.

Overloaded functions/ operators (polymorphism) [5 Hrs]
Overloaded declarations, The three steps of overload resolution, Argument type conversions, Overloading operators: Operators like =, ( ), ->, <<, >>, + and -- (Using both friend as well as member functions, Importance of this pointer).

UNIT- II

Generic programming using template function & template classes [6 Hrs]
Definition of generic programming, Function template, Template arguments and overloading function template.

Inheritance and io-stream library [8 Hrs]

Inheritance: Base class member access, Inheritance types, Protected mechanism, Virtual base classes. Virtual functions (Run-time polymorphism concept): Virtual functions, Pure virtual functions, Early vs. late binding. **The io-stream library: Streams, Stream classes, Managing unformatted and formatted I/O operations, Manipulators**.

Files/ exception handling [7 Hrs]

Classes for file stream operations, Accessing files, Sequential I/O operations, Random access, **Command- line arguments, Exception handling (throw, try, and catch).**

Text Books:

1. Herbert Schildt, "The Complete Reference C++", Tata McGraw Hill.
2. E. Balagurusamy, "Object Oriented Programming with C++", Tata McGraw Hill.

Reference Books:

1. Bjarne Stroustrup, "C++ Programming Language", Pearson.
2. Stanley B Lippman and Lajoie, "C++ Primer", Pearson.
3. Saurav Sahay, "OOP with C++", Oxford University Press.
4. B.L. Juneja and Anita Sethi, "Programming with C++", New Age International Publication.

Department of Computer Science and Engineering

BP 1391 **(2L/week)**

CONSTITUTION OF INDIA

Questions to be set having equal weightage/marks from each unit: SIX
TWO from UNIT I, TWO from UNIT II, and TWO from both UNIT I and UNIT II combined.
Questions to be answered: FIVE
Compulsory TWO Questions from UNIT I and UNIT II, and ANY ONE from the combination Question.

Objective: This course aims to reflect the idea of "Constitutionalism" – a modern and progressive concept historically developed by the thinkers of "liberalism" – an ideology which has been recognized as one of the most popular political ideology and result of historical struggles against arbitrary use of sovereign power by state.
Pre-requisites: NIL.

Course Outcomes: On successful completion of this course, students should be able to:
1. Describe the importance of the Constitution of India.
2. Identification and use of different types of political system in India.
3. Explain the parliamentary form of government in India.
4. Investigation of urban and local government systems and development of ideas for the betterment of government.
5. Development of the concept of democracy, fundamental rights, and laws.

UNIT I

Meaning of constitution law and constitutionalism

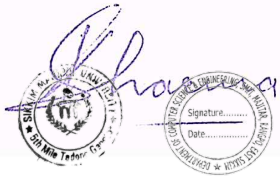
Evolution of Indian Constitution- Nationalist Movement and Philosophical Foundations; Preamble of Indian constitution.
Indian Federation- Features of federation; Centre – State Relations – Recent Trends; Fundamental Rights and Duties and Directive Principals of state policy.
Parliamentary form of government: Executive: President; Prime Minister and Council of Ministers - Election, Powers and Functions; **Legislature**: Lok Sabha and Rajya Sabha– Composition, Powers and Functions
Judiciary– Supreme Court, Composition, Powers, Functions and Judicial Review- Judicial Activism.

UNIT II

Amendment of the constitution: Powers and procedure; State Government – Governor, Chief Minister and Council of Ministers – Powers and Functions.
Party System: National and regional Parties; Trends in Party System Election Commission – Electoral Reforms and voting Behavior.
Rural Local Government: Evolution Structure and Function**;** Gram Sabha; Gram Panchayat; Panchayat Samiti; Zila Panchayat.
Urban Local government: Evolution structure and function; Municipal corporation**;** Nagar panchayat.

Text books:

1. Our Constitution: An Introduction to India's Constitution and Constitutional law by Kashyap Subhash
2. Introduction to the Constitution of India by D. D. Basu
3. Encyclopedia of Social Sciences (Vol.4, 1931)
4. History of Political Theories from Luther to Montesquieu by Dunning
5. The Indian Constitution: Cornerstone of a Nation by Austin Graville
6. Indian Government and Politics by S. S. Awasthy
7. Contemporary Indian Politics by Limaye Madhu
8. Indian polity by M. Laxmikanth



Department of Computer Science and Engineering

BP 1392 **(2L hrs/week)**

INDIAN TRADITIONAL KNOWLEDGE

Questions to be set having equal weightage/marks from each unit: SIX
TWO from UNIT I, TWO from UNIT II, and TWO from both UNIT I and UNIT II combined.
Questions to be answered: FIVE
Compulsory TWO Questions from UNIT I and UNIT II, and ANY ONE from the combination Question.

Objective: The course aims at imparting basic principles of thought process, reasoning and inferencing. Sustainability is at the core of Indian Traditional Knowledge Systems connecting society and nature. Holistic life style of yogic science and wisdom capsules in Sanskrit literature are also important in modern society with rapid technological advancements and societal disruptions.

Pre-requisites: NIL.

Course Outcomes: On successful completion of this course, students should be able to:
1. Identification of core features and importance of Vedic knowledge.
2. Discuss modern science, Indian knowledge, and yogic practices.
3. Develop philosophical understanding of Indian traditional and Indian linguistic systems.
4. Illustrate the impact of yogic practices.
5. Measure the impact of Indian traditional knowledge.

UNIT I

Basic structure of Indian knowledge system. Basic features and importance of Vedic knowledge; Astadash Vidhya- 4 Vedas, (Rig-Veda, Sama-Veda, Yajur-Veda, and Atharva) 4 Upa Vedas (Dhanurveda, Gandharvaveda, Ayurveda and Arthasastra), 6 Vedangs (Siksha, Chhanda, Vyakarana, Nirukta, Jyotisha and Kalpa) And 4 Upangas (Dharma Sastra, Memangsa, Purana and Tarka Sastra)

Modern Science and Indian Knowledge: Basic features, significance and relevance in modern society.
The Idea of Zero, the Decimal System, Numeral Notations, Fibonacci Numbers, Binary Numbers, a Theory of Atom, Plastic Surgery and Ayurveda.

Yoga and holistic health care: Origin of Yoga & its brief development, Meaning of Yoga & its importance, Yoga as a Science of Art (Yoga Philosophy), Meaning of meditation and its types and principles.
Principles of Yogic Practices: Meaning of Asana, its types and principles, meaning of Pranayama, its types and principles, Meaning of Kriya its types and principles.
Case Study

UNIT II

Philosophical Traditions:
Serve Darsana Sangraha: meaning features and significance (Charvaka System,Bauddha System, Arhata or ,Jaina System, Ramanuja System, Purna-prajna System, Nakulis-Pasupata System,Saiva System, Pratyabhijna or Rcognitive System, Rasesvara or Mercurial System, Vaiseshika or Aulukya System, Akshapada or Nyaya System, Jaiminlya System, Papiniya System, Sankhya System)

Indian Linguistic Tradition: **Theoretical**:
Phonetics: Sounds of a language–Phonology: Sound patterns–Morphology: Word formation and structure–Syntax: Sentence structure–Semantics: Study of meaning. **Applied**–Understanding and teaching other languages, translation, speech therapy.

Indian Artistic Tradition: Basic features, significance and importance and region associated:
Chitra Kala , Murti Kala, Bastu Kala, and Sangit, (The Famous Traditional Art Forms in India: Warli Art, Gond Art, Madhubani, Miniature Paintings ,Tanjore Paintings, Kalamkari , Kalighat Pats Phad Pai)

Case Study

Text books:

1. V Shivakrishnan (Ed) : Cultural Heritage Of India Course Material Vidhya Bhawan Mumbai 5th Edition ,2014
2. The Sarva-Darsana-Samgraha, Or Review Of The Different Systems Of Hindu Philosophy By Madhava Acharya Publication Date 1882 ,Topics Hinduism ,Publisher London, Contributor Robarts - University Of Toronto.
3. K.S Subrahmanialyer, Vakyapadiya Of Bhartrihari(Brahman Kanda) Deccan College Pine 1965.
4. Panini Shiksha, Motilal Banarasidas
5. V.N Jha , Language, Thoughts And Reality.
6. Pramod Chandra, Indian Arts , Abhinav Publications 1897
7. Light on Yoga by B.K.S. Iyengar
8. The Heart of Yoga: Developing a Personal Practice by T.K.V. Desikachar
9. The Seven Spiritual Laws of Yoga by Deepak Chopra
10. The Secret Power of Yoga: A Woman's Guide to the Heart and Spirit of the Yoga Sutras by Nischala Joy Devi
11. Yoga: The Iyengar Way by Silva, Mira, and Shyam Mehta
12. Yoga: The Iyengar Way by Silva, Mira, and Shyam Mehta

C206 **CS 1361** **(3 hrs/week)**

DATA STRUCTURES LAB

Objective: At least 10 experiments covering the entire syllabus of the corresponding theory paper to be carried out using the theory studied /programming skill of the subject concerned to get insight into the practical applications of the theoretical studies. The outcome of the lab classes must lead to a skilled and self-sustained program developer.

Pre-requisites: Corresponding theory paper CS 1302 Data Structures and associated prerequisites.

Course Outcomes: On successful completion of this course, students should be able to:

1. Write program related to application of data structures using programming constructs of a language like C programming language
2. Identify the suitable input and output for a specified problem statement
3. Conclude the working of various algorithms in terms of time and space complexity
4. Examine the errors encountered in the program using appropriate tools and fix them
5. Write well-indented and well-documented code

C207 **CS 1363** **(3 hrs/week)**

DIGITAL CIRCUITS AND LOGIC DESIGN LAB

Objective: At least 10 experiments covering the entire syllabus of the corresponding theory paper to be carried out using the theory of the subject concerned to get insight into the practical applications of the theoretical studies. The outcome of the lab classes must lead to a skilled and self-sustained program developer.

Pre-requisites: Corresponding theory paper CS 1304 Digital Circuits and Logic Design, Basic Electronics and 10+2 level Physics.

Course Outcomes: On successful completion of this course, students should be able to:

1. Design and analyze basic combinational circuits.
2. Relate logic circuits to solve digital electronics problems.
3. Express flip-flops as memory elements and design digital electronics circuit with a memory.
4. Design small sequential circuits and implement them in software and hardware.
5. Design programmable counters and implement them in software and hardware.

C212 **CS 1365** **(3 hrs/week)**

OBJECT ORIENTED CONCEPTS & PROGRAMMING USING C++ LAB

Objective: At least 10 experiments covering the entire syllabus of the corresponding theory paper to be carried out using the theory studied /programming skill of the subject concerned to get insight into the practical applications of the theoretical studies. The outcome of the lab classes must lead to a skilled and self-sustained program developer.

Pre-requisites: Corresponding theory paper CS 1308 Object Oriented Concepts & Programming using C++ and associated prerequisites.

Course Outcomes: On successful completion of this course, students should be able to:

1. Tell the syntax and semantics of the C++ programming language.
2. Apply the concepts and principles of Object Oriented programming while writing programs using C++.
3. Extend the concepts of encapsulation, polymorphism, inheritance using class, objects, function/operator overloading, function overriding, etc.
4. Write programs with Inheritance, virtual functions that supports code reusability, dynamic binding and run time polymorphism.
5. Adapt to bottom up approach of problem solving using classes and objects.

Department of Computer Science and Engineering

C230 **MA 1408** **(2L+1T hrs/week)**

NUMERICAL METHODS, COMPLEX AND FOURIER ANALYSIS

Questions to be set having equal weightage/marks from each unit: SIX
TWO from UNIT I, TWO from UNIT II, and TWO from both UNIT I and UNIT II combined.
Questions to be answered: FIVE
Compulsory TWO Questions from UNIT I and UNIT II, and ANY ONE from the combination Question

Objective: The objective of this course is to equip the students of Computer Science with computational aspects of many physical problems. Most of these problems do not possess exact or analytical solution. These problems are then solved by means of efficient numerical techniques. The emphasis will be more on algorithmic approach on these methods. Fourier transforms play an important role in many areas of computer science such as Image processing, pattern recognition. The course has been designed to empower the students to apply the concepts of Fourier analysis and transforms to different areas of their core courses. Complex analysis plays a critical part in most engineering branches, this module has been framed in such a way that it will have wide applications.

Course Outcome: On successful completion of this course, students should be able to:
1. Create ability to handle complex integrations appearing in different engineering areas.
2. Apply the concepts of interpolation to find best Curve fitting for given data and also evaluate Integration and differentiation numerically.
3. Solve differential equations numerically.
4. Evaluate solution of algebraic and Transcendental equations and system of linear equations using iterative methods.
5. Associate between the concepts of Fourier analysis and applications in the field of Signal processing, Image processing etc.

Pre-requisites: Differential & Integral calculus, differential equations, Linear algebra, Laplace transformations.

UNIT I

Numerical Methods [18 Hrs]
Introduction to Error, Interpolation and application: finite difference, central and divided differences, Newton-Gregory, Lagrange's, Dividend interpolation formulae. Numerical differentiation and integration: Trapezoidal rule, Simpson's one third rule. Solution of systems of linear equation: Jacobi, Gauss-Seidal, Solution of tridiagonal systems, computation of largest eigen value by power method.
Numerical solution of algebraic and transcendental equations using method of Regula Falsi and Newton Raphson's method.
Numerical solution of initial value problems in ordinary differential equations by Taylor series method, Picard's method, Euler's method, Modified Euler's method, Runge Kutta fourth order method, Milne's Predictor and Corrector method.

UNIT II

Complex Analysis [12 Hrs]
Complex functions, analyticity -Cauchy Riemann equations. Cauchy's integral theorem and Cauchy's integral formula , derivatives of analytic functions. Taylor, Maclaurin and Laurent's series, residue theorem, evaluation of standard real integrals using contour integrals.

Fourier Transforms [6 Hrs]
Fourier Series, Fourier Integrals, Fourier Transformations; sine and cosine transforms.

Text books:
1. Conte,S & deBoor: Elementary Numerical Analysis, An algorithmic approach, McGraw Hill.
2. S.S. Sastry : Introductory methods of numerical analysis, Prentice Hall India.

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3. V Rajaraman: Computer Oriented Numerical Methods, PHI.
4. R. V Churchil & Brown: Complex variables and its applications. TMH.
5. Erwin Kreyszig:, Advanced Engineering Mathematics, Wiley Eastern.

References :

1. Jain & Iyengar Jain: Numerical Methods, New Age publications
2. Kasana : Complex variables ; Theory and Applications
3. B. S. Grewal: Higher Engineering Mathematics.

Department of Computer Science and Engineering

C220 **CS 1403** **(2L+1T hrs/week)**

DATABASE MANAGEMENT SYSTEMS

Questions to be set having equal weightage/marks from each unit: SIX
TWO from UNIT I, TWO from UNIT II, and TWO from both UNIT I and UNIT II combined.
Questions to be answered: FIVE
Compulsory TWO Questions from UNIT I and UNIT II, and ANY ONE from the combination Question

Objective: This course provides the basic information about relational Database Management System and their development. The major objectives of the course is to provide an introduction of DBMS and their use, be familiar with the basic DBMS architecture, components, and interfaces, have experience using at least one modern Database Management System, understand and use database models in database and application design

Pre-requisites: Programming Concepts

Course Outcomes: On successful completion of this course, students should be able to:

1. Describe fundamental elements of a relational database management system.
2. Design entity-relationship diagrams to represent simple database application scenarios
3. Explain the basic concepts of relational data model, Entity-relationship model, Relational database design, relational algebra and database language SQL
4. Apply and relate the concept of transaction, concurrency control and recovery in database
5. Analyze various Normalization techniques and improve the database design by normalization

UNIT- I

Introduction [4 Hrs]

DBMS: Characteristics, Advantages, Architecture. Database concept and architecture, Data models, Instances and schema, Database languages, Database manager, Database administrator, Database users, Concept of centralized database management system and distributed database system.

Data modelling [6 Hrs]

Entity sets, attributes types and keys, Entity Relationship (ER) diagram, Type role and structural constraints, Enhanced entity-relationship (EER), Object modelling, Specialization and generalization, Modelling of union types, **Data models: Definition, Purpose and Types, Hierarchical models, Network model, Relational model,** Relational-algebra operations.

Database design [7 Hrs]

Database design process, Relational database design, Relation schema, Functional dependencies, Membership and minimal covers, Normal forms, Multivalued dependencies, Join dependencies, **Converting EER diagrams to relations, Effect of de-normalization on database performance**.

Data Storage and Indexes [3 Hrs]

File organizations, primary, secondary index structures, various index structures - hash-based, dynamic hashing techniques, multi-level indexes, B+ trees.

UNIT-II

Database query languages [4 Hrs]

Query-by-example (QBE), Introduction to SQL, Use of some special data types, Overview of SQL 92, Basic queries in SQL, Advanced queries in SQL, Functions in SQL, Basic data retrieval, Aggregation, Categorization, Updates in SQL, Embedded SQL and 4GLs, Procedural extension to SQL: PL/SQL.

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Transaction processing [5 Hrs]
Desirable properties of transactions, Implementation of atomicity and durability, Reconsistent model, Read only and write only model, Concurrent executions, Schedules and recoverability, Serializability of schedules, Concurrency control, Precedence graph.

Concurrency control and backup & recovery mechanisms [5 Hrs]
Overview of concurrency control, Locking techniques, Lock based protocols, Time stamp based protocols, Commit protocols, Optimistic technique, Granularity of data items, Time stamp ordering multi version concurrency control, Deadlock handling, Recovery mechanisms, Database recovery techniques based on immediate and deferred update, **Concepts of database security mechanisms, Case study of Distributed Database Systems.**

Graph Database [3 Hrs]
Overview of graph database, Structure and advantages of graph database, **high level view of graph space, Property graph model.**

NoSQL [3 Hrs]
An overview of NoSQL, Characteristics of NoSQL, Advantages and challenges of NoSQL, NoSQL storage types, Case study of MongoDB.

Text Books:
1. Elmasri and Navathe: "Fundamentals of Database Systems", Addison Wesley.
2. Silberschatz, Korth, Sudarshan, "Database System Concepts", McGraw-Hill.

Reference Books:
1. Thomas Connolly, Carolyn Begg, "Database Systems – A Practical Approach to Design, Implementation and Management", Pearson Education.
2. Jefrey D. Ullman, Jenifer Widom, "A First Course in Database Systems", Pearson Education.
3. Bipin C Desai, "An Introduction to Database Systems", Galgotia.
4. Atul Kahate, "Introduction to Database Management Systems", Pearson.
5. Ian Robinson, Jim Webber, Emil Eifrem,"Graph Databases",O'Reilly Media.
6. Gaurav Vaish, "Getting started with NoSQL", Packt.

Department of Computer Science and Engineering

C221

CS 1405 **(2L+1T hrs/week)**

DESIGN AND ANALYSIS OF ALGORITHMS

Questions to be set having equal weightage/marks from each unit: SIX
TWO from UNIT I, TWO from UNIT II, and TWO from both UNIT I and UNIT II combined.
Questions to be answered: FIVE
Compulsory TWO Questions from UNIT I and UNIT II, and ANY ONE from the combination Question

Objective: This course builds upon preliminary knowledge delivered in Data Structures. The main objectives of the course are to provide thorough knowledge and understanding of different algorithm analysis techniques, design strategies and their applications. Special purpose machines, some critical problems and innovative techniques are used in solving them.

Pre-requisites: Data Structures and Programming concepts

Course Outcomes: On successful completion of this course, students should be able to:

1. Define asymptotic notations and solve problems related to it
2. Calculate time and space complexities for recursive/non-recursive algorithm based on following algorithm design techniques - divide and conquer, greedy, dynamic programming and branch and bound.
3. Select appropriate algorithm design technique to solve a given problem.
4. Explain the working of existing algorithm / algorithm design techniques
5. Discuss and describe the classes P, NP, and NP-Complete

UNIT – I

Algorithms [4 Hrs]
Definition, Aim of the subject, Designing algorithms and Analyzing algorithms: An introduction, Performance of a program: Space and Time complexity.

Mathematical preliminaries [4 Hrs]
Asymptotic notations and common functions, Example: Insertion sort

Recurrences and divide and conquer [7 Hrs]
The basics of divide & conquer method, Merge sort , Quick sort, Solving recurrences: Substitution method, Recursion tree method, Master method: **Proof of master method**, **Finding maximum and minimum**, Strassen's matrix multiplication, **Binary search**.

Greedy method [7 Hrs]
Basics of greedy method, Applications- 0/1 Knapsack Problem – Topological sorting – **Bipartite Cover**, Heapsort, Huffman codes, **Activity selection**, Minimum spanning tree-Kruskal's algorithm, Prim's algorithm, Single source shortest path: Dijkstra's algorithm.

UNIT – II

Dynamic programming [7 Hrs]
Basics of dynamic programming, Applications- Matrix chain multiplication, Longest common subsequence, Traveling salesperson problem, all pair shortest path-Floyd and Wars hall's algorithm, **Non Crossing Subsets of Nets**.

Back Tracking [5 Hrs]
Backtracking Method, Applications-**Container Loading**, 0/1 Knapsack Problem, **Max Clique**, Travelling Salesperson, Board Permutations

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Branch And Bound [5 Hrs]

Branch and Bound Method, Applications-**Container Loading**, 0/1 Knapsack Problem, **Max Clique** ,Travelling Salesperson , **Board Permutations**

NP completeness [2 Hrs]

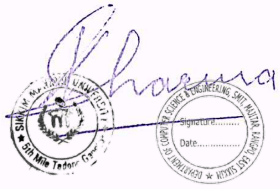
Basic Concepts, P NP, NP Complete, NP Hard problems, Travelling Salesman Problem.

Text Books:

1. T. H. Cormen, C. E. Leiserson, R. L. Rivest, C. Stein, "Introduction to Algorithms", PHI.
2. Sartaj Sahni, "Data Structures, Algorithms amd Applications in C++ ", University Press

Reference Books:

1. A. Levitin, "Introduction to the Design and Analysis of Algorithms", Pearson Education
2. S. Basse, A. Van Gelder, "Computer Algorithms-Introduction to Design and Analysis", Pearson
3. Alfred V. Aho, John E. Hop croft, Jeffrey D. Ullman, "Data Structures and Algorithms", Addison Wesley.
4. M. A. Weiss, "Data Structure and Algorithm Analysis in C", Pearson Education.



Department of Computer Science and Engineering

C222 **CS 1406** **(2L+1T hrs/week)**

ADVANCED COMPUTER ORGANIZATION AND ARCHITECTURE

Questions to be set having equal weightage/marks from each unit: SIX
TWO from UNIT I, TWO from UNIT II, and TWO from both UNIT I and UNIT II combined.
Questions to be answered: FIVE
Compulsory TWO Questions from UNIT I and UNIT II, and ANY ONE from the combination Question

Objectives: This course focuses on advanced computer organization and architectures such as pipelined and parallel systems. It also emphasizes on the concept of a complete system consisting of asynchronous interactions between concurrently executing hardware components and device driver software in order to illustrate the behavior of a computer system as a whole.

Pre-requisites: Computer Organization and Architecture.

Course Outcomes: On successful completion of this course, students should be able to:

1. Review Computer System Architecture.
2. Evaluate complexities in data representation and processing.
3. Apply concepts of parallel processing and multiprocessor architectures in reviewing processors.
4. Solve problems related to multiprocessing, distributed processing and non von Neumann architectures.
5. Illustrate the concept of data flow computers, Reduction computer architecture and systolic architecture

UNIT – I

Introduction to parallel processing [5 Hrs]
Criteria for judging the architecture, **Architectural classification schemes**, Trends towards parallel processing, Parallelism in uniprocessor systems, Parallel computer structure, Performance evaluation of Processors – Amdahl's law, **Applications of parallel processing.**

Principles of pipelining [5 Hrs]
Principles of linear and non-linear pipelining, **Classification of pipeline processors**, General pipelines and reservation tables, Interleaved memory organization.

Instruction-level parallelism [5 Hrs]
Concepts of instruction-level parallelism (ILP), Techniques for increasing ILP; Superscalar, super-pipelined and VLIW processor architectures; **Vector and symbolic processors**; **Case studies of contemporary microprocessors**

Structures and algorithms for array processors [5 Hrs]
SIMD array processors: SIMD computer organization, **Masking and data routing mechanisms**, SIMD interconnection networks: static v/s dynamic, Mesh connected ILLIAC network, Barrel shifter network, Shuffle-exchange and Omega network., Sequential matrix multiplication, Algorithm for processor array-2D mesh SIMD model, Hypercube SIMD model, Shuffle exchange mode.

UNIT – II

Multiprocessor architecture [6 Hrs]
Functional structures, UMA and NUMA multiprocessors, Interconnection Networks: **Time shared or common buses,** Bus arbitration algorithm, Cross bar switch and multiport memories, Comparison of multiprocessor interconnection structure, multistage networks for multiprocessors.

Elementary parallel algorithms [6 Hrs]
Developing algorithms for processor arrays/MIM computers, Process Communication and synchronization on MIMD**, Deadlock**, Task scheduling on MIMD.

Multiprocessor Architecture [5 Hrs] Taxonomy of parallel architectures; Centralized shared-memory architecture, synchronization, memory consistency, interconnection networks; Distributed shared-memory architecture, **Cluster computers, Case Study: Intel Montecito and Sun Niagara**.

Non von Neumann Architectures [3 Hrs] Data flow Computers, **Reduction computer architectures, Systolic Architectures**.

Text Books:

1. Kaihwang and Faye A. Briggs, "Computer Architecture and Parallel Processing", McGraw Hill.
2. Michael J. Quinn, "Parallel Computing: Theory and Practice", McGraw Hill.
3. John L. Hennessy and David A. Patterson, Computer Architecture: A Quantitative Approach, Morgan Kaufmann.

Reference Books:

1. Kaihwang, "Advanced Computer Architecture – Parallelism, Scalability, Programmability", Tata McGraw Hill.
2. Mark Allen Weiss, "Data Structures and Algorithm Analysis in C", Pearson.
3. Michael J.Quinn, "Parallel Computing Theory and Practice", McGraw Hill.
4. Rajiv Chopra, "Advanced Computer Architecture", S. Chand Group.

CS 14** **(2L+1T hrs/week)**

PROGRAMME ELECTIVE I

Questions to be set having equal weightage/marks from each unit: SIX
TWO from UNIT I, TWO from UNIT II, and TWO from both UNIT I and UNIT II combined.
Questions to be answered: FIVE
Compulsory TWO Questions from UNIT I and UNIT II, and ANY ONE from the combination Question
Objectives and Pre-requisites are given under Elective details
[TO BE CHOSEN FROM POOL OF ELECTIVES]

CS 14** **(2L+1T hrs/week)**

OPEN ELECTIVE I

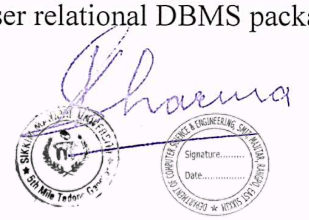
Questions to be set having equal weightage/marks from each unit: SIX
TWO from UNIT I, TWO from UNIT II, and TWO from both UNIT I and UNIT II combined.
Questions to be answered: FIVE
Compulsory TWO Questions from UNIT I and UNIT II, and ANY ONE from the combination Question
Objectives and Pre-requisites are given under Elective details.
[TO BE CHOSEN FROM POOL OF ELECTIVES]

C225 **CS 1462** **(3 hrs/week)**

DATABASE MANAGEMENT SYSTEM LAB

Objective: At least 10 experiments covering the entire syllabus of the corresponding theory paper to be carried out using the theory studied /programming skill of the subject concerned to get insight into the practical applications of the theoretical studies. The outcome of the lab classes must lead to a skilled and self-sustained program developer.
Pre-requisites: Corresponding theory paper CS 1403 Database Management Systems and associated prerequisites.
Course Outcomes: On successful completion of this course, the student should be able to:

1. Select appropriate SQL/MongoDB commands and functions for a given query on the database.
2. Infer constraints and relationships between tables from conceptual/logical level schema and convert them into relationship and integrity constraints at the physical level schema.
3. Write Oracle PL/SQL Programs for data processing.
4. Design nested queries for efficient data processing on the database.
5. Test an SQL interface of a multi-user relational DBMS package to create, secure, populate, maintain, and query a database.



C226 **CS 1464** **(3 hrs/week)**

ADVANCED PROGRAMMING LAB

Objective: At least 10 experiments covering the entire syllabus of the corresponding theory paper to be carried out using the theory studied /programming skill of the subject concerned to get insight into the practical applications of the theoretical studies. The outcome of the lab classes must lead to a skilled and self-sustained program developer.

Pre-requisites: Basic programming languages (C and C++).

Course Outcomes: On successful completion of this course, the student should be able to:

1. Discuss the concept of objects and class.
2. Evaluate requirements for given problem and decide the functionalities of programs accordingly.
3. Illustrate a diverse set of problem solutions using techniques of Interface, Packages, File Handling, Multi-threading, etc
4. Apply the concept java network program to establish connection between client and server.
5. Design modern website to fulfill user's requirement.

C227 **CS 1465** **(3 hrs/week)**

ALGORITHM LAB

Objective: At least 10 experiments covering the entire syllabus of the corresponding theory paper to be carried out using the theory studied /programming skill of the subject concerned to get insight into the practical applications of the theoretical studies. The outcome of the lab classes must lead to a skilled and self-sustained program developer.

Pre-requisites: Corresponding theory paper CS 1405 Design and Analysis of Algorithms and associated prerequisites.

Course Outcomes :On successful completion of this course, the students will be able to:

1. Calculate time and space complexities for algorithms using mathematical models
2. Calculate time and space complexities for algorithms by performing an empirical measurement
3. Select appropriate algorithm design technique to solve a given problem
4. Write a computer program to implement any algorithm using a programming language
5. Choose the most optimal algorithm by comparing time and space complexities

Department of Computer Science and Engineering

CS1841#Minor Specialisation **(2L+1T hrs/week)**

SIGNAL AND NETWORKS

1. **Questions to be set having equal weightage/marks from each unit**: SIX
TWO from UNIT I, TWO from UNIT II, and TWO from both UNIT I and UNIT II combined.
2. **Questions to be answered**: FIVE
Compulsory TWO Questions from UNIT I and UNIT II, and ANY ONE from the combination Question.

Objective: To serve as a beginner course in acquiring knowledge in Signals and network systems. This course describes fundamentals of Signals and networks, Fourier series, Fourier transform, Laplace transform and their application areas.
The course is designed for the analysis and design of communication systems with different approaches towards computer networking.

Pre-requisites: Integral and differential calculus, Solution of linear differential equation.

Course Outcome: On successful completion of this course, students will be able to:

1. Understand the basics of signals
2. Apply fourier analysis and laplace transform
3. Understand Telecommunication Network and Transmission Media
4. Explain and apply waveform coding techniques
5. Apply switching techniques

UNIT I

INTRODUCTION TO SIGNALS [4 HRS]:

Singularity Functions: Unit step, Unit Impulse and Unit Ramp Functions, Properties of different singularity functions, Classification of signals and their mathematical representations, Expressing signals as a sum of simpler signals, Basic Operations on Signals: Time shifting, Time scaling, Time reversal.

CONVOLUTION [4 HRS]:

Convolution Integrals and Convolution Sum, Properties of Convolution Integrals and Convolution Sum, Correlation of Signals: Cross correlation and autocorrelation of continuous and discrete time energy and power signals, Properties of cross correlation and autocorrelation.

FOURIER ANALYSIS [6 HRS]:

Fourier representation of continuous time signals, Fourier series: Dirichlet conditions, Harmonic analysis of common signals, Fourier transform (FT) - Existence –properties of FT, Energy spectral density and power spectral density

INTRODUCTION TO LAPLACE TRANSFORM [6 HRS]:

Introduction to Laplace Transform, Concept of poles and zeros, System transfer function, Necessity of Laplace Transform, Condition for existence of Laplace Transform, Region of convergence (ROC), ROC of finite duration signal, Necessity of Unilateral Laplace Transform, Significance of initial condition, Relationship between poles and ROC, Relationship between Laplace transform and Fourier transform, Properties of Laplace Transform, Initial value theorem, Final value theorem, Inverse Laplace Transform using partial fraction method.

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UNIT II

INTRODUCTION TO TELECOMMUNICATION NETWORKS [4 HRS]:

Introduction to Signal Fundamentals, Types of Analog and Digital Signals, Concepts on Signal Rate, Conversion of signals, Design issues-tools, Structure of telecommunication systems, Introduction to Transmission Impairments, Types of Transmission Impairments, Causes and Consequences of Transmission Impairments.

TRANSMISSION MEDIA [4 HRS]

Guided media: Characteristics performance parameters of various Twisted Pair, Coaxial, and Fibre Optic Cables. Unguided media: Transmission of Radio waves, Microwaves and Infrared.

WAVEFORM CODING TECHNIQUES [6 HRS]

Introduction to multiplexing of signals, Types of multiplexing: Frequency Division Multiplexing, Time Division Multiplexing, Code Division Multiplexing. Multiplexing Access (MA) Techniques: FDM/CDM/TDM and comparison of TDM and TDMA, CDM and CDMA, FDM and FDMA, Advantages and Disadvantages of various multiplexing techniques, Concepts on De-multiplexing

SWITCHING TECHNIQUES IN COMPUTER NETWORKS [6 HRS]

Introduction to switching techniques, Types of switching: Circuit-switching, Message- switching and Packet-switching, Datagram and virtual circuit networks, Routing in switched networks, Control signaling.

Text Books:

1. T.K. Rawat: Signals and Systems, Oxford University Press, ISBN-10: 0-19-806679-1
2. Behrouz A Forouzan: Introduction to Data Communication and Networking, McGraw Hill Education, ISBN 10: 0-07-063414-9

Reference Books:

1. A.V. Oppenheim, A.S.Willsky: Signals and Systems, PHI, ISBN-10: 0-13-814757-4.
2. William Stallings: Data and Computer Communication, 10th Edition, Pearson Edu. ISBN-10: 9788131715000

Department of Computer Science and Engineering

CS1842#Minor Specialisation **(2L+1T hrs/week)**

INTRODUCTION TO MACHINE LEARNING

1. **Questions to be set having equal weightage/marks from each unit**: SIX
TWO from UNIT I, TWO from UNIT II, and TWO from both UNIT I and UNIT II combined.
2. **Questions to be answered**: FIVE
Compulsory TWO Questions from UNIT I and UNIT II, and ANY ONE from the combination Question.

Objectives: It reflects recent developments while providing a comprehensive introduction to the fields of artificial intelligence and machine learning. It is aimed at advanced undergraduates assuming no previous knowledge of pattern recognition or machine learning concepts.

Pre-requisites: Knowledge of multivariate calculus and basic linear algebra, ability to understand complex algorithms, and basic probability theory

Course Outcomes: After completing the course, the students:

1. Acquire knowledge of machine learning theories fundamentals and so they will be able to design pattern recognition program systems using approaches of these theories for solving various real-world problems.
2. Awake the importance of tolerance of imprecision and uncertainty for design of robust and low-cost intelligent machines.
3. Display sufficient understanding of mathematical and engineering fundamentals in the perspective of machine learning theory.
4. Identify problems that can be solved using machine learning techniques.
5. Appreciate the importance of tolerance of imprecision and uncertainty for design of robust and low-cost intelligent machines.

UNIT I

Introduction[5 Hrs]

Introduction to Machine Learning. Types of systems of Machine Learning. Examples of Machine Learning Applications. Introduction to Learning Associations, Classification, Regression, Unsupervised Learning, Supervised Learning. Polynomial Curve Fitting, Probability Theory: Expectations and Co-variances.

Linear Models for Regression [6 Hrs]

Linear Basis Function Models: Maximum likelihood and least squares, Sequential learning, Regularized least squares, The Bias-Variance Decomposition: Bayesian Linear Regression and Probability, Parameter distribution, Predictive distribution, Gaussian distribution.

Linear Models for Classification [5 Hrs]

Discriminant Functions: Two classes, Multiple classes, Least squares for classification, Maximum likelihood solution, Probabilistic Discriminative Models: Logistic regression.

Kernel Methods [4 Hrs]

Dual Representations, Constructing Kernels, Radial Basis Function Networks.

UNIT II

Sparse Kernel Machines [4 Hrs]

Maximum Margin Classifiers: Overlapping class distributions, Relation to logistic regression, Multiclass SVMs

Neural Network [8 Hrs]

Introduction to Neural Networks, threshold logic units, linear machines, networks of threshold learning units, The McCulloch- Pitts neural model, The perceptron neural network architectures: Single layer feed forward ANNs, Training of feed forward networks by back propagations, neural networks vs. knowledge-based systems.

Mixture Models and EM [5 Hrs]

K-means Clustering, Mixtures of Gaussians, Maximum likelihood, EM for Gaussian mixtures.

Continuous Latent Variables [3 Hrs]

Principal Component Analysis: Maximum variance formulation, Applications of PCA, PCA for high-dimensional data.

Text Books:

1. Introduction to Machine learning, NilsJ.Nilsson

2. Christopher M. Bishop, "Pattern Recognition and Machine Learning", Springer.

3. David J.C. Mackay, "Information Theory, Inference and Learning Algorithms", Cambridge University Press, 2003.

Reference Books:

1. Andrew Ng, "Lecture Notes on Machine Learning".

Department of Computer Science and Engineering

CS 1843#Minor Specialisation **(2L+1T hrs/week)**

INTRODUCTION TO IOT & MICROPROCESSOR

1. **Questions to be set having equal weightage/marks from each unit**: SIX
TWO from UNIT I, TWO from UNIT II, and TWO from both UNIT I and UNIT II combined.
2. **Questions to be answered**: FIVE
Compulsory TWO Questions from UNIT I and UNIT II, and ANY ONE from the combination Question.

Objectives: The course is designed to provide foundation in Internet of Things, communication, IoT hardware and design technologies. It provides hands-on experience on latest IoT hardware and software's. The course also offers exploration of different IoT servers and Cloud technology.

Pre-requisites: Basic digital electronics and programming skill. Fundamentals of computer network, communication & internet technology, web technology.

Course Outcomes: A student successfully completing this unit will have the basic knowledge and skills in the fundamental technologies and architectures. Upon completion of the course a student is expected

1. Understanding of impact of information technology solutions on the society.
2. Understand the vision of IOT from a global context
3. Understand the application areas of IOT.
4. Understand different microprocessor based IoT system.
5. Design and development of IoT enabled device and system..

UNIT – I

INTRODUCTION TO INTERNET OF THINGS (IOT) [6 HRS]

Basic of networking, Communication Protocols,
Fundamentals of Internet of Things, IoT Definition, Characteristics of IoT, IoT Vision,
IoT Functional View, Application Areas.

DOMAIN SPECIFIC IOTS [8 HRS]

Home Automation, Smart city applications, Security and surveillance, Environment monitoring and device control, Energy, Retail, Logistics, Agriculture, Industry,
Health & Life Style..

ARCHITECTURE AND COMPONENTS OF INTERNET OF THINGS (IOT) [6 HRS]

Architectural overview, IoT and M2M, Physical Design of IOT, Logical design of IoT , IoT Enabling Technologies, IoT levels, Devices and gateways, Local and wide area networking, Data Analytics for IoT.

UNIT II

INTRODUCTION TO ADVANCED MICROPROCESSOR FOR IOT [6 HRS]

Introduction to general microprocessor- architecture, CISC and RISC architecture, instruction sets, addressing modes. ARM processor (features, architecture, advantages and applications). Microcontroller, System on Chip (SOC), Architecture and programming of Raspberry pi using python programming language.

SENSOR AND ACTUATOR INTERFACING WITH MICROPROCESSOR BASED HARDWARE [8 HRS]

Node MCU, Arduino, Raspberry- pi based Iot enabled device design and hands-on exploration.
Introduction to different sensors and actuators(characteristics, features and applications). Interfacing sensor, actuators and different I/O devices with Arduino, Node MCU, Raspberry pi Embedded platforms.

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DESIGN AND HANDS-ON IOT ENABLED DEVICE & SYSTEM [6 HRS]

Wireless technologies –Bluetooth, Zigbee, Wifi for IoT, Exploration and hands-on configuration of different IoT server- Blink, Think speak, IFTTT. Design of IoT based system. Various case studies, opportunity and challenges in IoT.

TEXT BOOK:

1. Vijay Madisetti and ArshdeepBahga, "**Internet of Things (A Hands-on Approach)**", 1st Edition, VPT, 2014,ISBN 978-81-7371-9547.
2. Raj Kamal "**Internet of Things: Architecture and Design Principles**" McGrawHill,2017,ISBN 13: 987-93-5260-522-4.
3. David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Rob Barton, Jerome Henry " **IoT Fundamentals: Networking Technologies, Protocols, and Use cases for the Internet of Things**", Ciscopress,2018,ISBN 978-93-868-7374-3

REFERENCE BOOKS:

1. "Internet of Things" Copyright 2016 by Tutorials Point (I) Pvt. Ltd.
2. Tim O'Reilly & Cory Doctorow "Opportunities and Challenges in the IoT",O'Reilly publication.
3. Pethuru Raj , Anupama C.Raman,"The Internet of Things, Enabling Technologies,platforms and use cases", CRC Press, ISBN-13: 978-1-4987-6128-4.
4. Ovidiu Vermesan,Peter Friess"**Internet of Things –From Research and Innovation to market Deployment**",River Publishers.
5. Jan Ho¨ ller, Vlasios Tsiatsis, Catherine Mulligan, Stamatis Karnouskos, Stefan Avesand, David Boyle **"From Machine-to-Machine to the Internet of Things Introduction to a New Age of Intelligence"**,Academic Press Elsevier, ISBN: 978-0-12-407684-6.
6. The Definitive Guide to ARM® Cortex®-M3 and Cortex®-M4 Processors Paperback, by Joseph Yiu, Newnes; 3rd edition (28 November 2013)
7. Build Your Own IoT Platform: Develop a Fully Flexible and Scalable Internet of Things Platform in 24, Apress; 1st ed. edition (April 30, 2019).

Department of Computer Science and Engineering

CS1844#Minor Specialisation

(2L+1T hrs/week)

Probability & Statistics for Data Analytics

1. **Questions to be set having equal weightage/marks from each unit**: SIX
TWO from UNIT I, TWO from UNIT II, and TWO from both UNIT I and UNIT II combined.
2. **Questions to be answered**: FIVE
Compulsory TWO Questions from UNIT I and UNIT II, and ANY ONE from the combination Question.

Objective:
The course reviews and expands upon core topics in probability and statistics through the study and practice of data analysis. Topics covered include probability and random variables, random sampling and statistical inference, estimation and testing of hypothesis, representation of data and descriptive statistics, regression analysis and analysis of variance. After completion of the course, students should be able to think critically about data and apply standard statistical inference procedures to draw conclusions from such analyses. Students are expected to work on a project on real life data.

Prerequisites: A prior knowledge of introduction to probability, statistics and random process.
Course Outcomes: On successful completion of this course, the students will be able to:

1. Analyse main statistical feature for a large dataset.
2. Think critically about data and apply standard statistical inference procedures to draw conclusions from such analyses.
3. To work on a project on real life data and apply probabilistic and statistical approach to analyse the data.
4. Discuss fundamentals of probability and statistical theories.
5. Apply the knowledge of probability and statistics to analyze different real-world situations

UNIT-I

Probability And Random Variables [8 HRS]
Concepts of Probability – Classical, frequency based, and Bayesian probability; Conditional probability, Bayes Theorem, Random variables – discrete and continuous, Probability distribution functions, Expectation and variance of a random variable

Random Sampling And Statistical Inference [8 HRS]
Concepts of population and sample, Random sampling and sampling distribution, Central Limit Theorem, Expectation and Standard Error of sample mean and sample proportion, Normal Distribution – Standard normal, Chi-square, t and F distribution

Estimation And Testing Of Hypothesis [4 HRS]
Point estimation and Interval estimation of parameters, Maximum Likelihood Estimator, Hypothesis testing and calculation of effect size.

UNIT-II

Representation Of Data And Descriptive Statistics [10 HRS]
Data Preparation, Measurement level of Data – Qualitative and quantitative, Measures of Central Tendency – Mean, Median and Mode; Measures of Asymmetry – Skewness, Measures of Variability - Range, Variance, and Standard Deviation; Measures of Quartiles and percentiles, Outlier treatment, Gini coefficient to

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understand inequality, Measures of Relationship – Covariance and Pearson's and Spearman's Rank Correlation

Regression Analysis And Analysis Of Variance [10 HRS]

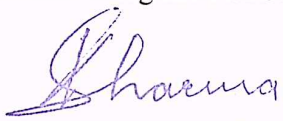
Gauss Markov theorem, Linear regression – Simple and Multiple regression, Logistic Regression, Concepts of residual, Fitted value and goodness of fit, Test of significance, one-way analysis of variance (ANOVA)

Text Books:

1. Laura Igual and Santi Seguí, Introduction to Data Science, A Python Approach to Concepts, Techniques and Applications, Springer, ISSN 1863-7310, ISBN 978-3-319-50016-4
2. Field, A. P., Miles, J., and Field, Z. (2012). Discovering Statistics using R, Sage publication, London.

Reference Books:

1. Wooldridge, J. M. (2013), Introductory Econometrics: A Modern Approach. South-Western, Cengage Learning. Ohio, USA. ISBN-13: 978-1-111-53104-1.
2. Arnold, J.C., and Milton, J.S. (2003), Introduction to Probability and Statistics. McGraw-Hill publication.
3. Field, A. P. (2013), Discovering Statistics using IBM SPSS Statistics, Sage publication, London.



Department of Computer Science and Engineering

C312 **MA 1502** **(2L + 1 T hrs/week)**

PROBABILITY, STATISTICS AND STOCHASTIC PROCESSES

Questions to be set having equal weightage/marks from each unit: SIX
TWO from UNIT I, TWO from UNIT II, and TWO from both UNIT I and UNIT II combined.
Questions to be answered: FIVE
Compulsory TWO Questions from UNIT I and UNIT II, and ANY ONE from the combination Question.

Course Objectives: The objective of this course is to enhance the capability of students to analyze the problems related to random phenomena. Concepts on probability theory will be of immense help to the students in analyze random experiments. Statistical Analysis plays a big role in areas like data mining and information retrieval. Stochastic models have tremendous applications in queuing theory. Students will find adequate tools in these modules which will be effective enough to solve their problems.

Course Outcome: On successful completion of this course, students will be able to:

1. Explain concept of probability, random variables.
2. Differentiate the ideas between discrete and continuous random variables.
3. Discuss fundamentals of probability and statistical theories.
4. Apply the knowledge of probability and statistics to analyze different real-world situations
5. Develop the models of many time dependent processes such as signals in communications , time series analysis.

Pre-requisite: Differential and Integral Calculus, Matrix Algebra, Permutation and Combination.

UNIT I

Probability Theory [18 Hrs]

Introduction, Classical definition of probability, Axiomatic definition of probability, Conditional probability, Baye's theorem. Random variable, Discrete random variable, Bernoulli trials, Poisson trials, Discrete distribution: Binomial, Poisson, Continuous distribution: Uniform, Normal, exponential. Expectation: Mean, Variance, Chebyshev's inequality, Central limit theorem. Two dimensional random variables: discrete and continuous, marginal distributions, Covariance, Correlation coefficient, conditional distributions, conditional expectations. Reliability & MTTF.

UNIT II

Statistics [6 Hrs]

Random sample, Sampling distribution, Statistic, Least square curve fitting Parameter estimation: Unbiased estimate, Consistent estimate, Maximum likelihood estimate, interval estimate. Testing of Hypothesis for mean with known variance for normal population.

Stochastic process & Queuing theory [12 Hrs]

Introduction to Stochastic Process, Poisson Process, Discrete parameter Markov Chains, Concept of a queues: Basic idea of continuous parameter Markov chain, Birth and death processes, M/M/1/∞, M/M/1/N queuing systems. (Approach for entire stochastic process will be more problem oriented).

Textbook:

1. K.S Trivedi, Probability & Statistics with Reliability, Queuing and Computer Science Applications, 2008, Wiley.
2. P.L. Meyer : Introductory Probability theory and statistical Applications, Second Ed. Oxford & IBM Publishers.
3. Miller & Freund: Probability & Statistics for Engineers, Eight Ed. Pearson Ltd.

Reference Books:

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1. Introduction to Probability Theory and its Applications, William Feller, 2008, Wiley.
2. Introduction to Probability with Statistical Applications, Geza Schay, 2007, Brikhaus.

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Department of Computer Science and Engineering

C301 **CS 1502** **(2L + 1 T hrs/week)**

OPERATING SYSTEMS

Questions to be set having equal weightage/marks from each unit: SIX
TWO from UNIT I, TWO from UNIT II, and TWO from both UNIT I and UNIT II combined.
Questions to be answered: FIVE
Compulsory TWO Questions from UNIT I and UNIT II, and ANY ONE from the combination Question

Objective: The principles and concepts that govern the design of modern computer operating systems are studied. Managing computing resources such as the memory, the processor and the Input/output devices are covered. Algorithms for CPU scheduling, memory and general resource allocation; process coordination and management; deadlocks and memory management techniques; case studies of Linux operating systems are also covered.

Pre-requisites: Computer Organization and Programming Language concepts.

Course Outcome: On successful completion of this course, students will be able to:

1. Describe the different operating system architectures and structures.
2. Select the appropriate scheduling algorithms or techniques for efficient utilization of computer resource like CPU, Memory, etc.
3. Interpret theory of data inconsistency problem and provide a procedure for synchronization problem.
4. Manage various technical issues related to operating systems' services using principles of computer science and engineering.
5. Compose methods for analyzing the performance of various identified algorithms or techniques in operating systems

UNIT – I

Introduction [4 Hrs]
Basics of Computer Organization, Interrupt, Bus, ISA, CPU Operation. What operating systems do? Operating system structure, Operating system operations, Special-purpose systems, Operating system services, User-operating system interface, System calls, Types of system calls, **Operating system design and implementation. Case study: Linux Design Principles.**

Process management [8 Hrs]
Process: Concept, Multithreaded programming, Multithreaded models, Thread libraries, Threading issues, Process scheduling criteria and algorithms, Thread scheduling, Operating-system examples. **Case study: Linux Process and I/O Scheduler.**

Process synchronization [8 Hrs]
Critical section problem, Peterson's solution, Synchronization hardware, Semaphores, Classic problems, **Monitors, Examples.**

UNIT-II

Deadlock [5 Hrs]
System model, Characterization, Methods of handling deadlocks, Prevention, Avoidance, Detection and recovery.

Memory management [5 Hrs]
Fixed and variable partition, Swapping, Paging and segmentation, Structure of page table, Combined systems, Virtual memory: Overlays, Demand paging, Copy-on-write, Page replacement, Allocation of frames, Thrashing, Allocating kernel memory. Case study: Linux Memory Management

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File systems [5 Hrs]

File system concept, Access methods, Directory structure, File-system mounting, File sharing, Protection, Allocation methods.

I/O systems [5 Hrs]

Overview, Kernel I/O subsystem, Kernel Data Structure, Transforming I/O requests to Hardware Operations, **Case Study: Linux I/O Systems.**

Text Books:

1. Abraham Silberschatz, Peter Baer Galvin, Greg Gagne, "Operating System Concepts", Wiley & Sons.Inc..
2. D M Dhamdhere, "Systems Programming & Operating Systems", Tata McGraw-Hill.

Reference Books:

1. Andrew S. Tanenbaum, "Modern Operating systems", PHI.
2. Mukesh Singhal, Niranjan G.Shivaratri, "Advanced Concepts in Operating Systems", Tata McGraw- Hill.
3. P. Balakrishna Prasad, "Operating Systems", Scitech Publication.
4. William Stallings, "Operating Systems-Internals and Design Principles", Pearson Education.

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Department of Computer Science and Engineering

C305 **CS 1508** **(2L + 1 T hrs/week)**

COMPUTER NETWORKS-I

Questions to be set having equal weightage/marks from each unit: SIX
TWO from UNIT I, TWO from UNIT II, and TWO from both UNIT I and UNIT II combined.
Questions to be answered: FIVE
Compulsory TWO Questions from UNIT I and UNIT II, and ANY ONE from the combination Question.

Objective: This course aims to highlight the functional evolution and role of data communications. Considerations in data communications, Applications in general, Design issues, System components and their interrelationships, Networks. Synchronous and asynchronous communications, Implementation of data communication in Physical layer and Data Link layer.

Pre-requisites: Communication Techniques.

Course Outcome: On successful completion of this course, students will be able to:

1. Understand and identify the engineering fundamentals concerning Data Communication and Computer Network.
2. Identify the complex engineering problem involved in Data communication and its architecture for a successful network based communication.
3. Ability to Practice and formulate a solution for an engineering problem concerning any layers in Data Communication model
4. Demonstrate an ability to formulate and interpret a model based on the fundamentals of Computer Networks
5. Compare and understand the IOS reference model and TCP-IP reference model for data communication

UNIT- I

Overview [3 Hrs]
Introduction to data communications, Data representation and data flow, Concepts of communication in computer networks, Layered architecture, OSI, TCP/IP, **ATM network models**, Addressing of network devices.

Physical layer and Transmission Media [6 Hrs]
Data and signal fundamentals, Analog and digital signals, Transmission impairments, Data rate limits, Performance, Guided media: Characteristics and performance parameters of various twisted pair, Coaxial, and fibre optic cables. Unguided media: Radio waves, Microwaves and infra-red.

Data transmission [6 Hrs]
Digital encoding techniques, Scrambling techniques, Pulse Code Modulation (PCM), Modulation, Transmission modes (parallel, serial).

Multiplexing and Switching methods [5 Hrs]
FDM, WDM, CDM, Time division multiplexing (synchronous and statistical), Spread spectrum (FHSS and DSSS), Circuit-switched, Datagram and virtual circuit networks, **Message switching**.

UNIT- II

Data link layer [8 Hrs]
Data link layer design issue, Error detection and correction: Parity bit, Modulo-2 arithmetic, Polynomial, FEC-Hamming code, Internet checksum, Elementary data link protocol: Stop-and-wait ARQ, Sliding

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window, Go-back-n, Selective repeat. Random Access: CSMA, CSMA/CA, CSMA/CD, **Controlled Access: Reservation, Polling. Channelization: FDMA, TDMA, CDMA.**

Network layer [7 Hrs]

Design issues of network layer protocols, Network layer protocols of TCP/IP model: Internet Protocol version 4 (IPv4) and Internet Protocol version 6 (IPv6), Addressing mechanism of IPv4 and IPv6.

Case study of popular LANs [5 Hrs]

Ethernet LAN: IEEE specification of physical media, Wireless LAN: IEEE 802.11 specification, **WLAN architecture.**

Text Books:

1. Behrouz A. Forouzan, "Data Communications and Networking", Tata McGraw Hill.
2. William Stallings, "Data and Computer Communications", PHI.

Reference Books:

1. Andrew S. Tanenbaum, "Computer Networks", PHI.
2. A S Godbole, "Data Communication and Networking", Tata McGraw Hill.
3. William C Y Lee, "Mobile Communication Engineering", Tata McGraw Hill.
4. Larry L. Peterson, Bruce S. Davie, "Computer Networks: A Systems Approach", Wiley.

Department of Computer Science and Engineering

C313 **CS 1509** **(2L + 1 T hrs/week)**

SOFTWARE ENGINEERING

Questions to be set having equal weightage/marks from each unit: SIX
TWO from UNIT I, TWO from UNIT II, and TWO from both UNIT I and UNIT II combined.
Questions to be answered: FIVE
Compulsory TWO Questions from UNIT I and UNIT II, and ANY ONE from the combination Question.

Objectives: This course presents a comprehensive study of software quality assurance, including software quality control management, processes, systems, methods, standards, certification, and reliability measurement.

Pre-requisites: Procedure oriented and object oriented programming paradigm.

Course Outcome: On successful completion of this course, students will be able to:

1. Demonstrate competence in using engineering fundamentals to visualize solutions using knowledge of software engineering skills.
2. Extend an ability to formulate a solution plan and methodology for an engineering problem using software engineering.
3. Apply an ability to formulate and interpret a model for project management
4. Explain an ability to define complex problem, find and analyze requirements
5. Apply new software models, techniques and technologies to bring out innovative and novelistic solutions for the growth of the society in all aspects and evolving into their continuous professional development.

UNIT – I

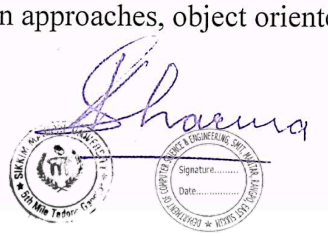
Introduction [2 Hrs]
The software engineering discipline-evaluation and impact, Programs vs. software products, Emergence of software engineering, Notable changes in software development practice, System engineering, handling complexity through Abstraction and Decomposition.

Software Life Cycle [6 Hrs]
Life Cycle Models: Classical waterfall model, Iterative waterfall model, Prototype model, Evolutionary model, Spiral model, RAD model, Agile models, Introduction to Agile software development, Extreme Programming and Scrum, DevOps, Domain Analysis, **Comparison of different life cycle models.**

Software Project Management [6 Hrs]
Responsibilities of project manager, Project planning, Metrics for project size estimation techniques, Empirical estimation techniques, COCOMO, Halstead's software science, Staffing level estimation, Scheduling, **Organization and team structure**, Staffing, Risk management, Software configuration management.

Requirements Analysis and Specification [2 Hrs]
Requirements gathering and analysis, Software requirement specification (SRS), Traceability, **Characteristics of a Good SRS Document, IEEE 830 guidelines**, Overview of formal system development techniques.

Software Design [4 Hrs]
Good Software Design, Cohesion and coupling, Control Hierarchy: Layering, Control Abstraction, Depth and width, Fan-out, Fan-in, Software design approaches, object oriented vs. function oriented design.



UNIT – II

Function-Oriented and Object Oriented Software Design [5 Hrs]
Overview of SA/SD methodology, structured analysis, Data flow diagram, Extending DFD technique to real life systems, structured design, detailed design, Design review. Unified Modeling Language (UML), UML Diagrams: Static and Dynamic.

User interface design [3 Hrs]
Characteristics of a Good User Interface, User Guidance and Online Help, Mode-based Vs Mode-less Interface, Types of user interfaces, Component-based GUI development, User interface design methodology: GUI design methodology, Task and object modeling, Selecting a metaphor, Interaction design and rough layout, **User interface inspection**.

Coding and Testing [5 Hrs]
Coding, Code review, Testing-Basic Concept of testing, Testing Strategies, Testing in the large vs. testing in the small, Unit testing, Black-box testing, Integration testing, System testing, Some general issues associated with testing, Test driven development, testing tools, Special Value Testing, Combinatorial Testing, Decision Table Testing, Cause effect graphing, Pairwise Testing, White box Testing, Condition Testing, MC/DC Coverage, MC/DC Testing, Path Testing, Dataflow and Mutation Testing, Debugging, Program analysis tools,

Software Reliability And Quality Management [3 Hrs]
Software reliability, Statistical testing, Software quality and management, ISO 9000, SEI capability maturity model, Personal software process (PSP), Six sigma, Software quality metrics

Computer Aided Software Engineering [2 Hrs]
Case and its scope, Case environment, Case support in software life cycle, **Other characteristics of case tools, Towards second generation case tool, Architecture of a case environment.**

Software Maintenance and Reuse [2 Hrs]
Characteristics of software maintenance, Software reverse engineering, Software maintenance processes model, Estimation maintenance cost. Basics issues in any reuse program, **Reuse approach, Reuse at organization level.**

Text Book:
1. Rajib Mall, "Fundamentals of Software Engineering", PHI.
2. Richard Fairley, "Software Engineering Concepts", Tata McGraw Hill.

Reference Books:
1. Jalote Pankaj, "An integrated approach to Software Engineering", Narosa.
2. Pressman R, "Software Engineering- Practioner Approach", McGraw Hill.
3. Somerville, "Software Engineering", Pearson
4. Budgen, "Software Design", Pearson

CS 15** **(2L+1T hrs/week)**

PROGRAMME ELECTIVE-II

Questions to be set having equal weightage/marks from each unit: SIX
TWO from UNIT I, TWO from UNIT II, and TWO from both UNIT I and UNIT II combined.
Questions to be answered: FIVE
Compulsory TWO Questions from UNIT I and UNIT II, and ANY ONE from the combination Question
Objectives and Pre-requisites are given under Elective details.
[TO BE CHOSEN FROM POOL OF ELECTIVES]

CS 15** **(2L+1T hrs/week)**

PROGRAMME ELECTIVE-III

Questions to be set having equal weightage/marks from each unit: SIX
TWO from UNIT I, TWO from UNIT II, and TWO from both UNIT I and UNIT II combined.
Questions to be answered: FIVE
Compulsory TWO Questions from UNIT I and UNIT II, and ANY ONE from the combination Question
Objectives and Pre-requisites are given under Elective details.
[TO BE CHOSEN FROM POOL OF ELECTIVES]

C307 **CS 1561** **(3 hrs/week)**

OPERATING SYSTEMS LAB

Objective: At least 10 experiments covering the entire syllabus of the corresponding theory paper to be carried out using the theory studied /programming skill of the subject concerned to get insight into the practical applications of the theoretical studies. The outcome of the lab classes must lead to a skilled and self-sustained program developer.

Pre-requisites: Corresponding theory paper CS 1502 Operating Systems and the associated prerequisites

Course Outcome: On successful completion of this course, students will be able to:

1. Illustrate the concept of process and thread creation for executing user's task.
2. Apply the theory for implementing various process scheduling algorithms.
3. Produce a optimal solution for data inconsistency problem by synchronizing processes and threads.
4. Examine the various memory management strategies for efficient resource utilization and implement it.
5. Analyse and debug various technical issues related to operating systems services and use different types of Modern OS

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Department of Computer Science and Engineering

CS1852#Minor Specialisation **(2L +1T hrs/week)**

ARTIFICIAL INTELLIGENCE

Questions to be set having equal weightage/marks from each unit: SIX
TWO from UNIT I, TWO from UNIT II, and TWO from both UNIT I and UNIT II combined.
Questions to be answered: FIVE
Compulsory TWO Questions from UNIT I and UNIT II, and ANY ONE from the combination Question.

Objectives: The aim of this course is to provide an introduction to some fundamental issues and algorithms in artificial intelligence (AI). The course approaches AI from an algorithmic, computer science-centric perspective. The course aims to provide some fundamental tools and algorithms required to produce AI systems able to exhibit limited human-like abilities, particularly in the form of problem solving by search, representing and reasoning with knowledge, planning, natural language understanding, computer vision, automatic programming and machine learning.

Pre-requisites: Algorithms will be an essential component, in addition the course requires some mathematics specially Calculus, Probability and statistics. Natural Sciences Mathematics or equivalent, and Discrete Mathematics, are likely to be helpful although not essential. Mathematical Methods for Computer Science, Probability, Logic and Proof, Prolog and Complexity Theory are likely to be useful.

Course Outcomes: At the end of the course students should be able to:

1. Appreciate the distinction between the popular view of the field and the actual research results;
2. Appreciate the fact that the computational complexity of most AI problems requires us regularly to deal with approximate techniques;
3. Appreciate different perspectives on what the problems of artificial intelligence are and how different approaches are justified;
4. Design basic problem solving methods based on AI-based search, knowledge representation, reasoning, planning, and machine learning algorithms.
5. Analyse techniques and resources to solve AI problems.

UNIT-I

Introduction to Artificial Intelligence [4 Hrs]
Definition of AI, Overview of Artificial Intelligence- Problems of AI, AI techniques, Intelligent and Rational agents, Turing test, Typical AI problems: Tic -Tac- Toe problem, 8-puzzle problem, 8-Quenes problem, Practical impact of AI.

Machine Learning [6 Hrs]
Learning- Supervised and Unsupervised learning, adaptive Learning, Reinforcement learning, Linear classification, Loss minimization, Stochastic gradient descent, K-Means Algorithm, The perceptron. Learning by gradient descent. Multilayer perceptron and the back propagation algorithm, Deep learning, Auto-encoders, CNNs, RNNs, Introduction to Natural Language Processing.

Problem solving by Search [5 Hrs]
Problems, Problem Space & search, Formulating problems: Pegs and Disks problem, Tic -Tac- Toe problem, 8-puzzle problem, 8-Quenes problem, Missionary Cannibals problem. State space search, Uninformed search strategies: BFS, DFS, Depth Limited search, Iterative Deepening DFS, Bi-directional depth first search.

Informed Search Techniques [6 Hrs]
Informed (Heuristic) Search Strategies, Best First Search (BFS), Greedy BFS, A* Search, Heuristic Functions, Iterative-Deepening A*, Hill Climbing Search, Simulated Annealing Search, Local Beam Search, Genetic Algorithms.

UNIT-II

Department of Computer Science and Engineering

CS1851#Minor Specialisation **(2L+1T hrs/week)**

ETHICAL HACKING AND DATA PRIVACY

Questions to be set having equal weightage/marks from each unit: SIX
TWO from UNIT I, TWO from UNIT II, and TWO from both UNIT I and UNIT II combined.
Questions to be answered: FIVE
Compulsory TWO Questions from UNIT I and UNIT II, and ANY ONE from the combination Question.

Objective: To learn the foundations of Cyber Security, Ethical Hacking and Data Privacy analysis and understand the algorithms useful for forensic detection. To identify insights on how to apply Cyber Security, Ethical Hacking to solve interdisciplinary problems. The course further explores the computational techniques useful for protecting the content and identity of an individual or entity while preserving the integrity of the data being exchanged.

Pre-requisites: Basic concept of computer networks, Abstract Algebra.

Course Outcomes: At the end of the course students should be able to:

1. Examine competence in applying acquired expertise in computer networks
2. Determine an ability to interpret and evaluate behaviour of malwares and their countermeasures
3. Evaluate the approaches used by hackers and work on its countermeasures to reach a valid conclusion
4. Describe an ability to identify the limitation of tools used to break an insecure web application
5. Decide the problem in the decision-making process between possible options using tools

UNIT I

Foundations of. Cyber Security Concepts [3]
Essential Terminologies: CIA, Risks, Breaches, Threats, Attacks, Exploits. Information Gathering (Social Engineering, Foot Printing & Scanning). Open Source/ Free/ Trial Tools: nmap, zenmap, Port Scanners, Network scanners.

Cryptography and Cryptanalysis [8]
Introduction to Cryptography, Substitution Vs Transposition, SPN Network, Symmetric key Cryptography : understanding and analysing DES, Asymmetric key Cryptography : RSA algorithm, Message Authentication and Hash functions, Digital Signatures, Applications of Cryptography. Overview of Firewalls- Types of Firewalls, User Management, VPN Security, Security Protocols: - security at the Application Layer, PGP and S/MIME, Security at Transport Layer- SSL and TLS, Security at Network Layer-IPSec.

Introduction to Ethical Hacking [5]
LINUX and Networking, Website/ IP information Gathering, Discovering IP Range and Open Port, Identifying Target Operating System and Services, Secure Bypassing Firewalls while Scanning, Understanding Wireless Networks, Fragmentation Attacks, Evil Twin Attack, Reveal Hidden SSID's, WPA and WPA2 wireless password hacking techniques, Cracking Wireless Passwords using Rainbow tables.

Server Hacking and Security Techniques [8]
Using Proxies and VPN as Hacking Tools for Scanning host, security measures for Phishing, Password Guessing and Mobile Phones. Hacking Windows Passwords using various methods & Security, Privilege Escalation in windows and Linux using Key loggers and Remote Administrations Tools (RATs), Protection against Trojans, Worms and Malwares, SQL Injection, Cross Site Scripting, Router Hacking, DNS poisoning, DOS attack against an IP address Flood. Packet Injection.

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UNIT II

Privacy Law, Policies and Practices [6]
Evolution of data privacy across countries and cultures. Privacy policies related to information technology codified in the 1960s and 1970s, Fair Information Practices (FIPS). Effects of Policies over social sectors (e.g., government, business, universities) or types of records (e.g., health, library circulation, video rentals), Broad view of a 'right to privacy'. Framework for the evolution of privacy practices in an era of big data, social media, Internet of Things, cyber hacking, ransomware and other recent developments. Evolution of privacy laws, policies and practices.

Techniques for Mining Information [6]
Evolution of information mining techniques, Various algorithms used to extract data: PageRank Algorithm, C4.5 Algorithm, Apriori Algorithm, Classification and Regression Trees (CART) Algorithm. Contribution algorithms towards the growth of web industry.

Privacy Risks and Harms [4]
Privacy affecting personal safety, health, financial harms, damage to social relationships, academic freedom, and human rights. Fundamental Trust Issues, Causes of Fundamental Trust Issues. Case study on Web Giants (Facebook, Google, etc.) techniques to collect, mine, and make decisions about people for the growth of industry.

Text Books:
1. William Stallings, "Cryptography and Network security Principles and Practices", Pearson/PHI.
2. V.K. Jain, "Cryptography and Network Security", Khanna Publishing House.
3. Gupta Sarika, "Information and Cyber Security", Khanna Publishing House, Delhi.
4. The basic of Hacking and Penetration testing, Second Edition on Ethical Hacking and Penetration by Patrick Engebretson.

Reference Books:
1. V.K. Pachghare, "Cryptography and Information Security", PHI Learning
2. Nina Godbole, "Information System Security", Wiley
3. Bothra Harsh, "Hacking", Khanna Publishing House, Delhi

Department of Computer Science and Engineering

CS1853#Minor Specialisation **(2L+1T hrs/week)**

INFORMATION THEORY

Questions to be set having equal weightage/marks from each unit: SIX
TWO from UNIT I, TWO from UNIT II, and TWO from both UNIT I and UNIT II combined.
Questions to be answered: FIVE
Compulsory TWO Questions from UNIT I and UNIT II, and ANY ONE from the combination Question.

Objective:

- To define and apply the basic concepts of information theory (entropy, channel capacity etc.)
- To learn the principles and applications of information theory in communication systems
- To study various data compression methods and describe the most common such methods
- To understand the theoretical framework upon which error-control codes are built

Pre-requisites: Probability (sets and events, probability distributions, probability density functions, probability mass functions, random variables, expected value, variance, popular probability laws).

Course Outcomes: At the end of the course students should be able to:

1. Understand the basics of Information Theory
2. Examine information measure
3. Apply source coding
4. Understand codes for error detection and correction
5. Apply convulational codes.

UNIT I

INTRODUCTION [5 HRS]:

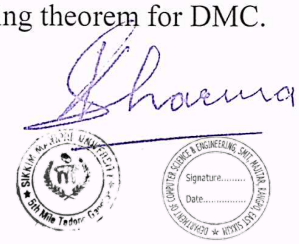
Concept of amount of information, information units, Entropy: marginal, conditional, joint and relative entropies, relation among entropies, Mutual information, information rate, channel capacity, redundancy and efficiency of channels.

INFORMATION MEASURE [8 HRS]:

Discrete channels – Symmetric channels, Binary Symmetric Channel, Binary Erasure Channel, Noise-Free Channel, Channel with independent I/O, Cascaded channels, repetition of symbols, Binary asymmetric channel, Shannon theorem, Discrete memoryless channel – channel capacity, fundamental theorem of information theory.

SOURCE CODING [7 HRS]:

Encoding techniques, Purpose of encoding, Instantaneous codes, Construction of instantaneous codes, Kraft's inequality, Coding efficiency and redundancy, Source coding theorem. Construction of basic source codes – Shannon Fano coding, Shannon Fano Elias coding, Huffman coding, Minimum variance Huffman coding, Adaptive Huffman coding, Arithmetic coding, Dictionary coding – LZ77, LZ78, LZW, ZIP coding, Channel coding, Channel coding theorem for DMC.



UNIT II

CODES FOR ERROR DETECTION AND CORRECTION [10 HRS]:

Parity check coding, Linear block codes, Error detecting and correcting capabilities, Generator and Parity check matrices, Standard array and Syndrome decoding, Hamming codes, Cyclic codes – Generator polynomial, Generator and Parity check matrices, Encoding of cyclic codes, Syndrome computation and error detection, Decoding of cyclic codes, BCH codes, RS codes, Burst error correction

CONVOLUTIONAL CODES [10 HRS]

Encoding and State, Tree and Trellis diagrams, Maximum likelihood decoding of convolutional codes - Viterbi algorithm, Sequential decoding -Stack algorithm. Interleaving techniques – Block and convolutional interleaving, Coding and interleaving applied to CD digital audio system - CIRC encoding and decoding, interpolation and muting. ARQ – Types of ARQ, Performance of ARQ, Probability of error and throughput.

Text Books:

1. T. M. Cover, J. A. Thomas, Elements of Information Theory, Wiley, ISBN-10: 0-47-124195-4
2. R. Togneri, C.J.S de Silva, Fundamentals of Information Theory and Coding Design, Taylor and Francis, ISBN-10: 1-58-488310-4

Reference Books:

1. R. J. McEliece, The Theory of Information and Coding, Cambridge University Press, ISBN-10: 0-52-183185-7
2. R. Bose, Information Theory Coding and Cryptography, Tata McGraw Hill, ISBN-10: 0-07-066901-5

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Department of Computer Science and Engineering

CS 1854 #Minor Specialisation **(2L +1T hrs/week)**

ARTIFICIAL INTELLIGENCE

Questions to be set having equal weightage/marks from each unit: SIX
TWO from UNIT I, TWO from UNIT II, and TWO from both UNIT I and UNIT II combined.
Questions to be answered: FIVE
Compulsory TWO Questions from UNIT I and UNIT II, and ANY ONE from the combination Question.

Objectives: The aim of this course is to introduce some fundamental issues and algorithms in artificial intelligence (AI). The course approaches AI from an algorithmic, computer science-centric perspective. The course aims to provide some fundamental tools and algorithms required to produce AI systems able to exhibit limited human-like abilities, particularly in the form of problem solving by search, representing, and reasoning with knowledge, planning, natural language understanding, computer vision, automatic programming and machine learning.

Pre-requisites: Algorithms will be an essential component, in addition the course requires some mathematics specially Calculus, Probability and statistics. Natural Sciences Mathematics or equivalent, and Discrete Mathematics, are likely to be helpful although not essential. Mathematical Methods for Computer Science, Probability, Logic and Proof, Prolog and Complexity Theory are likely to be useful.

Course Outcomes: At the end of the course students should be able to:

1. Appreciate the distinction between the popular view of the field and the actual research results.
2. Appreciate the fact that the computational complexity of most AI problems requires us regularly to deal with approximate techniques.
3. Appreciate different perspectives on what the problems of artificial intelligence are and how different approaches are justified.
4. Design basic problem-solving methods based on AI-based search, knowledge representation, reasoning, planning, and machine learning algorithms.
5. Analyse techniques and resources to solve AI problems.

UNIT-I

Introduction to Artificial Intelligence [4 Hrs]
Definition of AI, Overview of Artificial Intelligence- Problems of AI, AI techniques, Intelligent and Rational agents, Turing test, Typical AI problems: Tic -Tac- Toe problem, 8-puzzle problem, 8-Quenes problem, Practical impact of AI.

Machine Learning [6 Hrs]
Learning- Supervised and Unsupervised learning, adaptive Learning, Reinforcement learning, Linear classification, Loss minimization, Stochastic gradient descent, K-Means Algorithm, The perceptron. Learning by gradient descent. Multilayer perceptron and the back propagation algorithm, Deep learning, Auto-encoders, CNNs, RNNs, Introduction to Natural Language Processing.

Problem solving by Search [5 Hrs]
Problems, Problem Space & search, Formulating problems: Pegs and Disks problem, Tic -Tac- Toe problem, 8-puzzle problem, 8-Quenes problem, Missionary Cannibals problem. State space search, Uninformed search strategies: BFS, DFS, Depth Limited search, Iterative Deepening DFS, Bi-directional depth first search.

Informed Search Techniques [6 Hrs]
Informed (Heuristic) Search Strategies, Best First Search (BFS), Greedy BFS, A* Search, Heuristic

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Functions, Iterative-Deepening A*, Hill Climbing Search, Simulated Annealing Search, Local Beam Search, Genetic Algorithms.

UNIT-II

Adversarial Search [3 Hrs]
Game Trees, Optimal Decision in Games: Minimax Algorithm, Alpha Beta Pruning, TD learning, Game theory

Constraint Satisfaction Problems (CSPs) [6 Hrs]
Constraint Satisfaction Problems: N-Queen problem, Crossword puzzle, Map coloring problem, Boolean satisfiability problem (SAT). The backtracking algorithm for CSPs. Heuristics for improving the search for a solution. **Forward checking, Constraint propagation and arc consistency. Backtracking, Back jumping using Gaschnig's algorithm, Graph-based back jumping.**

Knowledge representation and Reasoning [8 Hrs]
Knowledge representation issues, representation & mapping, approaches to knowledge representation, Representing simple fact in logic, Syntax versus semantics, Propositional logic, Predicate logic, Horn clauses, First-order logic Resolution, representing instant & ISA relationship, computable functions & predicates, resolution, natural deduction. Procedural verses declarative knowledge, logic programming, forward verses backward reasoning, matching, control knowledge.

Bayesian Networks [4 Hrs]
Bayesian inference, Marginal independence, Hidden Markov models, Learning Bayesian networks, Laplace smoothing, Expectation Maximization, Representing knowledge in an uncertain domain, the semantics of Bayesian networks, Dempster-Shafer theory, Fuzzy sets & fuzzy logics.

Textbooks:

1. Russell, S. & Norvig, P. (2010). Artificial intelligence: a modern approach. Prentice Hall (3rd ed.).
2. Elaine Rich, Kevin Knight & Shivashankar B. Nair (2008). Artificial Intelligence (Third Edition) TMH.
3. Bishop, C. M. (2006) Machine Learning and Pattern Recognition. Berlin: Springer.

Reference Book:

1. Poole, D. L. & Mackworth, A. K. (2010). Artificial intelligence: foundations of computational agents. Cambridge University Press.
2. Nilsson, N. J. (1998) Artificial Intelligence - A Modern Synthesis. Palo Alto: Morgan Kaufmann.

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Department of Computer Science and Engineering

C331 **CS 1604** **(3L + 1 T hrs/week)**

FORMAL LANGUAGES AND AUTOMATA THEORY

Questions to be set having equal weightage/marks from each unit: SIX
TWO from UNIT I, TWO from UNIT II, and TWO from both UNIT I and UNIT II combined.
Questions to be answered: FIVE
Compulsory TWO Questions from UNIT I and UNIT II, and ANY ONE from the combination Question.

OBJECTIVES: This course builds upon preliminary knowledge delivered in discrete structure for computer science and computer programming concepts. The main objectives of the course are to provide learners with a detailed understanding of the mathematical models of the machines and their evolution through requirement generation and advancement in languages. Thorough the concepts and operations in Formal Language and Automata Theory, their use in Compiler Design and their application in Natural Language Processing.

PRE-REQUISITES: Knowledge in discrete mathematics and in programming.

Course Outcome: On successful completion of this course, students will be able to:

1. Explain different concepts in automata theory and formal languages.
2. Produce various grammars and their acceptors.
3. Analyze the various language acceptors.
4. Acquire a fundamental understanding of computational models related to decidability and recursive enumerability.
5. Illustrate various proofs using mathematical principles.

UNIT I

Introduction [2 Hrs]
Mathematical preliminaries: Sets, Logic, Functions, Relations, Languages. Definitions: Language, Grammar, Automata, Relation between language, Grammar and automata, Importance of automata theory.

Finite Automata [7Hrs]
Informal introduction: Drawing examples from everyday life to bring out the essence of finite automata, Finiteness and its importance in automata theory. Deterministic finite automata: Definition, Processing strings, Transition functions, Language of a DFA; Nondeterministic finite automata: Non-determinism, Definition, Extended transition functions, Language of a NFA, Equivalence of DFA and NFA, Kleene's theorem, Epsilon transitions, Applications of Finite automata in text search.

Regular Expressions and Regular Languages [6 Hrs]
Memory required to recognize a language, Regular expressions, Regular expression to finite automata, Finite automata to regular expression, Algebraic laws for regular expressions, applications of regular expressions, Criterion for regularity, Regular languages.

Properties Of Regular Languages [3 Hrs]
Pigeonhole principle, Pumping lemma for regular languages, Closure properties, **Testing membership of regular languages, Equivalence of automata.**

UNIT II

Context Free Grammars and Languages [6 Hrs]
Definition, Leftmost and rightmost grammars, Parse trees, Ambiguity: Ambiguous grammar, removing ambiguity. Normal forms, Applications of context free grammars: Parsers

Pushdown Automata and Context Free Languages [4 Hrs]

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Date.....

Definition of pushdown automata, Representing pushdown automata, Acceptance by pushdown automata: By final state, By empty stack, Deterministic pushdown automata, Equivalence of pushdown automata and context free grammars, **Pumping lemma for context free languages, Closureproperties of context free languages,** Testing membership of context free, Decision problems for context free languages.

Turing Machines [5 Hrs]
Definition, Language of a Turing Machine, Programming Turing Machines, The Church-Turing Thesis, A simple programming language, Extensions of the Basic Turing Machine.

Recursively Enumerable Languages [2 Hrs]
Definition, Enumeration, Chomsky hierarchy.

Undecidability [3 Hrs]
The halting problem, the post correspondence problem,**Time and space complexity of Turing machines, Complexity classes**.

Language Learning [2 Hrs]
Learning framework, Inductive inference, Grammar induction

1. **Text Books:**
   - **(T1):** John. E. Hopcroft, Rajeev Motwani, Jeffry.Ullman, Introduction to Automata Theory, Languages and Computation, Pearson Education.
   - **(T2):** Peter Linz, An Introduction to Formal Languages and Automata, Narosa

2. **Reference Books:**
   - **(R1):** James. L. Hein, Discrete Structures, Logic and Computability, Narosa
   - **(R2):** Partha Niyogi, The Computational Nature of Language Learning and Evolution, PHI.
   - **(R3):** C.K. Nagpal, Formal Languages and Automata Theory, Oxford University Press, 2011.
   - **(R4):** John Martin , Introduction to Languages and the Theory of Computation, Tata McGraw Hill.

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Department of Computer Science and Engineering

C333

CS 1606 **(3L + 1 T hrs/week)**

COMPUTER NETWORKS-II

Questions to be set having equal weightage/marks from each unit: SIX
TWO from UNIT I, TWO from UNIT II, and TWO from both UNIT I and UNIT II combined.
Questions to be answered: FIVE
Compulsory TWO Questions from UNIT I and UNIT II, and ANY ONE from the combination Question.

Objective: This course emphasizes on several computer network concepts, applications and protocols in OSI as well as TCP/IP layered architecture. It also covers the various protocols of various layers, their operations and applications. Further it discusses the concept of network security, challenges and their counter measures.

Pre-requisites: Communication Technique and Data Communication.

Course Outcome: On successful completion of this course, students will be able to:

1. Understand and discover the engineering fundamentals involved in Computer Network and other related frame work
2. Identify the complex engineering problem relating computer network relating to host Identification data delivery and routing.
3. Ability to formulate a solution plan and methodology for an engineering problem concerning Computer Networking like Sub network, super network, and DNS etc
4. Ability to formulate and interpret a model based on the Computer Networks and its related framework.
5. Understand and explain basic responsibilities/concept of protocols in protocol present stack, DNS, DHCP, security, etc.

UNIT- I

Network layer [6 Hrs]

IPv6 packets and addressing, Internet Control Message Protocol (ICMP), Internet Group Message Protocol (IGMP), Mapping Physical to Logical Address: Reverse Address Resolution Protocol (RARP) Bootstrap Protocol (BOOTP), Dynamic Host Configuration Protocol (DHCP).

Routing protocols for wired network [6 Hrs]

Unicast routing protocols: Shortest Path, Flooding, Distance Vector routing (DVR), Link state routing, Multi cast routing protocols. Interior gateway protocol: Open Shortest Path First (OSPF), Exterior gateway protocol: Border Gateway Protocol (BGP).

Transport layer [8 Hrs]

Functions of transport layer protocols: Congestion control, Reliable service, Introduction to Transmission Control Protocol (TCP) as Transport Layer Protocol, Header description, Congestion control mechanism of TCP, Transport Protocols User Datagram Protocol (UDP), Use of UDP, Header description, Stream Control Transmission Protocol (SCTP).

UNIT-II

Application layer [3 Hrs]

Brief overview of protocols in Application Layer: Domain Name Systems, Hyper Text Transmission Protocol, TELecomunications NETwork (TELNET), File Transfer Protocol, Dynamic Host Configuration Protocol. E-mail: Architecture and services.

Network security [4 Hrs]

Principles, Symmetric and Asymmetric Cryptography, Confidentiality, Authenticity, Integrity and Non-repudiation. Symmetric key algorithms: Data Encryption Standard (DES), Public key algorithms: Rivest,

Shamir and Adleman algorithm (RSA).

Software Defined Network (SDN) [3 Hrs]

History and evolution of Software Defined Network, Control and data plane separation, Control Plane, Network Virtualization, Data Plane, Open Flow.

Fundamentals of Distributed Systems [5 Hrs]

Introduction and challenges of Distributed Systems, Systems models, Logical time and logical clocks, Global states, Externval Data Representation and Marshalling, Request-Reply protocols, Remote Procedure Call, Remote Method Invocation.

Text Books:

1. Andrew S. Tanenbaum, "Computer Networks", PHI.
2. Behrouz A. Forouzan, "Data Communications and Networking", Tata McGraw-Hill.
3. George Coulouris, Jean Dollimore, Tim Kindberg, "Distributed Systems: Concepts and Design",Pearson
4. Pradeep K. Sinha, "Distributed Operating Systems", PHI.

Reference Books:

1. William Stallings, "Data and Computer Communications", PHI.
2. Alberto Leon-Garcia, Indra Widjaja, "Communication Networks – Fundamental Concepts and KeyArchitectures", Tata McGraw-Hill
3. Kurose Ross, "Computer Networks – A Top-Down Approach featuring the Internet", Pearson.
4. Thomas Nadeau and Ken Gray "SDN – Software Defined Networks"- O'Reilly Media
5. Patricia A Morreale and James M. Anderson, "Software Defined Networking: Design and Deployment"- CRC Press.
6. Mukesh Singhal, Niranjan G. Shivaratri, "Advanced Concepts in Operating System", McGraw Hill.

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CS 16** **(2L+1T hrs/week)**

PROGRAMME ELECTIVE-IV

Questions to be set having equal weightage/marks from each unit: SIX
TWO from UNIT I, TWO from UNIT II, and TWO from both UNIT I and UNIT II combined.
Questions to be answered: FIVE
Compulsory TWO Questions from UNIT I and UNIT II, and ANY ONE from the combination Question Objectives and Pre-requisites are given under Elective details.
[TO BE CHOSEN FROM POOL OF ELECTIVES]

CS 16** **(2L+1T hrs/week)**

PROGRAMME ELECTIVE-V

Questions to be set having equal weightage/marks from each unit: SIX
TWO from UNIT I, TWO from UNIT II, and TWO from both UNIT I and UNIT II combined.
Questions to be answered: FIVE
Compulsory TWO Questions from UNIT I and UNIT II, and ANY ONE from the combination Question Objectives and Pre-requisites are given under Elective details.
[TO BE CHOSEN FROM POOL OF ELECTIVES]

CS 16** **(2L+1T hrs/week)**

PROGRAMME ELECTIVE-VI

Questions to be set having equal weightage/marks from each unit: SIX
TWO from UNIT I, TWO from UNIT II, and TWO from both UNIT I and UNIT II combined.
Questions to be answered: FIVE
Compulsory TWO Questions from UNIT I and UNIT II, and ANY ONE from the combination Question Objectives and Pre-requisites are given under Elective details.
[TO BE CHOSEN FROM POOL OF ELECTIVES]

C336 **CS 1663** **(3 hrs/week)**

COMPUTER NETWORK LAB

Objective: At least 10 experiments covering the entire syllabus of the corresponding theory paper to be carried out using the theory studied /programming skill of the subject concerned to get insight into the practical applications of the theoretical studies. The outcome of the lab classes must lead to a skilled and self-sustained program developer.

Pre-requisites: Corresponding theory paper CS 1606 Computer Networks - II and associated prerequisites.

Course Outcome: On successful completion of this course, students will be able to:

1. Identify and understand various functions used in socket programs
2. Develop and test of socket program for client server interaction for various purpose.
3. Implementing and Validate Sub network with static and various dynamic routing protocols.
4. Analyze the packet structure of various protocols used for communication
5. Understand the fundamentals of SDN

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Department of Computer Science and Engineering

C352 **CS 1666** **(3 hrs/week)**

PARALLEL PROGRAMMING LAB

Objective: At least 10 experiments covering the syllabus to be carried out using programming skill of the subject concerned to get insight into the practical applications. The outcome of the lab classes must lead to a skilled and self-sustained program developer.

Pre-requisites: Concepts of Data Structures and Sorting Algorithms, Mutliprocessor, Multiprogramming architectures and their functioning.

Course Outcome: On successful completion of this course, students will be able to:

1. Classify the different parallel programming constructs.
2. Simulate various parallel programming constructs in any high level language.
3. Select appropriate constructs to be used in different algorithms.
4. Justify the output of a program in solving different problems and evaluate its performance and effectiveness.
5. Compare the performance of programs designed on two different paradigms.

C407 **CS 1671**

MINI PROJECT

Objective: The students are required to undertake innovative and research oriented project under the direct supervision of a faculty member of the department. The mini project should not only to reflect their knowledge gained in the previous seven semesters but also to acquire additional knowledge and skill of their own effort. The Mini Project are assigned at the end of Vth semester and the final evaluation and grades are awarded at the end of VIth semester

Course Outcome: On successful completion of this course, students will be able to:

1. Describe the basic concepts of computer science related to the problem under consideration
2. Identify an appropriate engineering problem to be solved
3. Construct an appropriate design methodology for software development and demonstrate effective communication and writing skills
4. Experiment on a designed model and develop an ability to work in a team
5. Evaluate the project based on application of knowledge and practical understanding of the model

Department of Computer Science and Engineering

CS1861#Minor Specialisation **(2L+1T hrs/week)**

CRYPTOGRAPHY AND NETWORK SECURITY

Questions to be set having equal weightage/marks from each unit: SIX
TWO from UNIT I, TWO from UNIT II, and TWO from both UNIT I and UNIT II combined.
Questions to be answered: FIVE
Compulsory TWO Questions from UNIT I and UNIT II, and ANY ONE from the combination Question.

Objective: To understand basics of Cryptography and Network Security. To be able to secure a message over insecure channel by various means. To learn about how to maintain the Confidentiality, Integrity and Availability of a data. To understand various protocols for network security to protect against the threats in the networks.

Pre-requisites: Basic concept of Computer Networks and Information Security.

Course Outcomes: On successful completion of this course, students will be able to:

1. Define mathematical modelling of a Security services to address modern security issues and challenges.
2. Demonstrate and an ability to formulate a solution plan and methodology for security in information systems using Cryptography.
3. Analyze diverse set of alternative design solutions to meet the basic requirements and goals of a security system.
4. Recognize technical issues for existing security principles and network applications consistent with their level of knowledge and understanding.
5. Develop solutions for existing security principles and network applications.

UNIT I

Introduction to Cryptography and Block Ciphers [8]

Introduction to Security Attacks - services and mechanism, Introduction to Cryptography, Conventional Encryption: Conventional encryption model, Classical Encryption Techniques - Substitution Ciphers And Transposition Ciphers, Cryptanalysis, Steganography, Modern Block Ciphers: Block ciphers principals, Shannon's theory of confusion and diffusion, - Fiestal Structure, Data Encryption Standard(DES),Strength of DES, Differential and Linear Crypt Analysis of DES, Block cipher modes of operations, Triple DES, AES.

Confidentiality and Modular Arithmetic [6]

Confidentiality Using Conventional Encryption, Traffic Confidentiality, Key Distribution - Random Number Generation, Introduction to Graph - Ring and Field, Prime and Relative Prime Numbers: Modular Arithmetic, Fermat's and Euler's Theorem, Primality Testing, Euclid's Algorithm, Chinese Remainder Theorem, Discrete Algorithms.

Public Key Cryptography and Authentication Requirements [9]

Principles of Public Key Crypto Systems, RSA Algorithm - Security of RSA, Key Management – Diffle-Hellman Key Exchange Algorithm, Introductory Idea of Elliptic Curve Cryptography, Elgamel Encryption, Message Authentication and Hash Function: Authentication Requirements, Authentication Functions, Message Authentication Code, Hash Functions, Birthday Attacks, Security of Hash Functions.

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UNIT II

Integrity Checks and Authentication Algorithms [8]

MD5 Message Digest Algorithm, Secure Hash Algorithm (SHA), Digital Signatures, Authentication Protocols, Digital Signature Standards (DSS) - Proof of Digital Signature Algorithm, Authentication Applications: Kerberos and X.509, Directory Authentication Service, Electronic Mail Security, Pretty Good Privacy (PGP), S/MIME.

IP Security and Key Management [4]

Evolution of IP Security, IP Security: Architecture, Authentication Header, Encapsulating Security Payloads, Combining Security Associations, Key Management.

Web and System Security [5]

Web Security: Secure Socket Layer and Transport Layer Security, Secure Electronic Transaction (SET), System Security: Intruders, Viruses and Related Threads, Firewall Design Principals, Trusted Systems.

Text Books

1. William Stallings, "Cryptography and Network security Principles and Practices", Pearson/PHI.
2. Wade Trappe, Lawrence C Washington, "Introduction to Cryptography with coding theory", Pearson.

Reference Books

1. W. Mao, "Modern Cryptography –Theory and Practice", Pearson Education.
2. Charles P. Pfleeger, Shari Lawrence Pfleeger, Security in computing, Prentice Hall of India.

Department of Computer Science and Engineering

CS 1863#Minor Specialisation **(2L +1T hrs/week)**

BLOCK CHAIN CODING

Questions to be set having equal weightage/marks from each unit: SIX
TWO from UNIT I, TWO from UNIT II, and TWO from both UNIT I and UNIT II combined.
Questions to be answered: FIVE
Compulsory TWO Questions from UNIT I and UNIT II, and ANY ONE from the combination Question.

Objectives: The syllabus is aimed at giving a basic understanding of cryptocurrency, its importance and the use of blockchain technology. It is focused on defining the technological backbone of Bitcoin fundamentals and expands the concepts to building the blockchain technology. It guides us to understand the history of digital currency, the polices involving laws and organizations, the latest trends, and the communities involved; which facilitates us to construct, visualize and understand the ecosystem of blockchain technology and its environment on which it is deployed.

Pre-requisites: Basics of Cryptography and Economics.

Course Outcomes: On successful completion of this course, students will be able to:
1. Understand crypto currencies and blockchain fundamentals.
2. To visualize the individual building blocks of product block chain and understand them and inter relationships.
3. Understand the working mechanism, importance of technologies.
4. Realise the impact on organizations which focuses on using them.
5.Apply the techniques in real world

UNIT–I

Introduction [3 Hrs] :

Trustless system, Decentralized transactions. History: How and when Blockchain & Bitcoin started, Milestones on the development of bit coin: creation, exchanges.

Basics [7 Hrs] :

Bitcoin: Nakamoto consensus, Research Perspectives & Challenges, Bitcoin mining strategy and attacks, Bitcoin community, economics & politics. BlockChain: What is Blockchain? Distinction between Blockchain vs Cryptocurrency vs Token, Pillars of Blockchain , Industry Applications of Blockchain. Cryptocurrencies: Bitcoin / Ethereum, How to Buy Bitcoin/Ethereum - How to Set up a Wallet.

Working Mechanism [5 Hrs]:

How Blockchain (and Bitcoin) Work, Peer to Peer network, What is a block?, blockchain drive : Proof of Work, Byzantine Generals, Distributed consensus, Cryptography: Hashing, Data Integrity, Merkle Trees, Public v Private Key Cryptography, Bitcoin and block sizes.

Mining and Cryptocurrencies [5 Hrs]:

Mining : Proof of Work v Stake, how miners make money- business model, overview, the purpose, impact to the world, Motivations, incentives, strategy. Pools : CPUS and GPUs, Revenue at a Protocol Level : Block Rewards/Fees/ETC

UNIT–II

Blockchain Types [6 Hrs] :

Public and Private Blockchains, JP Morgan Quorum, IBM's stuff, Using blockchain - Numerai, DAO, etc, Lightning networks and plasma, Sidechains, Digital Rights - ownership and accessibility, Industry - healthcare, identity, finance, Paradigm shift/future/big picture.

Consensus Building, Regulation and Anonymity [6 Hrs] :

What is it? Security Implications, 1 PC 1 vote , Environmental, Segwit and Forks, What is a smart contract? Smart contract legal issues. Regulation and Anonymity: ICO and SEC ruling, its anonymity, Governments regulating bitcoin, Anti Money Laundering ,Political Implications on blockchain, Government's current position and its effects on blockchain. Anonymity - Zcash,

Problems with Blockchain [3 Hrs]:

Security and Safeguards, Protection from attackers , Hacks on exchanges, What is stopping adoption?, Scalability problems, Network attacks to destroy Bitcoin, Case Study: Failed currencies & Blockchain.

Bitcoin and Ethereum [2 Hrs]:

Bitcoin creation and economy, Limited Supply and Deflation, Hacks , Ethereum concept and Ethereum classic, Altcoins : Major Altcoins - Zcash, Ripple, NEO

Blockchain applications [3 Hrs]:

Building on the Blockchain - Pros and cons of different implementations , Use cases of the different types Government, Identity management, Auto executing contracts, Three signature escrow, Triple entry accounting, Elections and voting?, Ethereum Interaction - Smart Contract and Token , Languages , How to create your own Blockchain.

Text Books:

1. Arvind Narayanan, Joseph Bonneau, Edward Felten, "Bitcoin and Cryptocurrency Technologies: A Comprehensive Introduction", Kindle Edition.
2. Andreas M. Antonopoulo,"Mastering Bitcoin: Programming the Open Blockchain",2nd Edition, Kindle Edition.

Other References:

1. https://bitcoin.org/bitcoin.pdf
2. http://scet.berkeley.edu/wp-content/uploads/BlockchainPaper.pdf.
3. http://chimera.labs.oreilly.com/books/1234000001802/ch07.html#_introduction_2
4. https://www.evry.com/globalassets/insight/bank2020/bank-2020---Blockchain-powering-the-internet-of-value---whitepaper.pdf.

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Department of Computer Science and Engineering

CS1865#Minor Specialisation **(2L+1T hrs/week)**

CLOUD ARCHITECTURE AND DEPLOYMENT

Questions to be set having equal weightage/marks from each unit: SIX
TWO from UNIT I, TWO from UNIT II, and TWO from both UNIT I and UNIT II combined.
Questions to be answered: FIVE
Compulsory TWO Questions from UNIT I and UNIT II, and ANY ONE from the combination Question.

Objective:

- To gain insight about basic technology behind the Cloud.
- To understand the movement from a traditional network infrastructure to a Cloud solution.
- To comprehend the Cloud computing applications.

Pre-requisites: Operating system, Computer Networks
Course Outcomes: On successful completion of this course, students will be able to:

1. Explain competence in using engineering fundamentals to visualize solutions using knowledge of software engineering skills.
2. Determine a solution plan and methodology for an engineering problem using software engineering.
3. Interpret a model for project management as well as define complex problem, also find and analyses requirements
4. Develop modern engineering tools, techniques and resources to solve software related problems.
5. Demonstrate an ability to identify/create modern engineering tools, techniques and resources to solve cloud architecture and storage solution.

UNIT I

OVERVIEW OF COMPUTING PARADIGM [3 HRS]:

Recent trends in Computing: Grid Computing, Cluster Computing, Distributed Computing, Utility Computing, Cloud Computing.

EVOLUTION OF CLOUD COMPUTING [8 HRS]:

Defining a Cloud, Cloud Types – NIST model, Cloud Cube model, Cloud components - Essential characteristics – On-demand self service, Broad network access, Location independent resource pooling.

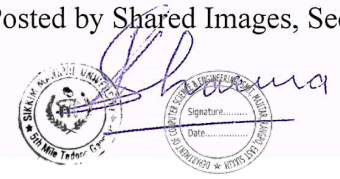
CLOUD ARCHITECTURE [9 HRS]:

Layers in cloud architecture, Software as a Service (SaaS), features of SaaS and benefits, Platform as a Service (PaaS), features of PaaS and benefits, Infrastructure as a Service (IaaS), features of IaaS and benefits, Service providers, challenges and risks in cloud adoption. Cloud deployment model: Public clouds – Private clouds – Community clouds - Hybrid clouds - Advantages of Cloud computing.

UNIT II

TASK SCHEDULING IN CLOUD [12 HRS]

Scheduling Algorithms for Computing Clouds, Fair Queuing Start Time, Fair Queuing Borrowed Virtual Time, Cloud Scheduling Subject to Deadlines, Scheduling Map, Reduce Applications Subject to Deadlines. Cloud Security - Cloud Security Risks, Trust, Operating System Security, VM Security, Security of Virtualization, Security Risks Posted by Shared Images, Security Risks Posted by



Management OS, Data privacy and security Issues, Identity & Access Management, Access Control, Authentication in cloud computing

CLOUD SIMULATOR- CloudSim [8 HRS]:

Introduction to Simulator, understanding CloudSim simulator, CloudSim Architecture(User code, CloudSim, GridSim, SimJava), Understanding Working platform for CloudSim.

Text Books:

1. Rajkumar Buyya, Christian Vecchiola, S. Thamarai Selvi, Mastering Cloud Computing, Tata McGraw Hill, ISBN-10: 0-12-411454-7
2. Chris Moyer, Building applications in cloud: Concept, Patterns and Projects, Pearson, ISBN-10: 0-32-172020-2

Reference Books:

1. Barrie Sosinsky, Cloud Computing Bible, Wiley, ISBN-10: 8-12-652980-6
2. Anthony T. Velte, Cloud computing: A practical approach, Tata McGraw Hill, ISBN-10: 0-07-068351-4

Department of Computer Science and Engineering

CS1867#Minor Specialisation **(2L +1T hrs/week)**

BIG DATA ANALYTICS

Questions to be set having equal weightage/marks from each unit: SIX
TWO from UNIT I, TWO from UNIT II, and TWO from both UNIT I and UNIT II combined.
Questions to be answered: FIVE
Compulsory TWO Questions from UNIT I and UNIT II, and ANY ONE from the combination Question.

Objectives:

1. To optimize business decisions and create competitive advantage with Big Data analytics
2. To explore the fundamental concepts of big data analytics.
3. To learn to analyze the big data using intelligent techniques.
4. To understand the various search methods and visualization techniques.
5. To learn to use various techniques for mining data stream.
6. To understand the applications using Map Reduce Concepts.
7. To introduce programming tools PIG & HIVE in Hadoop echo system

Prerequisites:

This will be a hands-on course. Students need to know at least one or more programming languages: C, C++, Java, Perl, Python, and/or JavaScript to finish homework's and final project.

Course Outcomes:

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

1. Work with big data platform and explore the big data analytics techniques business applications.
2. Design efficient algorithms for mining the data from large volumes.
3. Analyze the HADOOP and Map Reduce technologies associated with big data analytics.
4. Explore on Big Data Applications using Pig and Hive.
5. Understand the fundamentals of various big data analytics techniques.

UNIT-I

Introduction and Challenges in Big Data [6 Hours]

Introduction to big data : Introduction to Big Data Platform – Challenges of Conventional Systems - Intelligent data analysis – Nature of Data - Analytic Processes and Tools - Analysis vs Reporting.

Data Mining and Streams [10 Hours]

Mining data streams : Introduction to Streams Concepts – Stream Data Model and Architecture - Stream Computing - Sampling Data in a Stream – Filtering Streams – Counting Distinct Elements in a Stream – Estimating Moments – Counting Oneness in a Window – Decaying Window - Real time Analytics Platform(RTAP) Applications - Case Studies - Real Time Sentiment Analysis- Stock Market Predictions.

Introduction to Hadoop [10 Hours]

Hadoop: History of Hadoop- the Hadoop Distributed File System – Components of Hadoop Analyzing the Data with Hadoop- Scaling Out- Hadoop Streaming- Design of HDFS-Java interfaces to HDFS Basics-Developing a Map Reduce Application-How Map Reduce Works-Anatomy of a Map Reduce Job Run-Failures-Job Scheduling-Shuffle and Sort – Task execution - Map Reduce Types and Formats- Map Reduce Features Hadoop environment.

UNIT-II

Hadoop Frameworks [8 Hours]

Frameworks: Applications on Big Data Using Pig and Hive – Data processing operators in Pig – Hive services – HiveQL – Querying Data in Hive - fundamentals of HBase and Zookeeper - IBM Infosphere BigInsights and Streams.

Predictive Analytics [6 Hours]

Predictive Analytics- Simple linear regression- Multiple linear regression- Interpretation 5 of regression coefficients. Visualizations - Visual data analysis techniques- interaction techniques - Systems and applications.

References:

1. Michael Berthold, David J. Hand, "Intelligent Data Analysis", Springer, 2007.
2. Tom White "Hadoop: The Definitive Guide" Third Edition, O'reilly Media, 2012.
3. Chris Eaton, Dirk DeRoos, Tom Deutsch, George Lapis, Paul Zikopoulos, "Understanding Big Data: Analytics for Enterprise Class Hadoop and Streaming Data", McGrawHill Publishing, 2012.
4. Anand Rajaraman and Jeffrey David Ullman, "Mining of Massive Datasets", CUP, 2012.
5. Bill Franks, "Taming the Big Data Tidal Wave: Finding Opportunities in Huge Data Streams with Advanced Analytics", John Wiley& sons, 2012.
6. Glenn J. Myatt, "Making Sense of Data", John Wiley & Sons, 2007.
7. Pete Warden, "Big Data Glossary", O'Reilly, 2011.
8. Jiawei Han, Micheline Kamber "Data Mining Concepts and Techniques", 2 nd Edition, Elsevier, Reprinted 2008.
9. Da Ruan, Guoquing Chen, Etienne E.Kerre, Geert Wets, "Intelligent Data Mining", Springer, 2007. 10.Paul Zikopoulos, Dirkde Roos, Krishnan Parasuraman, Thomas Deutsch, James Giles , David Corrigan, "Harness the Power of Big Data The IBM Big Data Platform", Tata McGraw Hill Publications, 2012.
10. Arshdeep Bahga, Vijay Madisetti, "Big Data Science & Analytics: A HandsOn Approach ",VPT, 2016
11. Bart Baesens "Analytics in a Big Data World: The Essential Guide to Data Science and its Applications (WILEY E Data Series)", John Wiley & Sons,2014

Department of Computer Science and Engineering

C403 **CS 1703** **(3L + 1 T hrs/week)**

COMPILER DESIGN

Questions to be set having equal weightage/marks from each unit: SIX
TWO from UNIT I, TWO from UNIT II, and TWO from both UNIT I and UNIT II combined.
Questions to be answered: FIVE
Compulsory TWO Questions from UNIT I and UNIT II, and ANY ONE from the combination Question.

Objectives: The course is aimed at offering complete knowledge on compiler design and ends with the development of a working compiler in parts. Topics include compiler structure, symbol tables, regular expressions and languages, finite automata, lexical analysis, context-free languages, LL(1), recursive descent, LALR(1), and LR(1) parsing semantic analysis, and code generation. This will enable the learners to use formal attributed grammars for specifying the syntax and semantics of programming languages and their impact on compiler design.

Pre-requisites: Discrete Structures for Computer Science, Formal Language and Automata Theory and Programming skills.

Course Outcome: On successful completion of this course, students will be able to:

1. Define the competence in designing compilers.
2. Describe the functioning in various problem domains.
3. Discover complex engineering problem and able to solve it using the concept of compiler design.
4. Analyze and select optimal design scheme using compiler design principles
5. Develop and experiment using knowledge of compilers for compiling different programs.

UNIT- I

Compiler Structure [4 Hrs]
Analysis-synthesis model of compilation, Various phases of a compiler, Tool based approach to compiler construction, Input Buffering.

Lexical Analysis [6 Hrs]
Interface with input, Parser and symbol table, Token, Lexeme and patterns, Regular definition, Transition diagrams, LEX.

Syntax Analysis [8 Hrs]
CFG's, Ambiguity, Associativity, Precedence, Top down parsing, Recursive descend parsing,Transformation on the grammars, Predictive parsing, Bottom up parsing, Operator precedence grammars, LR parsers (SLR, Canonical, LALR), YACC.

Syntax Directed Translation [2 Hrs]
Inherited and synthesized attributes, Dependency graph, Evaluation order, Bottom up evaluation of S-attributed definitions L- attributed definitions and top down translation of attributes.

UNIT-II

Type Checking [2 Hrs]
Type system, Type expressions, Structural and name equivalence of types, **Type conversion**.

Run Time Environments [4 Hrs]
Storage organization, Storage-allocation strategies, Access to nonlocal names, Activation tree, Activation record, Parameter passing, Symbol table and **dynamic storage allocation.**

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Intermediate Code Generation [8 Hrs]
Intermediate representations, **Translation of declarations, Assignments, Control flow,** Boolean expressions and procedure calls ,Three-address code, Implementation of three address statements

(Quadruples, Triples, Indirect triples).

Code Generation [6 Hrs]

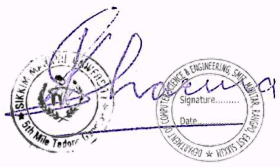
Issues in the design of a code generator, Basic blocks and flow graphs, Next use information, **Register allocation, Code generation algorithm,** Dag representation of programs, **Code generation from dags, Peephole optimization and code generator generators.**

Text Books:

1. A.V. Aho, R. Sethi, J.D. Ullman, "Compilers: Principles, Techniques and Tools", Addison – Wesley.
2. Steven S. Muchnick, "Advanced Compiler Design and Implementation", Elsevier.

Reference Books:

1. W. Appel, "Modern Compiler Implementation in C: Basic design", Cambridge Press.
2. Fraser and Hanson, "A Retargetable C Compiler: Design and Implementation", Addison-Wesley.
3. Dhamdhere, "Compiler Construction", McMillan.
4. A. V. Aho and J. D. Ullman, "Theory of Parsing, Translation and Compiling", Prentice Hall.



Department of Computer Science and Engineering

C404 **BA 1710** **(2L + 1 T hrs/week)**

INDUSTRIAL ENGINEERING MANAGEMENT

Questions to be set having equal weightage/marks from each unit: SIX
TWO from UNIT I, TWO from UNIT II, and TWO from both UNIT I and UNIT II combined.
Questions to be answered: FIVE
Compulsory TWO Questions from UNIT I and UNIT II, and ANY ONE from the combination Question.

Course Outcome: On successful completion of this course, students will be able to:

1. Understanding different concepts regarding Organization and Productivity in industries.
2. Evaluate control charts for variable as well as attribute data for different types of manufacturing processes and service activities.
3. Identify the techniques, skills and modern engineering tools necessary for engineering practice.
4. Applying knowledge of science, mathematics and engineering.
5. Analyze the concept of Inventory management, reliability.

UNIT-1

Philosophy and Development of Management thought:
Concept and definition of management, Functions and Roles of Management, Social Responsibilities of Management. Pioneers in Management, Taylor's Scientific Management, Contribution of Henry Fayol, Gilberth and Mayo.

Schools of Management Thought:
Human Behaviour, Social System, Systems approach, management process school. Control Charts for SQC : Statistical Quality Control (SQC). Control charts or variables such as X, R charts and control charts for attributes such as p-chart, c-chart.
Construction & use of the control charts. Process capability.

Reliability:
Introduction to reliability, bath-tub curve. Life expectancy. Reliability based esign. Series & Parallel System. **Defect Diagnosis and prevention : Basic causes of failure, curve/control of failure.** MTBF. Maintainability, **Condition monitoring and dignostic techniques.**

Value Engineering:
Elements of value analysis Techniques

UNIT-II

Quantitative Techniques in Managerial Decisions:
Concept of budget and budgetary control. Time-event network analysis; ABC Analysis, Break-even Analysis; Decision Tables; Concept of productivity, measuring productivity, Use information technology

Production Management:
Types of production; Types of Planning, Manufacturing Planning; Production planning, Scheduling; Work study & Method Study; Systems of wage payments, bonus, Automation. Organization of production, planning and control department.
Practice of purchasing and materials management, quality, quality standards and inspection, sources of supply; pricing principles and practices. Inventory Mangement, EOQ model.

Text Books:

1. H. Koontz and H. Weihrich, "Management", McGraw Hill, 1989.
2. Dobler W.D. "Purchasing & Materials Management", TMHC, New Delhi, 1984

CS 17** **(2L +1T hrs/week)**

PROGRAMME ELECTIVE-VII

Questions to be set having equal weightage/marks from each unit: SIX
TWO from UNIT I, TWO from UNIT II, and TWO from both UNIT I and UNIT II combined.
Questions to be answered: FIVE
Compulsory TWO Questions from UNIT I and UNIT II, and ANY ONE from the combination Question
Objectives and Pre-requisites are given under Elective details.
[TO BE CHOSEN FROM POOL OF ELECTIVES]

CS 17** **(2L +1T hrs/week)**

PROGRAMME ELECTIVE-VIII

Questions to be set having equal weightage/marks from each unit: SIX
TWO from UNIT I, TWO from UNIT II, and TWO from both UNIT I and UNIT II combined.
Questions to be answered: FIVE
Compulsory TWO Questions from UNIT I and UNIT II, and ANY ONE from the combination Question
Objectives and Pre-requisites are given under Elective details.
[TO BE CHOSEN FROM POOL OF ELECTIVES]

CS 17** **(3L +1T hrs/week)**

OPEN ELECTIVE II

Questions to be set having equal weightage/marks from each unit: SIX
TWO from UNIT I, TWO from UNIT II, and TWO from both UNIT I and UNIT II combined.
Questions to be answered: FIVE
Compulsory TWO Questions from UNIT I and UNIT II, and ANY ONE from the combination Question
Objectives and Pre-requisites are given under Elective details.
[TO BE CHOSEN FROM POOL OF ELECTIVES]

C406 **CS 1762** **(3 hrs/week)**

COMPILER DESIGN LAB

Objective: At least 10 experiments covering the entire syllabus of the corresponding theory paper to be carried out using the theory studied /programming skill of the subject concerned to get insight into the practical applications of the theoretical studies. The outcome of the lab classes must lead to a skilled and self-sustained program developer.
Pre-requisites: Corresponding theory paper CS 1703 Compiler Design and associated prerequisites.
Course Outcome: On successful completion of this course, students will be able to:

1. Simulate the functioning of various phases of compilers in various problem domains.
2. Devise solutions to solve complex engineering problem.
3. Identify an optimal design among all available design alternatives for further manipulation using compiler design principles to execute the code faster.
4. Apply tools using knowledge of compilers for compiling different programs.
5. Evaluate the effectiveness of different compilation tools.

Department of Computer Science and Engineering

C422 **CS 1763** **(3 hrs/week)**

INTELLIGENT SYSTEMS LAB

Objective: At least 10 experiments covering the entire syllabus of the corresponding theory paper to be carried out using the theory studied /programming skill of the subject concerned to get insight into the practical applications of the theoretical studies. The outcome of the lab classes must lead to a skilled and self-sustained program developer.

Pre-requisites: Basics of Machine Learning.

Course Outcome: On successful completion of this course, students will be able to:

1. Classify procedures for Machine Learning algorithms.
2. Simulate various procedures of Machine learning in any high level language.
3. Select appropriate datasets to be used in different algorithms.
4. Justify the application of an algorithm in solving real world problems and evaluate its performance and effectiveness.
5. Apply Machine learning algorithms in solving various real life problems.

Department of Computer Science and Engineering

CS1871#Minor Specialisation **(2L+1T hrs/week)**

DISTRIBUTED COMPUTING

Questions to be set having equal weightage/marks from each unit: SIX
TWO from UNIT I, TWO from UNIT II, and TWO from both UNIT I and UNIT II combined.
Questions to be answered: FIVE
Compulsory TWO Questions from UNIT I and UNIT II, and ANY ONE from the combination Question.

Objective: To understand the foundations of distributed systems. To learn issues related to clock Synchronization and the need for global state in distributed systems. To learn distributed mutual exclusion and deadlock detection algorithms. To understand the significance of agreement, fault tolerance and recovery protocols in Distributed Systems. To learn the characteristics of peer-to-peer and distributed shared memory systems

Pre-requisites: Basic concept of Computer Networks.
Course Outcomes: On successful completion of this course, students will be able to:

1. Understand the basics of distributed computing.
2. Observe distributed file system.
3. Construct distributed system support along with tansaction, security and replication in distributed computing.
4. Illustrate the ability to apply the knowledge in analysing and designing distributed systems.
5. Summarize the SOA and SOA security

UNIT I

Introduction to Distributed Computing [6]

Introduction to Distributed Systems, Examples Of Distributed Systems, Challenges, Architectural Models, Fundamental Models, Introduction to Interprocess Communications, External Data Representation and Marshalling Client Server Communication, Group Communication, Case Study: IPC In UNIX , Case Study: RMI, CORBA, Advances in Distributed Systems.

Distributed Objects and File System [6]

Introduction, Communication between Distributed Objects, Remote Procedure Call, Events and Notifications, Java RMI Case Study, Introduction to DFS, File Service Architecture, Sun Network File System, Introduction to Name Services- Name Services and DNS, Directory and Directory Services, Distributed Mutex and Deadlock

Distributed Operating System Support [6]

The operating system layer, Protection- Process and Threads, Communication and Invocation, Operating System Architecture, Introduction to Time and Global States, Clocks, Events and Process States, Synchronizing Physical Clocks, Logical Time and Logical Clocks, Global States, Distributed Debugging, Distributed Mutual Exclusion.

Transaction and Concurrency Control [4]

Transactions, Nested Transaction, Locks, Optimistic Concurrency Control, Timestamp Ordering, Comparison of Methods for Concurrency Control, Introduction to Distributed Transactions, Flat and Nested Distributed Transactions, Atomic Commit Protocols, Concurrency Control in Distributed Transactions, Distributed Deadlocks, Transaction Recovery.

Department of Computer Science and Engineering

UNIT II

Security and Replication [5]

Overview of Security Techniques, Cryptographic Algorithms, Digital Signatures, Cryptography Pragmatics, Replication, System Model and Group Communications, Fault Tolerant Services, Highly Available Services, Transactions with Replicated Data Issues in Designing Distributed System and Role of Middleware in Distributed System

Service-oriented architecture (SOA) [8]

Basic SOA Definition, Overview of SOA, SOA and Web Services, Service Oriented Grid, SOA Design and Development, Advantages and Future of SOA, SOA Support in J2EE, Java API for XML-based web services (JAX-WS), Java architecture for XML Binding (JAXB), Java API for XML Registries (JAXR), Java API for XML based RPC (JAX-RPC), Web Services Interoperability Technologies (WSIT), SOA support in .NET, Common Language Runtime, ASP.NET web forms, ASP.NET web services, Web Services Enhancements 08 (WSE).

SOA Security [6]

New Approach to Security for SOA, Extending SOAP for Security, Claiming and Verifying Identity with Passwords, WS-Security Standards, Kerberos with WS-Security, Encrypting SOAP Messages, XML Signatures, Implementing Security as a Service.

Text Books

1. Distributed O.S Concepts and Design , P.K.Sinha, PHI
2. Newcomer, Lomow, "Understanding SOA with Web Services", Pearson Education, 2005.
3. SOA Security, Ramarao, Manning.

Reference Books:

1. Advanced concepts in Operating Systems , Mukesh Singhal & N.G.Shivaratri, TMH
2. Distributed Computing , Sunita Mahajan, Seema Shah, OXFORD University Press
3. Distributed System Principles and Paradigms , Andrew S. Tanenbaum, 2nd edition , PHI
4. Distributed Systems , Colouris , 3rd Edition

Thomas Erl, "SOA Principles of Service Design "(The Prentice Hall Service-Oriented Computing Series from Thomas Erl), 2005.

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Department of Computer Science and Engineering

CS 1872#Minor Specialisation **(2L + 1 Thrs/week)**

SOFT COMPUTING

Questions to be set having equal weightage/marks from each unit: SIX
TWO from UNIT I, TWO from UNIT II, and TWO from both UNIT I and UNIT II combined.
Questions to be answered: FIVE
Compulsory TWO Questions from UNIT I and UNIT II, and ANY ONE from the combination Question.

Objectives: It comprises of computational techniques like Genetic/ Evolutionary algorithms, Artificial Neural Networks, Fuzzy Systems, Machine learning and probabilistic reasoning etc. This course thoroughly discusses Genetic Algorithms, Artificial Neural Networks (major topologies and learning algorithms) and Fuzzy Logic. At the end of the course, the students will be able to solve a variety of problems in their area of interest ranging from Optimization problems to Pattern recognition and Control tasks, by using soft computing tools.

Pre-requisites: Design and analysis of algorithms, Programming concepts.

Course Outcomes: On successful completion of this course, students will be able to:

1. Acquire knowledge of soft computing theories fundamentals and so they will be able to design program systems using approaches of these theories for solving various real-world problems.
2. Awake the importance of tolerance of imprecision and uncertainty for design of robust and low-cost intelligent machines.
3. Appreciate the importance of tolerance of imprecision and uncertainty for design of robust and low-cost intelligent systems.
4. Apply specified techniques in design and implementation of soft computing models for solving real life problems.
5. To acquire the knowledge of the fuzzy Neural network and Genetic Language.

UNIT-I

Introduction [4 Hrs]

Definition, Aspects of soft computing, Dealing with vagueness: Fuzzy systems, Rough sets, Modeling the brain-human cognition, Artificial neural networks, Modeling nature's optimization process: Natural evolution.

Fuzzy Set Theory [6 Hrs]

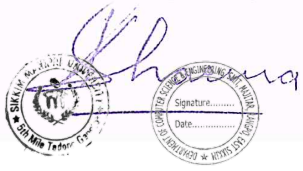
Review of crisp set theory: Sets and subsets, Definitions & notations - Universal set, Null set, Empty set, Subsets, Power set, Venn diagram, Operations on sets: Union, Intersection, Complementation, Difference Symmetric difference, Cartesian product, Properties of sets: Commutative, Associative, Distributive, DeMorgan's Law, Fuzzy sets: Fuzziness, Vagueness.

Fuzzy Membership Function [5 Hrs]

Crisp membership, Fuzzy membership, Membership profiles, Fuzzy sets: Definition, Notation, Features, Normality, Height, Support, Core cardinality, Transformation: Normalization, Dilation, Concentration, Contrast intensification, Fuzzification.

Fuzzy Set Operations [5 Hrs]

Operators – Union, Intersection, Complementation, Equality, Inclusion, Product, Difference, Disjunctive sum, Properties – Commutative, Associative, Distributive, Idempotency, De Morgan's law, Law Boundary conditions, Law of involution, Transitive law.



UNIT-II

Fuzzy Logic [5 Hrs]

Propositional logic: Propositions, Propositional logic well-formed formulae, Properties of wffs, Interpretation of logical expression, Logical equivalence, Tautology, Contradiction, Consistency, Validity of an argument.

Artificial Neural Networks [5 Hrs]

Basic concepts: The biological neuron, The artificial neuron, Characteristics of the brain, The McCulloch-Pitts neural model, The perceptron neural network architectures: Single layer feed forward ANNs, Multi-layer feed forward ANNs.

Back Propagation [5 Hrs]

Multilayer feed forward net- structure, Notations, Activation function, Generalized delta rule, The Back propagation Algorithm: Learning, Parameter choice, Initialization, Stopping criteria, Training set, Data representation, Hidden layers.

Advanced Search Algorithms [5 Hrs]

Genetic algorithms : Natural evolution, Chromosomes, Natural selection , Cross-over, Mutation, Basic GA, Encoding a solution as chromosome, decoding it, Fitness function, Population, GA operators- Selection, Tournament, Roulette wheel, Cross-over, Mutation, GA parameters , Convergence.

Text Books:

1. J. S. R. Jang, C. T. Sun, and E. Mizutani, "Neuro-Fuzzy and Soft Computing: A Computational Approach to Learning and Machine Intelligence", Prentice Hall.
2. Melanie Mitchell, "An Introduction to Genetic Algorithms", PHI.

Reference Books:

1. Simon Haykin, "Neural Networks – A Comprehensive Foundation", Prentice Hall.
2. Jerry M. Mendel, "Uncertain Rule-Based Fuzzy Logic Systems: Introduction and New Directions", Prentice Hall
3. Timothy J. Ross, "Fuzzy Logic with Engineering Applications", Wiley India.
4. Laurene Fausett, "Fundamentals of Neural Networks – Architecture, Algorithms and Applications", Pearson.

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Department of Computer Science and Engineering

CS1873#Minor Specialisation **(2L+1T hrs/week)**

IoT SECURITY

Questions to be set having equal weightage/marks from each unit: SIX
TWO from UNIT I, TWO from UNIT II, and TWO from both UNIT I and UNIT II combined.
Questions to be answered: FIVE
Compulsory TWO Questions from UNIT I and UNIT II, and ANY ONE from the combination Question.

Objective:

- To gain insight about IoT general models and security challenges
- To understand the different IoT protocols and their security measures
- To interpret how to secure an IoT environment
- To interpret different IoT types of attacks

Pre-requisites: Essentials of Internet of Things (IoT)

Course Outcomes: On successful completion of this course, students will be able to:

1. Have an overview of IoT Security
2. Understand the vulnerability issue
3. Understand the secured protocol for IoT
4. Summarise Securing Internet of Things Environment
5. Gain knowledge about various IoT Attacks

UNIT I

IoT- SECURITY OVERVIEW [10 HRS]:

IoT Reference Model- Introduction -Functional View, IoT Security Challenges-Hardware Security Risks - Hardcoded/Default Passwords -Resource Constrained Computations -Legacy Assets Connections - Devices Physical Security, Software Security Risks -Software Vulnerabilities -Data Interception - Identification of Endpoints -Tamper Detection, Lack of Industrial Standards

IoT- SECURITY & VULNERABILITY ISSUES [10 HRS]:

IoT Security Requirements -Data Confidentiality -Data Encryption -Data Authentication -Secured Access Control – IoT-Vulnerabilities – Secret-Key, Authentication/Authorization for Smart Devices - Constrained System Resources -Device Heterogeneity -Fixed Firmware. IoT Attacks -Side-channel Attacks - Reconnaissance -Spoofing -Sniffing -Neighbour -Discovery -Rogue Devices-Man-in-Middle.

UNIT II

SECURED PROTOCOLS FOR IoT [8 HRS]

Infrastructure-IPv6 -LowPAN, Identification-Electronic Product Code -uCode, Transport-Bluetooth - LPWAN, Data -MQTT -CoAP, Multi-layer Frameworks-Alljoyn,-IoTivity

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SECURING INTERNET OF THINGS ENVIRONMENT [8 HRS]:

IoT Hardware -Test Device Range-Latency and Capacity -Manufacturability Test -Secure from Physical Attacks, IoT Software -Trusted IoT Application Platforms, -Secure Firmware Updating -Network Enforced Policy -Secure Analytics, Visibility and Control

IoT ATTACKS -CASE STUDY [4 HRS]:

MIRAI Botnet Attack -Iran's Nuclear Facility, Stuxnet Attack -Tesla, Cryptojacking Attack -The TRENDnet, WebcamAttack -The Jeep SUV

Text Books:

1. Fei Hu, Security and Privacy in Internet of Things (IoTs): Models, Algorithms, and Implementations, CRC press, ISBN-10: 1-49-872318-7
2. Russell, Brian and Drew Van Duren, Practical Internet of Things Security, Packt publishing, ISBN-10: 9-78-178588963-9

Reference Books:

1. Ollie Whitehouse, Security of Things: An Implementer's Guide to Cyber-Security for Internet of Things Devices and Beyond, NCC group.

Department of Computer Science and Engineering

CS 1874#Minor Specialisation **(2L +1Thrs/week)**

INFORMATION RETRIEVAL

Questions to be set having equal weightage/marks from each unit: SIX
TWO from UNIT I, TWO from UNIT II, and TWO from both UNIT I and UNIT II combined.
Questions to be answered: FIVE
Compulsory TWO Questions from UNIT I and UNIT II, and ANY ONE from the combination Question.

Objectives:

1. Learn the information retrieval models.
2. Be familiar with Web Search Engine.
3. Be exposed to Link Analysis.
4. Understand Hadoop and Map Reduce.
5. Learn document text mining techniques.

Pre-requisites: Data Mining, Artificial Intelligence

Course Outcome: On successful completion of this course, students will be able to:

1. Apply information retrieval models.
2. Design Web Search Engine.
3. Use Link Analysis.
4. Use Hadoop and Map Reduce.
5. Apply document text mining techniques.

UNIT I

Introduction [6 Hrs]
Introduction -History of IR- Components of IR - Issues –Open source Search engine Frameworks - The impact of the web on IR - The role of artificial intelligence (AI) in IR – IR Versus Web Search - Components of a Search engine- Characterizing the web.

Information Retrieval [6 Hrs]
Boolean and vector-space retrieval models- Term weighting - TF-IDF weighting- cosine similarity – Preprocessing - Inverted indices - efficient processing with sparse vectors – Language Model based IR - Probabilistic IR –Latent Semantic Indexing - Relevance feedback and query expansion.

Web Search Engine – Introduction and Crawling [8 Hrs]
Web search overview, web structure, the user, paid placement, search engine optimization/ spam. Web size measurement - search engine optimization/spam – Web Search Architectures - crawling - meta-crawlers- Focused Crawling - web indexes –- Near-duplicate detection - Index Compression - XML retrieval.

UNIT II

Web Search – Link Analysis and Specialized Search [10 Hrs]
Link Analysis –hubs and authorities – Page Rank and HITS algorithms -Searching and Ranking – Relevance Scoring and ranking for Web – Similarity - Hadoop & Map Reduce - Evaluation -Personalized search - Collaborative filtering and content-based recommendation of documents and products – handling "invisible" Web - Snippet generation, Summarization, Question Answering, Cross- Lingual Retrieval.

Document Text Mining [6 Hrs]
Information filtering; organization and relevance feedback – Text Mining -Text classification and clustering - Categorization algorithms: naive Bayes; decision trees; and nearest neighbor - Clustering algorithms: agglomerative clustering; k-means; expectation maximization (EM).

Text Books:

1. C. Manning, P. Raghavan, and H. Schütze, Introduction to Information Retrieval , Cambridge University Press, 2008.
2. Ricardo Baeza -Yates and Berthier Ribeiro - Neto, Modern Information Retrieval: The Concepts and Technology behind Search 2 nd Edition, ACM Press Books 2011.

Reference Books:

1. Bruce Croft, Donald Metzler and Trevor Strohman, Search Engines: Information Retrieval in Practice, 1 st Edition Addison Wesley, 2009.
2. Mark Levene, An Introduction to Search Engines and Web Navigation, 2 nd Edition Wiley, 2010.
3. Stefan Buettcher, Charles L. A. Clarke, Gordon V. Cormack, Information Retrieval: Implementing and Evaluating Search Engines, The MIT Press, 2010.

Department of Computer Science and Engineering

C430

CS 1875
MAJOR PROJECT

The students are required to undertake innovative and research oriented project, not only to reflect their knowledge gained in the previous seven semesters but also to acquire additional knowledge and skill of their own effort. During their major project, the students are required to submit progress of their work in phases to make the department aware of his/her project. At the end of 16 weeks, students have to report to the internal guides/faculty members for final refinement and documentation. It is mandatory to follow the software engineering methodologies in carrying out the project work. The project is evaluated through internal presentation before the panel of faculty members followed by the evaluation by external examiner appointed by the university.

Course Outcome: On successful completion of this course, students will be able to:

1. Apply modern engineering tools, techniques, and resources to solve different existing engineering problems.
2. Propose set of alternative design solutions to problems for which standard algorithmic solutions do not exist.
3. select proper Plan/manage an engineering activity within time.
4. Illustrate the able to comprehend technical literature and document project work.
5. Test the ability of listening, speaking, and presentation.

Department of Computer Science and Engineering

C231 **CS 1437/ CS 1422** **(2L + 1 T hrs/week)**

ENTERPRISE RESOURCE PLANNING (ERP)

Questions to be set having equal weightage/marks from each unit: SIX
TWO from UNIT I, TWO from UNIT II, and TWO from both UNIT I and UNIT II combined.
Questions to be answered: FIVE
Compulsory TWO Questions from UNIT I and UNIT II, and ANY ONE from the combination Question

Objectives:

- To understand the business process of an enterprise
- To grasp the activities of ERP project management cycle
- To understand the emerging trends in ERP developments

Prerequisite: NIL

Course Outcomes: On successful completion of this course, the student should be able to:

1. Identify the important business functions provided by typical business software such as enterprise resource planning and customer relationship management.
2. Illustrate basic concepts of ERP systems for manufacturing or service companies
3. Analyze the technical aspect of telecommunication systems, internet and their roles in business environment.
4. Reframe open-ended problem descriptions to feasible solutions
5. Illustrate the use of various tools used in ERP for industry

UNIT I

Introduction to ERP[4 hrs]
Evolution of ERP; what is ERP? Reasons for the Growth of ERP; Scenario and Justification of ERP in India; Evaluation of ERP; Various Modules of ERP; Advantage of ERP

An Overview of Enterprise[5 hrs]
An Overview of Enterprise; Integrated Management Information; Business Modelling; ERP for Small Business; ERP for Make to Order Companies; Business Process Mapping for ERP Module Design; Hardware Environment and its Selection for ERP Implementation.

ERP and Related Technologies[7 hrs]
ERP and Related Technologies; Business Process Reengineering (BPR); Management Information System (MIS); Executive Information System (EIS); Decision support System (DSS); Supply Chain Management (SCM).

ERP Implementation-I & Lifecycle [7 hrs]
Planning Evaluation and selection of ERP systems - Implementation life cycle - ERP implementation, Methodology and Frame work- Training – Data Migration. People Organization in implementation- Consultants, Vendors and Employees.

UNIT II

Post Implementation[5 hrs]
Maintenance of ERP- Organizational and Industrial impact; Success and Failure factors of ERP Implementation

Benefits of ERP[5 hrs]
Reduction of Lead-Time, On-time Shipment, Reduction in Cycle Time, Improved Resource Utilization, Better Customer Satisfaction, Improved Supplier Performance, Increased Flexibility, Reduced Quality Costs, Improved Information Accuracy and Design-making Capability

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Future Directions in ERP[5 hrs]

Future Directions in ERP; New Markets; New Channels; Faster Implementation Methodologies; Business Modules and BAPIs; Convergence on Windows NT; Application Platform; New Business Segments; More Features; Web Enabling; Market Snapshot

ERP Market & Introduction to ERP tools[2 hrs]

ERP Market Place, SAP AG, Peoplesoft, Baan, JD Edwards, Oracle, QAD, SSA

TEXT BOOKS:

1. Alexis Leon, ERP demystified, second Edition Tata McGraw-Hill, 2008.

REFERENCE BOOKS:

1. Sinha P. Magal and Jeffery Word, Essentials of Business Process and Information System, Wiley India, 2012
2. Jagan Nathan Vaman, ERP in Practice, Tata McGraw-Hill, 2008
3. Alexis Leon, Enterprise Resource Planning, second edition, Tata McGraw-Hill, 2008.
4. Mahadeo Jaiswal and Ganesh Vanapalli, ERP Macmillan India, 2009
5. Vinod Kumar Grag and N.K. Venkitakrishnan, ERP- Concepts and Practice, Prentice Hall of India, 2006.
6. Summer, ERP, Pearson Education, 2008

Department of Computer Science and Engineering

C229 **CS 1438/ CS 1431** **(2L +1T hrs/week)**

MICROPROCESSORS AND PERIPHERAL DEVICES

Questions to be set having equal weightage/marks from each unit: SIX
TWO from UNIT I, TWO from UNIT II, and TWO from both UNIT I and UNIT II combined.
Questions to be answered: FIVE
Compulsory TWO Questions from UNIT I and UNIT II, and ANY ONE from the combination Question

Objective: The course is intended to give students good understanding of internal architectural details and functioning of 8085 and 8086 microprocessors. The students will have thorough and in-depth knowledge of microprocessors, its architecture, working principles including timing diagrams and assembly language programming using hand assembly as well as assembler. This course also highlights 8051 Microcontroller.

Pre-requisites: Digital Circuits & Logic Design and Computer Organization & Architecture.

Course Outcomes: On successful completion of this course, students will be able to:

1. Identify and describe the structure and functions of basic elements of 8085, 8086 Microprocessors and various peripheral devices.
2. Sketch block diagrams of Microprocessors and peripheral devices. Illustrate the execution of instructions by the MP using timing diagrams. Explain interfacing of MP with peripheral devices
3. Design circuit diagrams for interfacing the MP with peripheral devices as per the problem statement for creating an application
4. Write programs for microprocessors and MP based applications using assembly language
5. Describe the MP-specific assembly language constructs and syntaxes.

UNIT- I

Introduction to microprocessors [02 Hrs]
Microprocessors Evolution and Types, Overview of microprocessor-based systems.

Introduction to 8085[05Hrs]
Pin description &Internal Architecture of 8085, Multiplexed data/address bus, Addressing modes of 8085, 8085 instructions, Instruction cycle, Machine cycle, Bus timing of 8085, and 8085 interrupts.

Programming in 8085[03 Hrs]
Programming using 8085 instructions using hand assembly. Counters and time delays,8085 **Stacks and subroutines.**

Introduction to 8086[10 Hrs]
Pin descriptions of 8086, internal architecture of 8086, **Addressing modes supported by 8086,** 8086 instructions, interrupts of 8086& interrupt vector table.

UNIT- II

Assembly language programming using 8086[03 Hrs]
An introduction to assembly language programming in 8086, **assembler directives**, macros, procedures, and **DOS interrupt 21H functions**.

Memory System Design and I/O System Design[05 Hrs]
8086 address and data buses, RAM/ROM interfacing to 8086, **I/O mapped I/O and memory mapped I/O,** 8086 port addressing space, **designing a port address decoder**.

Introduction to Peripheral Devices[06 Hrs]
Introduction to 8259 PIC, 8254 PIT, **8255 PPI**, 8251 USART.

Introduction to 80286, 80386 and 8051 microcontroller[06 Hrs]
Internal architectures of 80286 and 80386, special registers of 80286 and 80386, **Memory management in 80286 and 80386, Architecture 16 bit & 32 bit processors.**

Text Books:

1. Microprocessor Architecture, Programming and Applications with 8085, by Ramesh Gaonkar, Penram International Publishing (India) Pvt. Ltd., Fifth Edition.
2. The 8088 and 8086 Microprocessors: Programming, Interfacing, Software, Hardware, and Applications, by Walter A. Triebel and Avtar Singh, Pearson Education, Fourth Edition.
3. Microprocessors and Microcomputer based system design, by MahamedRafiquzzaman, UBS, 1994 (Only for MOTORALA 68000 Microprocessor)

Reference Books:

1. Microprocessor X86 Programming - K R Venugopal and Raj Kumar, BPB Publications, 1995.
2. IBM PC Assembly Language Programming , by Peter Abel, Pearson Education Asia, Fifth edition.
3. Advanced Microprocessors & Peripherals Architecture, Programming &Interfacing , by A K Ray, K M Bhurchandi, Tata Mcgraw Hill Publishing Company Limited, 2000.

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Department of Computer Science and Engineering

C223 **CS 1439/EC 1424/ CS 1407** **(2L + 1 T hrs/week)**

COMMUNICATION TECHNIQUES

Questions to be set having equal weightage/marks from each unit: SIX
TWO from UNIT I, TWO from UNIT II, and TWO from both UNIT I and UNIT II combined.
Questions to be answered: FIVE
Compulsory TWO Questions from UNIT I and UNIT II, and ANY ONE from the combination Question

Course Outcomes: On successful completion of this course, students will be able to:

1. Describe the basic component of a complete communication system.
2. Identify and analyze signal level analysis of the communication system at the physical layer.
3. Identify and distinguish the various modulation and demodulation techniques of a communication system.
4. Analyse transmitter and receiver circuits.
5. Compare and contrast design issues, advantages, disadvantages and limitations of a communication system.

Pre-requisite: Knowledge of calculus, trigonometric and basic electronics.

UNIT- I

Signal model and classification, **generalized Fourier series, Fourier series, Fourier transform, Properties of Fourier transform, Transmission of signals through linear system**, **Distortion-less transmission and signal distortion over channel. Inverse Fourier Transform,** Power spectral density, Correlation and convolution.

Amplitude modulation, Frequency modulation, Method of frequency translation, recovery of the base band signal, **Amplitude modulation,** Circuit analysis, Spectrum of amplitude modulated signal, double side band suppressed carrier modulation, balance modulator, Single side band modalities, Method of generation, Detection of amplitude modulated signal.

UNIT-II

Angle modulation, Phase and frequency modulation, Phase and frequency deviation, Spectrum of an FM Signal, FM generation and detection, Voltage controlled oscillators and phase locked loop.

Basic principle of an AM transmitter, Block diagram, description, Mixer R.F. and IF amplifiers, Super heterodyne concept, Practical mixer circuits, Tuned small signal RF amplifiers.

Classification of power amplifiers, Ideal Class-A power amplifier, Class-B, Class-AB, and Class-C amplifier.

Text Books:

1. S. Haykin, An Introduction to Analog and Digital Communications, Wiley, 2nd Edition,2003
2. A.P.Malvino, Electronic Principles, McGraw Hill, 7th Edition, 1998.

Reference Books:

1. George Kennedy, Communication Systems , Penram, 5th edition, 2011
2. Roddy and Coolean , Communication Systems, Pearson Education, 4th edition,1995
3. Taub , Shelling. Principles of Communication Systems, Tata Mcgraw Hill,3rd Edition,2008

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Department of Computer Science and Engineering

C232 **CS 1440/CS 1425** **(2L + 1 T hrs/week)**

INTERNET, TECHNOLOGY AND SOCIETY

Questions to be set having equal weightage/marks from each unit: SIX
TWO from UNIT I, TWO from UNIT II, and TWO from both UNIT I and UNIT II combined.
Questions to be answered: FIVE
Compulsory TWO Questions from UNIT I and UNIT II, and ANY ONE from the combination Question

Objective: The primary objective of this course is to develop an understanding of the impact created by technology and internet on the modern society. It also emphasizes on the ways to cope-up with the negative impacts.

Pre-requisites: NIL
Course Outcome: On successful completion of this course, students will be able to:

1. Describe while identifying the impact of technology and internet on the modern society
2. Interpret software freedom principles and free/open-source licensing system
3. Identify ethical issues related to surveillance system, digital divide and identify data privacy concerns
4. Prioritize privacy concerns by applying free & open-source software solutions
5. Recognize the impact of engineering and industrial practices on social contexts.

UNIT - I

Introduction [3 Hrs]
Introduction, History of Internet, Perspectives on the relations between technology, internet and society, The impact of technology and internet on society, Technological determinism, social determinism

Information & Society [5 Hrs]
Theories of Information Society, The Geography of internet and the digital divide, Issues affecting digital divide, Digital Inequality, Access to Knowledge, Technology Accessibility, Net neutrality, Uses and Gratification Theory, Cultural Cognition Theory

Technology, Economy & Society [7 Hrs]
Attention Economy, Pros and cons of attention economy, Case Study: Social media, e-commerce and messaging systems, Growing up digital, Digital childhood and adolescence, Trust, credibility & reputation in social systems, Social isolation, Automation in workplace, Technology & income inequality

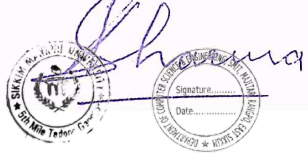
Privacy and Surveillance [7 Hrs]
Data Privacy, Data Breach, Privacy, work and family, Case Study: Facebook Analytica, The fundamental right to privacy, Privacy and Data Protection in India, Surveillance, Mass Surveillance, Case Study: PRISM, Software as a service and its privacy implications, Security - Encryption, Signing & Web Security, Phishing in social media, Identifying fraudulent entities.

UNIT - II

Software Freedom [5 Hrs]
Code is Law, The regulation of code, Software ethics, Proprietary software, Digital Restrictions Management, Free Software Movement, Free/Libre software vs Open source software, Four essential software freedom, Secure Boot vs. Restricted Boot, Free JavaScript, GNU OS, Free BIOS Campaign,

Software Licenses [4 Hrs]
Intellectual Property Rights, Software Patents, Copyright vs. Copyleft, Creative Commons, EULA, Free and Open source licenses, GNU Licenses

Protecting our privacy and freedom [7 Hrs]
Free/libre OS, Free/libre software alternatives, Protecting privacy on internet, Protecting privacy on mobile phone, Email self defence, Free Android, Freedom Campaigns



Conclusion [2 Hrs]

The future of internet and technology: cultural and technical perspective

Text Books:

1. Anabel Quan-Haase, "Technology and Society: Social Networks, Work, and Inequality", Oxford University Press.
2. Lawrence Lessig, "Code version 2.0", Basic Books.

References:

1. The Center for Internet & Society: https://cis-india.org/
2. Free Software Foundation: https://www.fsf.org/

Department of Computer Science and Engineering

C238 **CS 1423/CS 1432** **(2L + 1 T hrs/week)**

PC HARDWARE AND PERIPHERALS

Questions to be set having equal weightage/marks from each unit: SIX
TWO from UNIT I, TWO from UNIT II, and TWO from both UNIT I and UNIT II combined.
Questions to be answered: FIVE
Compulsory TWO Questions from UNIT I and UNIT II, and ANY ONE from the combination Question

Objective: The objective of this course is to acquire basic knowledge in Computer hardware and peripherals for installation, trouble shooting and maintenance. This course is also aimed at being a curtain raiser for later courses on Computer Organization and Microprocessors.
Pre-requisites: Basic Electronics
Course Outcomes: On successful completion of this course, students will be able to:

1. Indicate the names and functions of hardware ports and the parts of the motherboard
2. Identify the names and distinguishing features of different kinds of input and output devices
3. Describe how the CPU processes data and instructions and controls the operation of all other devices
4. Illustrate the names, distinguishing features, and units for measuring different kinds of memory and storage devices
5. Assess the troubleshoots in microcomputer systems hardware and software and other peripheral equipment.

UNIT I

Microcomputer System [4 Hrs]
Computer Organization, Memory, Arithmetic and Logic Units, Control Unit, Instruction pre-fetch, Interrupts, I/O techniques, Device Controllers, Microprocessors**, Personal Computer Concepts and Techniques.**

Peripheral Devices [2 Hrs]
Keyboard and keyboard interface; CRT display monitor, Printer, Magnetic Storage Devices, Floppy Disk Drive, Hard disk drive.

PC Hardware Overview [3 Hrs]
Hardware-BIOS-DOS interaction, PC family, PC hardware, motherboard logic, memory space, I/O port addresses, I/O data transfer, DMA channels.

Hardware Components and IC's [4 Hrs]
Hardware components - discrete and integrated; Pulse, Circuits and waveforms, positive and negative logic.

Basics of Microprocessors [7 Hrs]
Introduction, **Evolution and Applications**, 8085 Architecture, Addressing Modes, Instruction Sets, Bus Timings.

UNIT II

Motherboard support chips and circuits [5 Hrs]
Clock generator, Interrupt controller, Programmable Interval Timer, 8255A- PPI(Programmable Peripheral Interface). Motherboard functions and logic (RAM, ROM, Reset). Control, Address, and Data bus logic. Motherboard connectors and jumpers, SMPS.

Printer, Hard Disk Controller and Display Adapter [6 Hrs]
Introduction to controller and use of controller. Printer Controller: Interface hardware overview and circuit description. Hard Disk Controller(HDC): Organization Overview, Disk Drive Types and Interface, Controller Port, Description, Hard Disk Format and format procedure and HDC layout. **Motorola 6845, CGA (Color/Graphics Adapter) and Advanced Graphics Adapter**.

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Date.....

Auxiliary Subsystems [3 Hrs]
Data communication, Serial Port, Real Time Clock, LAN, **Memory expansion option.**

Troubleshooting and Overview of Advance PCs [6 Hrs]
Computer Faults, Nature of faults and its types. Diagnostic Programs and tools. Fault elimination process, diagnosis and rectification. **Systematic Troubleshooting**, POST, **Motherboard problem diagnosis.**

Text Books:
1. B. Govindarajalu, "IBM PC and Clones", Tata McGraw-Hill.
2. A. Ray, K. M. Bhurchandi, "Advanced Microprocessors and Peripherals: Architecture, Programming and Interfacing", Tata McGraw Hill.

Reference Books:
1. Clements, Alan, "Principles of Computer Hardware", Oxford University Press.
2. Rajaram, "Fundamentals of Computer", Prentice Hall of India.
3. Mathivanam, "Microprocessors PC Hardware and Interfacing", Prentice Hall of India.
4. Peterson, "Computer Organization and Design, The Hardware/Software Interface", Elsevier.

Department of Computer Science and Engineering

C228 **CS 1434/CS 1421** **(2L+1T hrs/week)**

JAVA PROGRAMMING

Questions to be set having equal weightage/marks from each unit: SIX
TWO from UNIT I, TWO from UNIT II, and TWO from both UNIT I and UNIT II combined.
Questions to be answered: FIVE
Compulsory TWO Questions from UNIT I and UNIT II, and ANY ONE from the combination Question

Objective: The Java Programming Language course provides students with a solid foundation for programming with JAVA. It also highlights the creation of graphical user interfaces (GUIs), exceptions, file input/output (I/O), and threads; and network programming.

Pre-requisites: Object Oriented Programming.

Course Outcomes: On successful completion of this course, students will be able to:

1. Demonstrate an ability describe and recall the various object oriented concept
2. Formulate and interpret an object oriented model and design solution using object oriented concepts.
3. Ability to illustrate a diverse set of design solutions using techniques of Interface, Packages, File Handling, Multi-threading, etc.
4. Select and design methodology using bottom up approach and solve open ended problems using Java.
5. Define and create modern engineering tools, techniques and resources to build software using Java programming language.

UNIT-I

Introduction to Java [4 Hrs]
Evolution and features of java, Overview of java, **Two control statements, Lexical issues**, Data types, Variables and arrays, **Literals, Variables**, Type conversion and casting, Type promotion in expression, arrays, **Operators, Bitwise operators, Relational operators, Boolean and logical operators, Assignment Operators, The '?' operator, Operator precedence,** JAVA statements.

Introducing classes [2 Hrs]
Class fundamentals, Declaring objects, Assigning object reference Variables, Introducing methods, Constructors, 'this' keyword, **Garbage collection**, The finalize() method, **stack class.**

Methods and classes [4 Hrs]
Overloading methods and constructors, using object as parameters, Argument passing, Returning objects, **Recursion**, Access control, Static methods, Nested and inner classes, Command line argument.

Strings handling [4 Hrs]
String constructors, String length, Special string operators, Character extraction, String comparison, String searching, String modification, Changing case of characters within a string, Compression and String buffer, String builder.

Inheritance, Interfaces and Packages [4 Hrs]
Basics of inheritance, Types of inheritance, Using super keyword, method overriding, Dynamic method dispatch, Abstract class, Using final with inheritance, The object class, Defining and implementing interface, Extending interfaces, Nested interfaces, Applying interfaces, Defining and creating packages, Access protection, Importing packages.

Exception Handling [3 Hrs]
Fundamentals, Exception types, Uncaught exceptions, Using try and catch, Multiple catch clauses, Nested try statements, **Throws**, Finally, Java's built in exceptions, Creating own exception classes.

UNIT II

Input/Output and file handling [4 Hrs]
Java I/O classes and interfaces, The stream classes, Byte streams, The character streams, The console class, File class, Byte-stream class, Random access files.

Multithreaded programming [5 Hrs]
Thread basics, Java's thread model, Thread priorities, **Synchronization**, Messaging, Thread class and runnable interface. The main thread, Creating a thread, Creating multiple threads, Interthread communication, Suspending/resuming and stopping threads.

Network programming [5 Hrs]
Networking basics, The networking classes and interfaces, The InetAddress class, Inet4Address, TCP socket, **URL, URLConnection, HTTP/URL Connection, TCP/IP server sockets, Datagram socket and Datagram Packet.**

Event Based Programming [5 Hrs]
The applet class, Repaint(), The HTML applet tag, Passing Parameter to applet, Event handling, **Using delegation event model, Abstract Window program, Displaying information within a window, AWT controls.**

Text Books:

1. Programming With JAVA, 2nd Edition, E. Balaguruswami and TMH Publication.
2. Java: The Complete Reference, 7th Edition, Herbert Scheldt, TMH Publication.

Reference Books:

1. The Java Programming Language: K.Arnold and J. Gosling.
2. Professional java Server Programming: Allamaraju.
3. JAVA2: The Complete Reference, 3rd Edition, Patrick Naughton and HarbertSchildt, TMH Publication.
4. Internet & Java Program: R.Krishnamoorthy& S. Prabhu, New Age Internet Publisher.

Department of Computer Science and Engineering

C234 **CS 1435** **(2L +1T hrs/week)**

PYTHON PROGRAMMING

Questions to be set having equal weightage/marks from each unit: SIX
TWO from UNIT I, TWO from UNIT II, and TWO from both UNIT I and UNIT II combined.
Questions to be answered: FIVE
Compulsory TWO Questions from UNIT I and UNIT II, and ANY ONE from the combination Question

Objective: This course introduces Python as a imperative, functional, procedural and object oriented programming language. Python also serves as a scripting language for web applications. The units covers the Python language with a focus on its object-oriented features, web applicability and how these can be implemented as part of program designs and implementation. The students shall also gain knowledge on practical applications of python in scientific computing using libraries such as NumPy, Matplotlib etc.

Pre-requisites: Computer Programming concepts of C, C++ etc.

Course Outcomes: On successful completion of this course, students will be able to:

1. Define the basic structure of python programming.
2. Differentiate imperative, functional and procedural programming features in Python
3. Practice features for designing and implementing python program.
4. Compose applications using various libraries and concepts of Python.
5. Select methods to build and package Python modules for reusability

UNIT – I

Introduction [3 Hrs]
History, need of python programming, data types, variables, expressions, operators, sequence, list, tuple, set, dictionary, print statement, etc.

Python Program Flow Control [6 Hrs]
Conditional blocks using if, else and elseif, Simple for loops in python, For loop using ranges, string, Use of while loops in python, Loop manipulation using pass, continue, break and else, Programming using Python conditional and loops block, Functions.

Python Object–based programming [8Hrs]
Concept of class, object and instances, Constructor, class attributes and destructors, Real time use of class, Inheritance, overlapping and overloading operators, Adding and retrieving dynamic attributes of classes

Error and Exceptions [3 Hrs]
Difference between an error and Exception, Handling Exception, try except block, Raising Exceptions, User Defined Exceptions.

UNIT- II

Python Regular Expression and GUI design [4 Hrs]
Powerful pattern matching and searching, Real time parsing of networking or system data, Widgets and basic components, Layout options, Event handling

Python Database Interaction and File Operation [8 Hrs]
SQL Database connection using python, Creating and searching tables, Reading and storing config information on database, Programming using database connections, Reading config files in python, Writing log files in python, Understanding read functions: read(), readline() and readlines()

Python Standard Library [4 Hrs]

Study of modules for creating graphical user interfaces, connecting to relational databases, generating pseudorandom numbers, arithmetic with arbitrary precision decimals, manipulating regular expressions, unit testing, Python Package Index(PyPI)

Applications [4 Hrs]

APIs for scripting: Web Server Gateway Interface, Web frameworks like Django, Pylons, Pyramid, TurboGears,web2py, Tornado, Flask, Bottle, Zope etc., Libraries for scientific computing such as NumPy, SciPy and Matplotlib.

Text Books:

1. Mark Lutz, "Programming Python", O'Reilly.
2. W.Chun, "Core Python Programming", Pearson.

Reference Books:

1. Allen Downey, "Think Python", Green Tea Press
2. Mark Lutz, "Learning Python", 3rd Edition, O'Reilly
3. Guido van Rossum and Jr. Fred L. Drake , "An Introduction to Python", Network Theory Ltd.

Department of Computer Science and Engineering

C235 **CS 1436/CS 1642** **(2L +1T hrs/week)**

FUNDAMENTALS OF WEB TECHNOLOGIES

Questions to be set having equal weightage/marks from each unit: SIX
TWO from UNIT I, TWO from UNIT II, and TWO from both UNIT I and UNIT II combined.
Questions to be answered: FIVE
Compulsory TWO Questions from UNIT I and UNIT II, and ANY ONE from the combination Question

Objectives:

- To equip learners with adequate skills to conceptualize, design and develop well-engineered web systems.
- To enable learners to apply free and open source web technologies for developing powerful and scalable web applications.

Pre-requisites: Programming language concepts, Computer Networks, Database Systems.

Course Outcomes: On successful completion of this course, students will be able to:

1. Identify the various terms and components of HTML, CSS, JavaScript, PHP and Drupal
2. Illustrate various components of web development languages
3. Connect different modules of open source technologies for website development
4. Select appropriate web technology for implementing solution to a given problem
5. Construct a web domain using appropriate tools and techniques

UNIT – I

Introduction [4 Hrs]
History of internet and world wide web, World Wide Web consortium, Web architecture, Web 2.0, HTTP protocol, Personal, distributed and client-server computing, **Web browser basics**, **Browser portability**.

HTML AND XHTML [4 Hrs]
Introduction, editing XHTML, w3c XHTML validation service, headers, linking, images, special characters, unsorted lists, nested and ordered lists, XHTML tables, XHTML forms, internal linking, **meta elements**.

HTML5 [6 Hrs]
HTML5 Basics, HTML5 Syntax ,New HTML5 Elements, Times and Dates, Browser Support, Semantic Formatting , New Input Types and Attributes, New Form Elements and Attributes, Playing Audio, Playing Video, **The Canvas**, **Other HTML5 Technologies**.

Style Sheets [6 Hrs]
Inline styles, embedded style sheets, conflicting styles, linking external style sheets, positioning elements, backgrounds, element dimensions, Box Model and text flow, Media Types, Building a CSS drop-down menu, **User style sheets**.

UNIT-II

JQuery and Ajax [5 Hrs]
JQuery: Introduction, What JQuery does, Functions, Selecting elements, Useful predefined Jquery functions, **Formatting elements**, Add page elements, Adding events, Ajax: Introduction to Ajax: Overview of Ajax; The basics of Ajax.

Server Side Programming [5 Hrs]
LAMP Technology, PHP: Origins and uses of PHP, Overview of PHP, General syntactic characteristic, Primitives, operations and expressions, Control statements, Looping, Arrays, Functions, Form handling, Files, **Cookies**, **Session tracking**.

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Database Access through the Web[3 Hrs]
Relational Databases, An introduction to SQL, **Architectures for Database access**, The MySQL Database system, Database access with with PHP and MySQL.

Case studies: Drupal as a Content Management System [8 Hrs]
Basics of CMS, Workflow management using CMS, Free and open source content management frameworks in PHP: **Wordpress**, **Joomla** and Drupal. Drupal: Drupal technology Stack in LAMP Platform, Drupal modules: Core, contributed and custom modules, Drupal Theme Configuration, Site Building: Content Type, Entity, Nodes, Views, Blocks, Taxonmoy, User management, **permission and roles**.

Text Books:
1.M. Deitel, P.J. Deitel, A. B. Goldberg, "Internet & World Wide Web How to program", 3rd Edition, Pearson Education, 4 th edition, PHI, 2011. 2. Robert W. Sebesta, "Programming the World Wide Web", 4th Edition, Pearson Education.

Reference Books:
1. Chris Bates, "Web Programming Building Internet Applications", 3rd Edition, Wiley India. 2. Joyce Farrell, XueBai, Michael Ekedahl, "The Web Warrior Guide to Web Programming", Thomson.

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Department of Computer Science and Engineering

C237 **CS 1442** **(2L+1T hrs/week)**

USER INTERFACE / USER EXPERIENCE DESIGN (UI/UX DESIGN)

Questions to be set having equal weightage/marks from each unit: SIX
TWO from UNIT I, TWO from UNIT II, and TWO from both UNIT I and UNIT II combined.
Questions to be answered: FIVE
Compulsory TWO Questions from UNIT I and UNIT II, and ANY ONE from the combination Question

Objective: To understand the basic process of web designing. To grasp the concept of user experience with respect to the user interface. To understand the trends of UI/UX development.
Prerequisites: Coordinate Geometry, Basic Computing Knowledge

Course Outcomes: On successful completion of this course, students will be able to:

1. Select and utilize design thinking processes and UX/UI tools,
2. Differentiate between user interface and user experience design
3. Discover how typography and layout enrich the user experience
4. Distinguish various tools available for user interface design
5. Assess various HCI (human-computer interaction) and the psychology behind user decision-making.

UNIT I

Introduction to UI/UX design history
What is UI? What is UX? History of UI and UX Design
UI Design Tools
Wireframing - Introduction, Designing Process, Picking Tools, Setting a grid and determine a layout box, Typography, Grayscale, Conclusion, UI Design and Prototyping – Introduction, General Prototyping Scheme ,Other Tools – Golden Ratio Typography Calculator, Zeplin
UX Design
Introduction – An overview of UX Design Process and Documentation, How They All Relate, Guiding Principles, Objective Processes In a Subjective Environment.
Defining a Product before Diving Into Design
Why Product Definition Matters, The Kickoff Meeting, Lean & Business Model Canvas, Concept Maps & Mockups, Defining Your Vision.

UNIT II

Researching Products before Diving Into Design
Why Research Matters, Market Segmentation Report, Survey Results, Heuristic Evaluations, User Research Report, Analytics Reports, Research, Test, Validate.
Analyzing Users Before Diving Into Design
Why Analysis is Important, Personas, User Stories & Job Stories, Defining Your Vision, User Task Matrix, User Content Matrix, Prioritized Requirements Spreadsheet.
Product Design Process & Documentation Essentials
Iterated Sketching & Wireframing, Detailed Mockups, Prototypes, Design Specifications, Define, Design and Refine.
Product Implementation Process & Documentation Essentials
Build It, Eat Your Own Dogfood, Feed Your Dogfood to Others, Use What Works and Scrap the Rest.
Product Launch Process & Documentation Essentials
Create a Product Launch, Plan, Create content to empower customers and sales teams, Pack a punch with your product launch.

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Text Books

1.Dominik Pacholczyk, Web UI Design Best Practices, UXPin
2. Jerry Cao, Chris Bank, The Guide To UX DESIGN PROCESS & DOCUMENTATION ,- UXPin - 2015
3.Frank Chimero, The Shape of Design, First Edition 2012, Licensed under the Creative Commons Attribution Non-Commercial Share-Alike 3.0 Unported License http://creativecommons.org/licenses/by-nc-sa/3.0/

References

1. https://pidoco.com/en/help/ux/user-interface-design
2. https://www.interaction-design.org/literature/topics/ui-design
3. https://ebooks.webflow.com/ebook/the-modern-web-design-process

Department of Computer Science and Engineering

C357 **CS 1539** **(2L + 1 T hrs/week)**

BIOLOGY

Questions to be set having equal weightage/marks from each unit: SIX
TWO from UNIT I, TWO from UNIT II, and TWO from both UNIT I and UNIT II combined.
Questions to be answered: FIVE
Compulsory TWO Questions from UNIT I and UNIT II, and ANY ONE from the combination Question

Objectives: This course aims to introduce the basics of biology such as cell structure and functions, inheritance & evolution, basic concepts of genetics, and an introduction to microbiology.

Pre-requisites: NIL

Course Outcomes: On successful completion of this course, students will be able to:

1. Describe how biological observations lead to major discoveries
2. Identify classification and Genetics in biology
3. Understand cell structure and functions, inheritance & evolution
4. Illustrate Macromolecular analysis and Metabolism
5. Identify introduction to microbiology.

UNIT I

Introduction [2 Hrs]
Biology as important a scientific discipline, differences between science and engineering using comparison of eye and camera, Bird flying and aircraft, need to study biology, Biological observations of 18th Century, examples from Brownian motion and the origin of thermodynamics .

Classification [3 Hrs]
morphological, biochemical or ecological criteria, Hierarchy of life forms at phenomenological level, classification based on (a) cellularity- Unicellular or multicellular (b) ultrastructure- prokaryotes or eucaryotes. (c) energy and Carbon utilization -Autotrophs,heterotrophs, lithotropes (d) Ammonia excretion – aminotelic, uricoteliec, ureotelic (e)Habitata- acquatic or terrestrial (e) Molecular taxonomy- three major kingdoms of life. Model organisms: E.coli, S.cerevisiae, D. Melanogaster,C. elegance, A. Thaliana, M. musculus.

Genetics [4 Hrs]
Discuss "Genetics is to biology what Newton's laws are to Physical Sciences", Mendel's laws, Concept of segregation and independent assortment. Concept of allele. Gene mapping, Gene interaction, Epistasis. Meiosis and Mitosis be taught as a part of genetics. Passes of genetic material from parent to offspring. Concepts of recessiveness and dominance, mapping of phenotype to genes, single gene disorders in humans, complementation using human genetics.

Biomolecules [4 Hrs]
Monomeric units and polymeric structures, sugars, starch, cellulose, Amino acids and proteins. Nucleotides and DNA/RNA, two carbon units and lipids.

Enzymes [4 Hrs]
Enzymology, enzyme catalyze reactions. Enzyme classification. Mechanism of enzyme action, Enzyme kinetics and kinetic parameters, RNA catalysis.

Information Transfer [4 Hrs]
Molecular basis of information transfer. DNA as a genetic material, Hierarchy of DNA structure- from single stranded to double helix to nucleosomes.

Macromolecular analysis [7 Hrs]
Proteins- structure and function. Hierarchy in protein structure. Primary secondary, tertiary and quaternary structure. Proteins as enzymes, transporters, receptors and structural elements.

Metabolism [4 Hrs]
Thermodynamics as applied to biological systems, Exothermic and endothermic versus endergonic and exergoinc reactions, Keq and its relation to standard free energy, Spontaneity.

Microbiology[4 Hrs]
Single celled organisms, Species and strains. Identification and classification of microorganisms, microscopy. Ecological aspects of single celled organisms, Sterilization and media compositions. Growth kinetics.

Text Books:
1. Biology: A global approach: Campbell, N. A.; Reece, J. B.; Urry, Lisa; Cain, M, L.; Wasserman, S. A.; Minorsky, P. V.; Jackson, R. B. Pearson Education Ltd.
2. Outlines of Biochemistry, Conn, E.E; Stumpf, P.K; Bruening, G; Doi, R.H., John Wiley and Sons.

Reference Books:
1. Principles of Biochemistry (V Edition), By Nelson, D. L.; and Cox, M. M.W.H. Freeman and Company.
2. Molecular Genetics (Second edition), Stent, G. S.; and Calender, R.W.H. Freeman and company, Distributed by Satish Kumar Jain for CBS Publisher.
3. Microbiology, Prescott, L.M J.P. Harley and C.A. Klein 1995. 2nd edition Wm, C. Brown Publishers.

Department of Computer Science and Engineering

C355 **CS 1531** **(2L +1T hrs/week)**

INFORMATION TRANSMISSION AND CODING THEORY

Questions to be set having equal weightage/marks from each unit: SIX
TWO from UNIT I, TWO from UNIT II, and TWO from both UNIT I and UNIT II combined.
Questions to be answered: FIVE
Compulsory TWO Questions from UNIT I and UNIT II, and ANY ONE from the combination Question.

Objectives: This course aims to offer a broad introduction to information theory and its real-world applications. Emphasizes are given on the theory and applications of entropy and information.

Pre-requisites: Basic mathematics & higher algebra and Probability concepts.

Course Outcome: On successful completion of this course, students will be able to:

1. Describe the principles and applications of information theory.
2. Differentiate the various types of coding schemes available in coding theory
3. Compare various error control encoding and decoding techniques
4. Compute amount of information in terms of entropy and apply in source coding and channel coding
5. Compose methods for analyzing the performance of error control codes

UNIT-I

Introduction [2 Hrs]
An overview of communication systems, Discrete systems, Continuous systems, Mixed systems.

Discrete noiseless systems [6 Hrs]
Discrete sources, Information content of discrete sources, Entropy as an information measure, Properties of entropy, Uncertainty and entropy, A source coding system, Fixed length and variable length codes, **Unique decipherability, Prefix codes, Kraft's inequality and Kraft's theorem,** The Noiseless coding theorem (Source coding theorem for a noiseless channel), Discrete noiseless channels, Capacity of discrete noiseless channels, Compression techniques.

Communication through discrete noisy channels [6 Hrs]
Representation of a discrete noisy channel, Discrete memory less channel, Examples of discrete noisy channels, Conditional entropy and mutual information, Properties of conditional entropy, Properties of mutual information, Average mutual information, Properties of average mutual information, Capacity of a discrete noisy channel, Properties of Channel Capacity.

Continuous systems [4 Hrs]
Continuous amplitude signals, Information measure of continuous signals, Entropy of continuous signals, Capacity of continuous signals.

UNIT-II

Coding for reliable digital transmission [3Hrs]
Types of channel codes, Maximum likelihood decoding, Types of errors, Error control strategies.

Linear block codes [4 Hrs]
Introduction to linear block codes, Syndrome and error detection, Minimum distance of block code, Error detecting and correcting capabilities of block codes, Standard array and syndrome decoding.

Cyclic codes [4 Hrs]
Generation of parity check matrices of cyclic codes, Encoding of cyclic codes, Syndrome computation and error detection, Decoding of cyclic codes.

BCH codes [4 Hrs]

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Encoding and decoding of BCH codes, Implementation of error correction, Non binary BCH codes and Reed Solomon Codes.

Convolution codes [6 Hrs]

Encoding of convolution codes, Structural properties of convolution codes, Distance properties of convolution codes, Maximum likelihood decoding of convolution codes, Sequential decoding of convolution codes, Majority logic decoding of convolution codes.

Text Books:

1. S. Lin and D. J. Costello, "Error Control Coding- Fundamentals and Applications", Prentice Hall, Inc. Englewood Cliffs, 1983.
2. T. M. Cover and J. A. Thomas, "Elements of Information Theory", Second Edition, Wiley Interscience, 2006.

Reference Books:

1. Bose, Ranjan, "Information theory coding and cryptography", Tata Mcgraw Hill, 2010.
2. Mackay, "Information theory, inference and learning algorithm", Cambridge University, 2004.
3. Gravano, Salvatore, "Introduction to error control codes", Oxford University Press.
4. Robert B. Ash, "Information theory", Dover Publishing Inc.

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Department of Computer Science and Engineering

C310 **CS 1532** **(2L +1T hrs/week)**

ADVANCED JAVA ROGRAMMING

Questions to be set having equal weightage/marks from each unit: SIX
TWO from UNIT I, TWO from UNIT II, and TWO from both UNIT I and UNIT II combined.
Questions to be answered: FIVE
Compulsory TWO Questions from UNIT I and UNIT II, and ANY ONE from the combination Question.

Objectives: This course covers the advanced topics in java programming such as collection framework, language package, Network Programming, GUI programming using AWT and Swings, advanced Web Programming using Servlet and JSP, and Accessing Database with Java.

Pre-requisites: Object Oriented programming, Database Management System, Computer Network and Distributed System.

Course Outcomes: On successful completion of this course, students will be able to:

1. Write program codes displaying competence in basic object-oriented programming using Java
2. Compare and able to develop scalable network applications using Java
3. Illustrate and practice component-based software.
4. Explain and able to conduct investigations of technical issues consistent with their level of knowledge on distributed applications.
5. Design and implement the understanding pertaining to database applications

UNIT- I

Java fundamentals [4 Hrs]
Java I/O streaming, Filter and pipe streams, **Byte code interpretation**, **Threading**, Swing.

Network programming in java [8 Hrs]
Sockets, secure sockets, custom sockets, UDP datagrams, Multicast sockets, URL classes, Reading data from the server, Writing data, Configuring the connection, Reading the header, **Telnet application**, Java messaging services.

Applications in distributed environment [10 Hrs]
Remote method invocation, activation models, RMI custom sockets, Object serialization, RMI, **IIOP implementation, CORBA, IDL technology, Naming services, CORBA programming models**, JAR file creation.

UNIT-II

Multi-tier application development [10 Hrs]
Server side programming, Servlets, Java server pages, Applet to applet communication, Applet to servlet communication, JDBC, Applications on databases, **Multimedia streaming applications**, **Java media framework**.

Enterprise applications [8 Hrs]
Server Side Component Architecture, Introduction to J2EE, Session Beans, Entity beans, **Persistent entity beans**.

Text Books:

1. Elliotte Rusty Harold, "Java Network Programming", Shroff.
2. Ed Roman, "Mastering Enterprise Java Beans", John Wiley & Sons.

Reference Books:

1. Patrick Naughton, "Complete Reference: Java2", Tata McGraw Hill.
2. Hortsmann& Cornell, "Core Java 2 Advanced Features, VOL II", Pearson education.

3. Amir Afzal, "Advanced Java Programming", Pearson.
4. Joe Wigglesworth, Paula McMillan, "Java Programming: Advanced Topics", Course Technology.

Department of Computer Science and Engineering

C356 **CS 1533** **(2L + 1 T hrs/week)**

SYSTEM PROGRAMMING

Questions to be set having equal weightage/marks from each unit: SIX
TWO from UNIT I, TWO from UNIT II, and TWO from both UNIT I and UNIT II combined.
Questions to be answered: FIVE
Compulsory TWO Questions from UNIT I and UNIT II, and ANY ONE from the combination Question.

Objective: This course emphasizes on systems programs: operating systems, assemblers, compilers, interpreters, macro processors and loaders. This course also discusses the design of the system programs: assembler, linkers and loaders.

Pre-requisites: Programming language Design, Data Structures and Microprocessor and Peripheral Devices.

Course Outcomes: On successful completion of this course, students will be able to:

1. Describe the evolution of Programming and understand how an Operating and other system software have evolved since its inception.
2. Examine various system programs and it's usage for proper functioning of Computer System.
3. Analyze the theory and design the procedure for implementing assembler and macro-processor system programs.
4. Compare various program loading schemes and discuss issues pertaining to design of some loading schemes.
5. Understand the basic concepts of Compiler Program and issues related to its design.

UNIT I

Scope of Systems Programming and Background [7 Hrs]
Introduction to application software and systems software, Concept of hardware, System software concept, System design and methods of system design, Properties of good and structured system, **Software and software hierarchy**, Machine structure, **Components of a system programming, Evolution of Operating Systems, Operating System functions.**

General machine structure and machine language [3 Hrs]
General machine structure, Instruction set, Machine language, Assembly language (IBM-360).

Assemblers [5 Hrs]
Assemblers, General design procedure, Design of assembler: One pass assembler, **Two pass assembler.**

Macros [5 Hrs]
Macros language and macro processer: Macro instruction arguments, Conditional macro expansion, Macro calls within macros, Macro instructions defining macros, **Implementation of restricted facility: A two pass algorithm.**

UNIT II

Loaders [8 Hrs]
Loaders, Loader schemes, Compile and go loaders, General loader scheme: Absolute loaders, Subroutine linkages, Relocating loader, Loader schemes binders, Linking loaders, Overlays, Dynamic binders, Design of an absolute loader and **design of a direct linking loader**.

Language processor [8 Hrs]
Introduction, Language processing activities, Fundamentals of language processing, Fundamentals of language specification, **Language processor development tools**.

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Compilers [4 Hrs]

Introduction to compilers, Aspects of compilation, **Memory allocation**, Compilation of expressions, Compilation of control structures, **Code optimization, Interpreters.**

Text Books:

1. John J. Donovan, "Systems Programming", Tata McGraw Hill.
2. Srimanta Pal, "Systems Programming", Oxford.

Reference Books:

1. D M Dhamdhere, "Systems Programming & Operating Systems", Tata McGraw Hill.
2. Aho, Ulmann, Sethi , "Compiler Design", Pearson Education.
3. Leland L.Beck, D.Manjula, "System Software-An Introduction to System Programming", Pearson
4. A.C. Shalini, "System Software", SCITECH Publication.

Department of Computer Science and Engineering

C304 **CS 1534 /CS 1507** **(2L + 1 T hrs/week)**

DISCRETE STRUCTURE

Questions to be set having equal weightage/marks from each unit: SIX
TWO from UNIT I, TWO from UNIT II, and TWO from both UNIT I and UNIT II combined.
Questions to be answered: FIVE
Compulsory TWO Questions from UNIT I and UNIT II, and ANY ONE from the combination Question.

Objective: This course emphasizes on mathematical structures for describing data, algorithms and computing machines. Theory and Applications of sets, relations, functions, combinatorics, matrices, graphs and algebraic structures, which are pertinent to computer science are also covered.

Pre-requisites: Data Structures and Concepts of algorithms. Some programming experience is helpful but not necessary.

Course Outcomes: On successful completion of this course, students will be able to:

1. Identify effectively algebraic techniques to analyze basic discrete structures and algorithms.
2. Apply the concepts of sets, integers, reals and functions of such quantities to solve simple problems
3. Understand and relate the graphs and related discrete structures to practical examples
4. Understand the notion of mathematical and algorithmic thinking and apply them for problem solving
5. Infer logical reasoning to solve a problem

UNIT-I

Sets [2 Hrs]
Definition, **Operations, Counting, Comparing the size of sets, Countable sets**, Diagonalization, Limits of computability, Bags (multisets).

Ordered structures [3 Hrs]
Tuples, Lists, Strings and languages, Relations.

Inductively defined sets [5 Hrs]
Numbers, Strings, Lists, Binary trees, Cartesian products of sets.

Recursive functions and procedures [6 Hrs]
Numbers, Strings, Lists, Binary trees, Infinite sequences, Recursion in programs, Repetitive program design.

Propositional calculus [4 Hrs]
Well-formed formulas and semantics, Equivalence, Truth functions and normal forms.

UNIT-II

Predicate logic [5 Hrs]
Predicates, Qualifiers, Well-formed formulas, Semantics and interpretations, Validity, Equivalence, Normal Forms, Formalizing English sentences.

Program logic [5 Hrs]
Equality, Imperative program correctness, **Array assignment**, Termination.

Automatic reasoning [5 Hrs]
Clauses, Propositions, Substitution and unification, Resolution, Logic programming: Family trees, Logic program, Logic programming techniques.

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Algebraic structures and abstract data types [5 Hrs]

Natural numbers, Lists and strings, Stacks and queues, **Binary trees** and Priority queues, **Abstract arrays, Container classes**.

Text Books:

1. James L. Hein, "Discrete Structures, Logic and Computability", Narosa.
2. J.P. Tremblay, R.Manohar, "Discrete Mathematical Structures with Applications to Computer Science", Tata McGraw Hill.

Reference Books:

1. Leon S. Levy, "Eastern, Discrete Structures of Computer Science", Wiley
2. C.L.Liu, "Elements of Discrete Mathematics", McGraw-Hill.
3. Bruce Mills, "Theoretical Introduction to Programming" , Springer.
4. Fletcher R. Norris, "Discrete structures: An introduction to mathematics for computer science" Prentice Hall.

Department of Computer Science and Engineering

C314 **CS 1535/CS 1636** **(2L +1T hrs/week)**

GRAPH THEORY

Questions to be set having equal weightage/marks from each unit: SIX
TWO from UNIT I, TWO from UNIT II, and TWO from both UNIT I and UNIT II combined.
Questions to be answered: FIVE
Compulsory TWO Questions from UNIT I and UNIT II, and ANY ONE from the combination Question.

Objectives: This course provides a formal introduction to the theory of graphs including paths, circuits, trees, matrix representation of graphs and their applications. The goal of this course is to make students aware of how graphs are used to model different situations and processes with special emphases on computer science and engineering applications.

Pre-requisites: Data Structures, Concepts of algorithms, Engineering mathematics and Programming concepts.

Course Outcomes: On successful completion of this course, students will be able to:

1. Distinguish competence in graphical modelling of problems
2. Compute a solution process using graph theoretical concepts and analyze results for multiple problems
3. Illustrate and interpret a graph model.
4. Develop diverse set of alternative design solutions for multiple problems
5. Analyze and interpret the results using contemporary tools.

UNIT- I

Introduction [2 Hrs]
Definitions, applications of graph in Diagram tracing, Konigsberg bridge problem, **Chinese postman problem, DNA fragment assembly, floor design, Knight's tour, Integer programming,** Solution to the travelling salesman problem. Isomorphism, walks, paths, circuits, connected, disconnected, graphs, operations in graphs-Euler & Hamilton graphs.

Tree [5 Hrs]
Properties, distance &centers, binary trees, fundamental circuits, minimal spanning tree.Tree traversal. Applications of Tree in manipulating hierarchical data, **Parse tree, File system**, manipulate sorted lists of data, **workflow for compositing digital images for visual effects and Routing algorithms.**

Cut sets [4 Hrs]
Properties, Fundamental circuits and cut sets, connectivity, separatability network flows, 1-2 isomorphism. Applications of cut sets to solve graph models for reliability analysis, **identify potential single point failures in a modelled system, state equation for network and superposition network theorem.**

Planar and dual graphs [4 Hrs]
Combinational representation, planar graphs, Kuratowshi's graphs detection of planarity, dual graphs. Applications of planar graphs in image segmentation, **shape matching, extended modeling capabilities, route planning.**

Matrix representation of graph [5Hrs]
Incidence matrix, circuit matrix, cut set matrix, fundamental matrices, relationships among matrices, path matrix, and adjacency matrix. Applications of Matrix in computer programming language for the computation of path or circuit.

UNIT-II

Coloring, covering & partitioning [6 Hrs]
Chromatic number, chromatic partitioning, matching, covering, four color problem.Coloring and covering concepts used in pattern matching, **register allocation, frequency assignment in GSM,**

time tabling, scheduling and computer network security.

Directed graphs [6 Hrs]
Different types, directed path, and connectedness, Euler digraphs, Trees, matrix representation, tournament. **Directed graphs used in compiler construction, finite state machine, combinational circuit design,** traffic flow problem.

Graph theoretic algorithms [5 Hrs]
Computer representation of graphs, Input / output. Devising algorithms for connectedness, a spanning tree, fundamental circuits, cut vertices, directed circuits, shortest paths. **Applications of Graph theoretic algorithm in worm propagation, workflow for compositing digital images for visual effects, routing algorithms.**

Applications [3Hrs]
Graph in sequential switching networks, graph in coding theory, graph in signal flow graph, graph in markov process, and graphics in computer programming. Applications in code generation, sequential switching networks, graphics.

Text Books:
1. N.Deo, "Graph Theory with applications to Engineering and Computer Science", PHI
2. Jonathan L. Gross and Jay Yellen, "Graph Theory and Its Applications", CRC Press.

Reference Books:
1. M. N. S. Swamy, K. Thulasiraman, "Graphs, Networks & Algorithms", Wiley Interscience.
2. F. Harary, "Graph Theory", Narosa.
3. Jonathan L. Gross and Jay Yellen, "Handbook of Graph Theory", CRC Press.
4. Jonathan L. Gross and Thomas W. Tucker, "Topological Graph Theory", Dover

Department of Computer Science and Engineering

C311 **CS 1536/CS 1638** **(2L +1T hrs/week)**

SYSTEM SIMULATION AND MODELING

Questions to be set having equal weightage/marks from each unit: SIX
TWO from UNIT I, TWO from UNIT II, and TWO from both UNIT I and UNIT II combined.
Questions to be answered: FIVE
Compulsory TWO Questions from UNIT I and UNIT II, and ANY ONE from the combination Question.

Objectives: This course envisages the fundamentals of discrete event simulation (DES), which includes discrete event simulation methodology, development of simulation models, verification and validation, and the design of simulation experiments.

Pre-requisites: Probability & Statistics and System Analysis concepts.

Course Outcomes: On successful completion of this course, students will be able to:

1. Explain the understanding of mathematical modeling through use in computer system modelling and simulations
2. Describe the system behavior in investigating discrete event simulation, modeling and system dynamics
3. Develop simulation models
4. Test validity of model through analysis of output data
5. Simulate the models for the purpose of optimum control by using different software.

UNIT – I

Introduction to Simulation [5 Hrs]
Components of a system, Model of a system, Types of models, Discrete and continuous systems, Components and organization of a discrete event simulation model, Continuous simulation, **Combined discrete-continuous simulation,** Monte Carlo simulation, Steps in simulation study, Advantages Disadvantages, and **pitfalls of simulation.**

Simulation Examples [3 Hrs]
Simulation of Queuing systems, Simulation of inventory systems, Simulation of Reliability Systems.

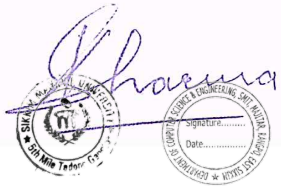
General Principles and Modeling Complex Systems [5 Hrs]
The event scheduling approach, The process interaction approach, The activity scanning approach, List processing in simulation: Approaches to storing lists in a computer, Time-shared computer model, **Multi-teller Bank with Jockeying, Job-Shop Model, Efficient event-list manipulation.**

Statistical Models in Simulation [2 Hrs]
Review of terminology and concepts, Useful statistical models, discrete distributions, Continuous distributions.

Queueing Theory [5 Hrs]
Characteristics of queuing systems, Queueing Notations, Transient and Steady-State behaviour of Queues, Long –Run measures of performance of Queueing Systems, Steady state behavior of Infinite population Morkovian models [M/G/1 only], **Networks of Queues.**

UNIT – II

Random Number Generation [4 Hrs]
Properties of random numbers, Generation of pseudo random numbers, Random-Number Generators : Linear Congruential Generators, Combined Linear Congruential Generators, **Feedback Shift Register Generators, Tests for Random Number Generators**. Building Valid, Credible, and Appropriately Detailed.



Simulation Models [4 Hrs]

Guidelines for determining the level of Model Details, Verification of Simulation Computer Programs, Techniques for increasing Model Validity and Credibility, **Statistical Procedures for Comparing Real-World Observations and Simulation Output Data.**

Selecting Input Probability Distributions [5 Hrs]

Identifying the distribution with data, Estimation of Parameters, Determining how representative the fitted distributions are, Selecting input Models in the absence of data, Models of arrival Processes(Poisson process, Non stationary Poisson process, batch arrivals).

Output Data Analysis for a Single System [4 Hrs]

Transient and Steady State behavior of a stochastic process, Types of simulations with respect to output analysis.

Experimental Design [3 Hrs]

Common mistakes in experimentation, Types of Experimental Designs, 2k factorial Designs, **2kr factorial Designs.**

Text Books:

1. Averill M Law, "Simulation Modeling and Analysis", Tata McGraw Hill.
2. Banks, Carson, Nelson, Nicol, "Discrete-Event System Simulation", Pearson Education.

Reference Books:

1. Raj Jain, "The Art of Computer Systems Performance Analysis: Techniques for Experimental Design, Measurement, Simulation, and Modeling", John Wiley & Sons.
2. Gordon, "System Simulation", Prentice Hall.
3. Singh V.P, "System Modeling and Simulation", New Age International.
4. Frank L. Severence, "System ModelingAnd Simulation: An Introduction", Wiley.

Department of Computer Science and Engineering

C315 **CS 1537** **(2L +1T hrs/week)**

ADVANCED WEB TECHNOLOGIES

Questions to be set having equal weightage/marks from each unit: SIX
TWO from UNIT I, TWO from UNIT II, and TWO from both UNIT I and UNIT II combined.
Questions to be answered: FIVE
Compulsory TWO Questions from UNIT I and UNIT II, and ANY ONE from the combination Question.

Objective: To enable learners to understand and apply the various steps in designing a creative and dynamic website using latest web technologies.

Pre-requisites: Fundamentals of Web Technologies.

Course Outcomes: On successful completion of this course, students will be able to:

1. Define the basic terms of HTML, CSS and JavaScript
2. Identify appropriate web based technologies for developing dynamic webpages
3. Choose an appropriate database language and technologies for conecting front end to backend
4. Distinguish major frameworks for development of web services and cloud applications
5. Test appropriate content management system for developing scalable websites

UNIT – I

Mark-up Language [6 hrs]
Mark-up languages, XML, Uses of XML. WELL-FORMED XML: Parsing XML, Tags,text, elements, attributes, comments and empty elements. XML Declaration, Processing Instructions, **Errors in XML** XML NAMESPACES: Need for namespaces, How XML namespaces work, URIs, **When to use namespace**.

Javascript[6 hrs]
Introduction, Obtaining user inputs, memory concepts, Operators, Control Structures, Looping constructs, break, continue statements, Programmer defined functions, Scoping rules, **Recursion and iteration**, Array declaration and allocation, passing arrays to function, Objects: String, Date, Boolean, Window, document; using cookies, Handling Events Using JavaScript.

Web Optimization & SEO [8 hrs]
Web Browsers, Caching, Downloading and Rendering, Persistent Connections, DNS caching and prefetching, Buffering, Weblog Optimization and Security: Parallel Downloading, Controlling caches, Content compression, Load balancers, Tuning MYSQL, Using query caching, **Optimizing query execution and optimization**

Search engines: Searching techniques used by search engines, keywords, Search engine optimization for individual web pages: header entries, tags, selection of URL, alt tags, Search engine optimization for entire website, Google analytics.

UNIT II

Advanced PHP [12 hours]
Installing and Configuring MySQL and PHP, Basic Security Guidelines, Variables, Data Types, Operators and Expressions, Constants, Flow Control Functions; Switching Flow, Loops, **Code Blocks and Browser Output**, Form processing, Connecting to database, using cookies, dynamic contents, Validating User Input, Handling and Avoiding Errors, **Configuring email with PHP**.

Web services & Content Management System [8 hrs]
Web services, Design and modelling of web services, Introduction to Service Oriented Architecture, combining protocols to build Web services – clarifying web services, REST Services, WS-* Web services

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using SOAP and WSDL, **REST vs WS-* services**, Case Study: Drupal as open source content management system – **Site building**, **Site configuration** and Module development.

Text Books:

1. Deitel H.M., Deitel P.J., "Internet & World Wide Web: How to program", Pearson Education.
2. Boronczyk, Naramore, "Beginning PHP, Apache, MySQL Web Development", Wiley India Pvt. Ltd.

Reference Books:

1. Peter Smith, "Professional Website performance", Wiley India Pvt. Ltd.
2. Kogent Learning, "Web Technologies: HTML, JavaScript, PHP, Java, JSP, XML, AJAX Black Book", Wiley India Pvt. Ltd.

Department of Computer Science and Engineering

C316 **CS 1538/ CS 1601** **(2L + 1 T hrs/week)**

OBJECT ORIENTED ANALYSIS AND DESIGN USING UML

Questions to be set having equal weightage/marks from each unit: SIX
TWO from UNIT I, TWO from UNIT II, and TWO from both UNIT I and UNIT II combined.
Questions to be answered: FIVE
Compulsory TWO Questions from UNIT I and UNIT II, and ANY ONE from the combination Question.

Objective: This course delves into the processes of both object-oriented analysis and object-oriented design using UML as the notation language to provide a common, standard notation for recording both analysis models and design artifacts. Facets of the Unified Process approach to designing and building a software system are also covered.

Pre-requisites: Object oriented Design concepts, Design & Analysis of Algorithms and software engineering.

Course Outcomes: On successful completion of this course, students will be able to:

1. Identify object oriented design techniques suitable for a complex problem
2. Demonstrate an ability to formulate a solution plan and methodology for an engineering problem using object oriented analysis and design using UML.
3. Determination of the formula and interpretation of a model for project management.
4. Investigate a problem to identify technical issues and solve the problems using various object oriented design tools and techniques.
5. Design real-life application using modern UML tools, techniques and resources.

UNIT I

Introduction [2 Hrs]
Challenges in Software Engineering, Complexity of Software, Structure and Attributes of a Complex System, Evolution of Object Models - Programming Languages and Paradigms , Foundations of the Object Model - OOA, OOD and OOP, **About Object Orientated Technology,** Development and OO Modeling History.

Modeling Concepts [4 Hrs]
Elements of Object Model-Abstraction and Encapsulation, Modularity and Hierarchy, Typing, Concurrency and Persistence, Nature of an object: State, Behavior and Identity, Relationships among objects, **Modeling design Technique,** Three models- Class Model, State model and Interaction model. Overview of UML

Class Modeling [6 Hrs]
Nature of a class: Interface and Implementation, Relationships among classes, Object and class concepts, link and association, **Generalization and Inheritance,** Advanced class modeling- aggregation, Abstract class metadata, constraints. How to build quality Classes and Objects.

State Modeling [6 Hrs]
Event, state, Transition and conditions, state diagram, state diagram behavior, concurrency, Relation of Class and State models.

Interaction Modeling [2 Hrs]
Notations, Relationships and Examples - Use case Models, sequence models, activity models.

UNIT II

Analysis and Design [7 Hrs]
Development Life cycle, Development stages, Domain Analysis-Domain class model, domain state model, domain interaction model, Iterating and analysis. Application Interaction model, Application class model, Application state Model, Adding operation.

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System Design [7 Hrs]

Estimating Performance, **Making a reuse plan**, breaking system into subsystems ,identifying concurrency, allocation of subsystems, management of data storage, Handling Global resources, choosing a software control strategy, Handling boundary condition, common Architectural style.

Class design [6 Hrs]

Overview of class design, designing algorithms, recursing downward, refactoring, design optimization, **Adjustment of Inheritance, Reification of Behavior.**

Text Books:

1. Michael R Blaha, James R Rumbaugh, "Object-Oriented Modeling and Design with UML", Pearson.
2. Ali Bahrami, "Object Oriented Systems using the United Modeling Language", McGraw Hill.

Reference Books:

1. Grady Booch, James Rumbaugh, Ivar Jacobson, "The Unified Modeling Language", Pearson Education.
2. Grady Booch, "Object Oriented Analysis and Design", Pearson Education.
3. Graig Larman, "Applying UML and Patterns", Addison Wesley.
4. Perdita Stevens, Rob Pooley, "Using UML Software Engineering with Objects and Components",Pearson.

Department of Computer Science and Engineering

C340 **CS 1540/ CS 1632** **(2L +1T hrs/week)**

BIOINFORMATICS

Questions to be set having equal weightage/marks from each unit: SIX
TWO from UNIT I, TWO from UNIT II, and TWO from both UNIT I and UNIT II combined.
Questions to be answered: FIVE
Compulsory TWO Questions from UNIT I and UNIT II, and ANY ONE from the combination Question.

Objectives: The course is designed to introduce the basic concepts, methods, and tools used in Bioinformatics. The objective is to help the students to reach rapidly the frontier of bioinformatics and working knowledge of a variety of publicly available data and the bioinformatics tools in handling flood of biological data and to solve the problems on their own research. The course also highlights the programming paradigm of Bioinformatics.

Pre-requisites: Concept of Algorithms, Probability and Statistics and Knowledge of Biology.

Course Outcomes: On successful completion of this course, students will be able to:

1. Describe basic principles and concepts of biology, computer science and mathematics
2. Choose suitable computational models to solve the problem for a given biological sequence analysis problem
3. Compare various approaches of data analysis by evaluating their advantages and disadvantages
4. Analyze various bioinformatics tools for handling biological data and to solve problems by applying acquired knowledge, facts, techniques and rules in a different way.
5. Develop computer programs for bioinformatics data analysis.

UNIT I

Bioinformatics an Overview [7 Hrs]
Definition and history, Information networks, Internet in bioinformatics, EMBnet, Commercial databases and software's, **Intranet and internet packages**, Bioinformatics glossary.

Bioinformatics Programming using Perl [10 Hrs]
Basics of programming PERL, Basics, String handling, subroutines.**HTML basics, Tags, Text handling, Image handling, Links, Frames and tables. XML Basics,** Data binding and record sets.

UNIT II

Protein Information Resources [10 Hrs]
Biological databases, Primary sequence databases, Composite protein sequence databases, - Secondary databases, Prosite, Prints, **Blocks profiles and identity.**

Genome Information Resources [8 Hrs]
DNA sequence databases, EMBL DDBJ, Genbank GSDB (Genome, Sequence database), **UniGene**.

Evolution of Bioinformatics [5 Hrs]
Scope, Potentials of bioinformatics, Human genome project, **Bioinformatics in India**, Future of bioinformatics.

Text Books:

1. Arthur M. Lesk, Introduction to Bioinformatics, Oxford University Press, New Delhi
2. T.K. Attwood and D.J. Parry-Smith, Introduction to Bioinformatics, Pearson Education Ltd., New Delhi

Reference Books:

1. D. Higgins and W. Taylor (Eds), Bioinformatics- Sequence, structure and databanks, Oxford

University Press, New Delhi

2. Baxevanisand B.F. Ouellette. Bioinformatics: A practical Guide to the Analysis of Genes and Proteins, Wiley-Interscience, Hoboken, NJ
3. S. R. Swindell, R.R.Miller and G.S.A.Myers (Eds.), Internet for the Molecular Biologist, Horizon Scientific Press, Wymondham, UK
4. Andrea Cabibbo, Richard Grant and Manuela Helmer-Citterich (Eds.), The Internet for Cell and Molecular Biologists (2nd Edn.), Horizon scientific Press, Norwich, UK

Department of Computer Science and Engineering

C341 **CS 1541/ CS 1633** **(2L +1T hrs/week)**

DIGITAL IMAGE PROCESSING

Questions to be set having equal weightage/marks from each unit: SIX
TWO from UNIT I, TWO from UNIT II, and TWO from both UNIT I and UNIT II combined.
Questions to be answered: FIVE
Compulsory TWO Questions from UNIT I and UNIT II, and ANY ONE from the combination Question.

Objectives: The objective of this course is to provide the students a general understanding of the fundamentals of digital image processing. It also introduces analytical tools which are currently used in digital image processing. By the end of the course student will be able to develop any software/programs that uses image enhancement, segmentation, restoration, enhancement, representation and description, etc.

Pre-requisites: Computer Graphics, Engineering Mathematics and Probability & Statistics

Course Outcomes: On successful completion of this course, students will be able to:

1. Describe the fundamental concepts of a digital image processing system.
2. Analyze images in the spatial domain using mathematical transformation function.
3. Write the procedure for implementing various image enhancement techniques.
4. Interpret image segmentation and representation techniques.
5. Select the morphological operation for extracting different features from an image.

UNIT I

Introduction [2 Hrs]
Introduction to Digital Image, Digital image representation, Fundamental steps in Image Processing, Elements of DIP systems.

Digital Image Fundamentals [5 Hrs]
Elements of Visual Perception, Image formation, Sampling and Quantization, Relationships between pixels, Linear and Nonlinear operations, Basics of Image Interpolation and Re-sampling: Zooming and Shrinking.

Image Enhancement in Spatial domain and frequency Domain [10 Hrs]
Enhancement by Point Processing, Histogram Processing, Mask Processing examples, Different noise model, Various Spatial Filtering. Introduction to the Fourier Transform, The discrete Fourier Transform, Properties of the two-dimensional Fourier Transform, Smoothing Frequency-domain filters, Sharpening Frequency domain filters.

Image Compression [3 Hrs]
Fundamentals, Image Compression Models, **Error Free Compression, Lossy Compression**.

UNIT II

Image Segmentation [6 Hrs]
Similarity based and dissimilarity based image segmentation, various threshold techniques, Point, Line and Edge detection, Region Growing, K-means segmentation. Various Color models and color image Segmentation and Other color image processing.

Image Morphology [4 Hrs]
Introduction of image morphology and its properties. Basic morphological operation-erosion and dilation and its application. Advanced morphological operation- open, close and hit-or-miss transformation. Other advanced morphological operation- thickening, thinning, skeletonization, boundary extraction, region filling.

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Representation and Description [5 Hrs]

Various Representation and description Schemes, Different types of Boundary Descriptors and Regional Descriptors.

Object Recognition [5 Hrs]

Patterns and Pattern Classes, Recognition based on Decision-theoretic methods, structural methods.

Text Books:

1. Rafael C Gonzalez, Richard E Woods, "Digital Image Processing", Pearson Education Publications.
2. RajjanShinghal, "Pattern Recognition", Oxford Publications.

Reference Books:

1. Chanda and Majumder, "Digital Image Processing and Analysis", Prentice Hall Publications.
2. Rafael C Gonzalez, Richard E Woods, "Digital Image Processing with Matlab", Pearson Education Publications.
3. S. Sridhar, "Digital Image Processing", Oxford University Press.
4. Jayaraman, "Digital Image Processing", McGraw Hill.

Department of Computer Science and Engineering

C358 **CS 1542 / CS 1635** **(2L +1T hrs/week)**

EMBEDDED SYSTEMS

Questions to be set having equal weightage/marks from each unit: SIX
TWO from UNIT I, TWO from UNIT II, and TWO from both UNIT I and UNIT II combined.
Questions to be answered: FIVE
Compulsory TWO Questions from UNIT I and UNIT II, and ANY ONE from the combination Question.

Objective: Explores the fundamentals of embedded system hardware design. Issues such as embedded processor selection, hardware/software partitioning, glue logic, circuit design, circuit layout, circuit debugging, development tools will be discussed in reference of microcontrollers.

Pre-requisites: Digital Logic and Circuit Design, Computer Organization and Architecture, Micro-processors and peripheral devices, PC hardware and peripherals.

Course Outcomes: On successful completion of this course, students will be able to:

1. Identify the internal architecture and interfacing of different peripheral devices with Microcontrollers
2. Understand hardware and software design requirements of embedded systems
3. Analyze the role of embedded systems in industry
4. Evaluate the requirements of programming Embedded Systems, related software architectures and tool chain for Embedded Systems
5. Design real time embedded systems using the concepts of RTOS.

UNIT-I

An overview of embedded system [4 Hrs]
Definition and Categories of embedded systems, Requirements of embedded systems, Challenges and issues in embedded systems, **Trends in embedded software development.**

Application of embedded systems [4 Hrs]
Application market segments, Control systems and industrial automation, Networks information appliances, telecommunications, Wireless communications.

Hardware architectures for embedded systems [7 Hrs]
Hardware architecture, Processor, Memory, Latch and buffers crystal, Reset circuit, ADC & DAC, Application specific control circuitry, Display units, Keypads, Example 8031 based control systems, **The Smart card case study**, **A micro controller architecture, The 8051 architecture 16 bit and 32 bit processors**, DSP architecture, communication interface standards, Development tools, **Hardware and software interaction.**

Developing for embedded systems [7 Hrs]
Embedded system development process coding issues, Verification of software on host and embedded system, Embedded software development environments operating systems, Embedded operating systems, Task scheduling in embedded systems, Context switch, Task synchronization timers, **Types of embedded operating systems Programming languages, Structure of a C compiler**, Java programming language development tools for target processors, Implementing embedded systems.

UNIT-II

Mobile network and RT embedded system [6 Hrs]
Serial communication programming, Development of a navigation system development environment, Project overview, Embedded applications over mobile networks development environment, Example projects, Real time embedded development.

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Embedded database applications [4 Hrs]
Development environment, Salary survey.

Networked Java enabled information appliances [6 Hrs]
Development environment, Customer relations management software embedded process control system, **Mobile Java Applications**, Software development in windows XP embedded development environment, **Remote control of an air conditioner**, Typing speed indicator, Electronic voting.

Future Trends in embedded systems [2 Hrs]

Text Books:

1. Dreamtech S/W. team, "Programming for embedded systems cracking the code", Wiley.
2. Arnold S. Berger, "Embedded systems design: An introduction to processes, tools and techniques", CMP Books.

Reference Books:

1. Jean J. Labrosse, "Embedded systems building blocks", CMP Books.
2. Jack Ganssle, "The art of designing embedded systems", Elsevier.
3. Tammy Noergaard, "Embedded systems architecture: A comprehensive guide for engineers and programmers (Embedded technology"), Elsevier.
4. Qing Li, "Real time concepts for embedded systems", Elsevier.

Department of Computer Science and Engineering

C359 **CS 1543** **(2L +1T hrs/week)**

LOW POWER CIRCUITS AND SYSTEMS

Questions to be set having equal weightage/marks from each unit: SIX
TWO from UNIT I, TWO from UNIT II, and TWO from both UNIT I and UNIT II combined.
Questions to be answered: FIVE
Compulsory TWO Questions from UNIT I and UNIT II, and ANY ONE from the combination Question.

Objectives: The course covers fundamentals of low power circuit and system design.
Pre-requisites: Digital Circuits, Embedded Systems.
Course Outcomes: On successful completion of this course, students will be able to:

1. Explain the sources of power dissipation in MOS devices
2. Classify the special techniques to mitigate the power consumption in VLSI circuits
3. Summarize the power optimization and trade-off techniques in digital circuits
4. Compare the power estimation at logic and circuit level
5. Formulate the software design for low power in various level

UNIT I

Basics of MOS circuits [6 Hrs]
MOS Transistor structure and device modeling; MOS Inverters; MOSCombinational Circuits – Different Logic Families

Sources of Power dissipation [6 Hrs]
Dynamic Power Dissipation: Short Circuit Power; Switching Power; Gliching Power: Static Power Dissipation.

Supply Voltage Scaling Approaches [3 Hrs]
Device feature size scaling; Multi-Vdd Circuits.

Architectural level approaches [5 Hrs]
Parallelism, Pipelining; Voltage scaling using high-level transformations; Dynamic voltage scaling; Power Management.

UNIT II

Switched Capacitance Minimization Approaches [7 Hrs]
Hardware Software Tradeoff; Bus Encoding; Two's complement Vs Sign Magnitude; Architectural optimization; Clock Gating; Logic styles

Leakage Power minimization Approaches [7 Hrs] **Variable-threshold-voltage CMOS (VTCMOS) approach; Multithreshold-voltage CMOS (MTCMOS) approach**; Dual-Vt assignment approach (DTCMOS); Transistor stacking.

Switching and Synthesis [6 Hrs]
Adiabatic Switching Circuits; Battery-aware Synthesis; Variation tolerant design

Text Books

1. Sung_Mo Kang, Yusuf Leblebici, CMOS Digital Integrated Circuits, Tata McGraw Hill
2. Neil H. E. Weste and K. Eshraghian, Principles of CMOS VLSI Design, 2nd Edition, Addison Wesley (Indian reprint).

Reference Books:

1. A. Bellamour, and M. I. Elmasri, Low Power VLSI CMOS Circuit Design, Kluwer Academic Press, 1995
2. Anantha P. Chandrakasan and Robert W. Brodersen, Low Power Digital CMOS Design, Kluwer Academic Publishers, 1995
3. Kaushik Roy and Sharat C. Prasad, Low-Power CMOS VLSI Design, Wiley-Interscience, 2000

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Department of Computer Science and Engineering

C360 **CS 1544** **(2L +1T hrs/week)**

INFORMATION RETRIEVAL

Questions to be set having equal weightage/marks from each unit: SIX
TWO from UNIT I, TWO from UNIT II, and TWO from both UNIT I and UNIT II combined.
Questions to be answered: FIVE
Compulsory TWO Questions from UNIT I and UNIT II, and ANY ONE from the combination Question.

Objectives:

- Learn the information retrieval models.
- Be familiar with Web Search Engine.
- Be exposed to Link Analysis.
- Understand Hadoop and Map Reduce.
- Learn document text mining techniques.

Pre-requisites: Data Mining, Artificial Intelligence
Course Outcomes: On successful completion of this course, students will be able to:

1. Define information retrieval models.
2. Develop Web Search Engine.
3. Analyze the different tools, techniques and algorithms with an experiment.
4. Experiment with Hadoop and Map Reduce.
5. Select appropriate tools and techniques.

UNIT I

Introduction [6 Hrs]
Introduction -History of IR- Components of IR - Issues –Open source Search engine Frameworks - The impact of the web on IR - The role of artificial intelligence (AI) in IR – IR Versus Web Search - Components of a Search engine- Characterizing the web.

Information Retrieval [6 Hrs]
Boolean and vector-space retrieval models- Term weighting - TF-IDF weighting- cosine similarity – Preprocessing - Inverted indices - efficient processing with sparse vectors – Language Model based IR - Probabilistic IR –Latent Semantic Indexing - Relevance feedback and query expansion.

Web Search Engine – Introduction and Crawling [8 Hrs]
Web search overview, web structure, the user, paid placement, search engine optimization/ spam. Web size measurement - search engine optimization/spam – Web Search Architectures - crawling - meta-crawlers- Focused Crawling - web indexes –- Near-duplicate detection - Index Compression - XML retrieval.

UNIT II

Web Search – Link Analysis and Specialized Search [10 Hrs]
Link Analysis –hubs and authorities – Page Rank and HITS algorithms -Searching and Ranking – Relevance Scoring and ranking for Web – Similarity - Hadoop & Map Reduce - Evaluation -Personalized search - Collaborative filtering and content-based recommendation of documents and products – handling "invisible" Web - Snippet generation, Summarization, Question Answering, Cross- Lingual Retrieval.

Document Text Mining [6 Hrs]
Information filtering; organization and relevance feedback – Text Mining -Text classification and clustering - Categorization algorithms: naive Bayes; decision trees; and nearest neighbor - Clustering algorithms: agglomerative clustering; k-means; expectation maximization (EM).

Text Books:

1. C. Manning, P. Raghavan, and H. Schütze, Introduction to Information Retrieval , Cambridge University Press, 2008.

2. Ricardo Baeza -Yates and Berthier Ribeiro - Neto, Modern Information Retrieval: The Concepts and Technology behind Search 2 nd Edition, ACM Press Books 2011.

Reference Books:

1. Bruce Croft, Donald Metzler and Trevor Strohman, Search Engines: Information Retrieval in Practice, 1st Edition Addison Wesley, 2009.
2. Mark Levene, An Introduction to Search Engines and Web Navigation, 2 nd Edition Wiley, 2010.
3. Stefan Buettcher, Charles L. A. Clarke, Gordon V. Cormack, Information Retrieval: Implementing and Evaluating Search Engines, The MIT Press, 2010.

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Department of Computer Science and Engineering

C319 **CS 1546/CS 1404** **(2L + 1 T hrs/week)**

COMPUTER GRAPHICS

Questions to be set having equal weightage/marks from each unit: SIX
TWO from UNIT I, TWO from UNIT II, and TWO from both UNIT I and UNIT II combined.
Questions to be answered: FIVE
Compulsory TWO Questions from UNIT I and UNIT II, and ANY ONE from the combination Question.

Objective: This course highlights the overview of display devices and peripherals, software and techniques used in computer graphics. Study of the principles of interactive computer graphics; systems organization and device technologies for raster and vector displays; region filling techniques; 2-D and 3-D viewing, clipping, segmentation and interaction handling; 3-D geometrical transformations, projections and hierarchical data structures for graphics modelling including hidden lines and surfaces, lighting, texturing, shading and colour models.

Pre-requisites: Programming concepts and Basic Mathematics

Course Outcomes: On successful completion of this course, students will be able to:

1. Describe the competence in application of mathematical modelling to computer graphics
2. Explain an ability to interpret a solution plan and methodology for an engineering problem using computer graphics
3. Discuss an ability to conduct investigations of technical issues related to computer vision with their level of knowledge and understanding
4. Illustrate an ability to advance an engineering design to defined end state
5. Compare different algorithms used to solve a computer vision problem.

UNIT – I

Introduction, overview of graphics systems [3 Hrs]
Display devices, Hard copy devices, Interactive input devices, Display processors.

Output primitives [5 Hrs]
Points and lines, Line drawing algorithm, Anti-aliasing lines, Circle generating algorithms (Bresenham's), Ellipse, Other curves, Character generation.

Attributes of output primitives [3 Hrs]
Line styles, Color and intensity, Solid area scan conversion, Character attributes, Inquiry functions, Bundled attributes.

Two dimensional transformations [5 Hrs]
Basic Transformations, Homogenous co-ordinates, Composite Transformations, Reflections, Shear.

Windowing and clipping [4 Hrs]
Windowing concepts, Clipping Algorithms, Line clipping (Cohen Sutherland & Mid-point sub division), Area Clipping, Text Clipping, Window to view port transformation.

UNIT – II

Segments [2 Hrs]
Concepts, Segment files, Attributes, Segment naming schemes, Default error conditions.

Interactive input methods [3 Hrs]
Physical input devices, Logical classification of input devices, Interactive picture construction techniques.

Modeling methods: [5 Hrs]
Basic modeling concepts, Master co-ordinates & modeling transformations, structured display files, symbol operations, combining modeling & viewing operations.

Three dimensional concepts [2 Hrs]
3-D Co-ordinate system, Display techniques, 3-D Representation, Polygon surfaces, Curved surfaces, 3-D transformations.

Signature
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3-D viewing: [3 Hrs]
Projections, Viewing transformations, Implementations of viewing operations.

Hidden surface & hidden line removal: [5 Hrs]
Depth buffer algorithms, Scan line coherence algorithms, Area coherence algorithm, Priority algorithms, Shading & color model.

Text Books:

1. Donald Hearn & M. Pauline Baker, "Computer Graphics", PHI.
2. William M. Newman Robert F. Spronill, "Principles of Interactive Computer Graphics, McGraw-Hill.

Reference Books:

1. Steven Harington, "Interactive Computer Graphics", Tata McGraw Hill.
2. Dabod G. Rfgers, "Procedure elements for Computer Graphics", McGraw Hill.
3. A. Plastick & Gordon Kalley , "Computer Graphics, Schaum's Outline series", McGraw Hill.
4. Amarendra N Sinha and Arun D Udai , "Computer Graphics", McGraw Hill.

Department of Computer Science and Engineering

C444 **CS 1752** **(2L +1T hrs/week)**

ADVANCED ALGORITHMS

Questions to be set having equal weightage/marks from each unit: SIX
TWO from UNIT I, TWO from UNIT II, and TWO from both UNIT I and UNIT II combined.
Questions to be answered: FIVE
Compulsory TWO Questions from UNIT I and UNIT II, and ANY ONE from the combination Question.

Objectives: Algorithm design and analysis is a fundamental and important part of computer science. This course introduces students to advanced techniques for the design and analysis of algorithms, and explores a variety of applications.

Pre-requisites: Design and Analysis of Algorithms and Probability& Statistics.
Course Outcomes: On successful completion of this course, students will be able to:

1. Describe the divide-and-conquer paradigm with an approach to design an algorithm.
2. Define the dynamic-programming paradigm to explain an algorithmic design.
3. Identify the greedy paradigm with an approach to design an algorithm.
4. Analyze randomized algorithms for a given set of problems.
5. Explain competitive analysis of various algorithms for a given set of problems.

UNIT I

Design Paradigms: Overview: [8 Hrs]
Overview of Divide and Conquer, Greedy and Dynamic Programming strategies. Basic search and traversal techniques for graphs, Backtracking, Branch and Bound.

Max Flow Problem [6 Hrs]
Introduction to string-matching problem, Naïve algorithm, Rabin Karp, Knuth Morris Pratt, BoyerMoore algorithms and complexity analysis.

Theory of NP- Hard and NP-Complete Problems [6 Hrs]
P, NP and NP-Complete complexity classes; A few NP-Completeness proofs; Other complexity classes.

UNIT II

Approximation Algorithms [6 Hrs]
Introduction, Combinatorial Optimization, approximation factor, PTAS, FPTAS, Approximation algorithms for vertex cover, set cover, **TSP, knapsack, bin packing, subset-sum problem etc. Analysis of the expected time complexity of the algorithms**.

Parallel Algorithms [6 Hrs]
Introduction, Models, speedup and efficiency, Some basic techniques, Examples from graph theory, sorting, Parallel sorting networks. Parallel algorithms and their parallel time and processors complexity.

Probabilistic Algorithms & Randomized Algorithms [8 Hrs]
Numerical probabilistic algorithms, Las Vegas and Monte Carlo algorithms, Game-theoretic techniques, Applications on graph problems

Text Books:
1. Introduction to Algorithms : T.H. Cormen, C.E.Leiserson and R.L. Rivest
2. Fundamentals of Algorithmics : G.Brassard and P.Bratley

Reference Books:
3. Approximation Algorithms: Vijay V.Vazirani
4. Randomized Algorithms: R. Motwani and P.Raghavan
5. Reference book: Algorithmics :The spirit of computing: D.Harel

Department of Computer Science and Engineering

C344 **CS 1759 /CS 1644** **(2L +1T hrs/week)**

ARTIFICIAL INTELLIGENCE

Questions to be set having equal weightage/marks from each unit: SIX
TWO from UNIT I, TWO from UNIT II, and TWO from both UNIT I and UNIT II combined.
Questions to be answered: FIVE
Compulsory TWO Questions from UNIT I and UNIT II, and ANY ONE from the combination Question.

Objectives: The aim of this course is to provide an introduction to some fundamental issues and algorithms in artificial intelligence (AI). The course approaches AI from an algorithmic, computer science-centric perspective. The course aims to provide some fundamental tools and algorithms required to produce AI systems able to exhibit limited human-like abilities, particularly in the form of problem solving by search, representing and reasoning with knowledge, planning, natural language understanding, computer vision, automatic programming and machine learning.

Pre-requisites: Algorithms will be an essential component, in addition the course requires some mathematics specially Calculus, Probability and statistics. Natural Sciences Mathematics or equivalent, and Discrete Mathematics, are likely to be helpful although not essential. Mathematical Methods for Computer Science, Probability, Logic and Proof, Prolog and Complexity Theory are likely to be useful.

Course Outcomes: On successful completion of this course, students will be able to:

1. Identify areas in engineering and real life where Artificial Intelligence (AI) can find its application
2. Discuss the role of mathematical and statistical models in AI
3. Demonstrate an ability to formulate problems using AI
4. Analyse techniques and resources to solve AI problems
5. Test techniques and resources to solve AI problems

UNIT-I

Introduction to Artificial Intelligence [4 Hrs]
Brief history, Definition of AI, Overview of Artificial Intelligence- Problems of AI, AI techniques, **Intelligent and Rational agents,** Turing test, Typical AI problems: Tic -Tac- Toe problem, 8-puzzle problem, 8-Quenes problem, **Practical impact of AI**.

Uninformed search strategies & Problem solving by Search [4 Hrs]
Introduction to Uninformed search strategies; BFS, DFS, Depth Limited search, Iterative Deepening DFS, Bi-directional depth first search. Tic -Tac- Toe problem, 8-puzzle problem, 8-Quenes problem **Problems, Problem Space & search, Formulating problems: Pegs and Disks problem, Missionary Cannibals problem. State space search**

Informed Search Techniques [6 Hrs]
Informed (Heuristic) Search Strategies, Best First Search (BFS), Greedy BFS, A* Search, Heuristic Functions, Iterative-Deepening A*, Hill Climbing Search, **Simulated Annealing Search, Local Beam Search,** Genetic Algorithms.

Constraint Satisfaction Problems (CSPs) [6 Hrs]
Constraint Satisfaction Problems: N-Queen problem, Crossword puzzle, Map coloring problem, Boolean satisfiability problem (SAT). The backtracking algorithm for CSPs. Heuristics for improving the search for a solution. **Forward checking, Constraint propagation and arc consistency. Backtracking, Back jumping using Gaschnig's algorithm, Graph-based back jumping.**

UNIT-II

Adversarial Search [3 Hrs]
Game Trees, Optimal Decision in Games: Minimax Algorithm, Alpha Beta Pruning, TD learning, Game theory

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Knowledge representation and Reasoning [4 Hrs]

Knowledge representation issues, representation & mapping, approaches to knowledge representation, 1st Order Predicate Logic & Inference, forward verses backward reasoning, matching, control knowledge, logic programming, forward verses backward reasoning, matching, control knowledge.

Bayesian Networks [4 Hrs]

Bayesian inference, Marginal independence, Hidden Markov models, Learning Bayesian networks, Laplace smoothing, Expectation Maximization, Representing knowledge in an uncertain domain, the semantics of Bayesian networks, Dempster-Shafer theory, Fuzzy sets & fuzzy logics.

Machine Learning [6 Hrs]

Learning-**Supervised and Unsupervised learning, Adaptive Learning, Reinforcement learning,** Linear classification, Loss minimization, Stochastic gradient descent, K-Means Algorithm, The perceptron, Learning by gradient descent, Multilayer perceptron and the back propagation algorithm, Deep learning

Application of AI [3]

Computer Vision, Robotics, NLP.

Text Books:

1. Russell, S. & Norvig, P. (2010). Artificial intelligence: a modern approach. Prentice Hall (3rd ed.).
2. Elaine Rich, Kevin Knight & Shivashankar B. Nair (2008). Artificial Intelligence (Third Edition) TMH.
3. Bishop, C. M. (2006) Machine Learning and Pattern Recognition. Berlin: Springer.

Reference Book:

1. Poole, D. L. & Mackworth, A. K. (2010). Artificial intelligence: foundations of computational agents. Cambridge University Press.
2. Nilsson, N. J. (1998) Artificial Intelligence - A Modern Synthesis. Palo Alto: Morgan Kaufmann.

Department of Computer Science and Engineering

C318 **CS 1545** **(2L+1T hrs/week)**

ARTIFICIAL NEURAL NETWORKS

Questions to be set having equal weightage/marks from each unit: SIX
TWO from UNIT I, TWO from UNIT II, and TWO from both UNIT I and UNIT II combined.
Questions to be answered: FIVE
Compulsory TWO Questions from UNIT I and UNIT II, and ANY ONE from the combination Question.

Objective: The objective of this paper is to give the students an in-depth understanding of Artificial Neural Networks (ANN). Different models of ANN with their functionalities, architecture and algorithms are covered. The learner is exposed to ANN concepts from ground up, gradually moving to theoretical and mathematical proofs with applications.

Prerequisites: Linear algebra, Multivariate calculus, Basic notions of statistics.

Course Outcomes: On successful completion of this course, students will be able to:

1. Display sufficient understanding of mathematical and engineering fundamentals in the perspective of Artificial neural network theory.
2. Identify Artificial Neural network suitable for a complex problem.
3. Awake the importance of tolerance of imprecision and uncertainty for design of robust and low-cost intelligent machines.
4. Investigate a problem to identify technical issues and solve the problems using various Artificial neural network.
5. Design real-life application using various neural network algorithm.

UNIT-I

Introduction [3 Hrs]

What is a Neural Network, Biological Neuron, Artificial Neuron, Human Brain, Feedback and Feedforward, Network Architectures, Knowledge Reresentation, Learning Process, Learning Task, Uses of Neural Nets.

Basic Concepts [4 Hrs]

Perceptron, Perceptron Convergence Theorem, Rosenblatt Model, McCulloch Pitts Model, Pattern based Computation, Classification, Association, Linear Regression -Pattern Classification, AND, OR, XOR Problem, Activation Functions, Identity, Step, Sigmoid, Hyperbolic Tangent.

Pattern Classifiers [9 Hrs]

Hebb Nets: Architecture, Algorithm, Perceptron: Architecture, Algorithm, Application, Perceptron Convergence Theorem – Revisit, ADALINE, Architecture, Algorithm, Application, Derivations, MADALINE, Architecture, Algorithm.

UNIT-II

Pattern Associators [9 Hrs]

Training Algorithms: Hebb Rule for Association, Delta Rule, Hetero-associative Networks: Architecture, Algorithm, Auto-associative Networks: Architecture, Algorithm, Training, Application, Elimination of Self-connection, Recognition of Noisy Patterns, Storage, Iterative Autoassociative Net: Recurrent Linear Autoassociator, Brain-State-in-a-Box, Autoassociator with Threshold Function, Hopfield Networks, Bidirectional Associative Memory: Architecture, Algorithm, Application, Analysis.

Competitive Neural Networks [9 Hrs]

MAXNET: Training, Application, Kohonen's Self Organizing Map: Architecture, Algorithm, Application, Learning Vector Quantization: Architecture, Algorithm, Application, Adaptive Resonance Theory: Stability-

Plasticity, Basic Architecture, Basic Operation, ART1: Architecture, Algorithm, Application, ART2: Architecture, Algorithm, Application.

Backpropagation [4 Hrs]

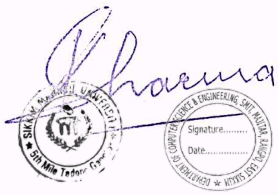
Multi-layered Feedforward Networks, Architecture, Generalized Delta Rule, Algorithm: Parameters Choice, Applications.

Text Books:

1. Fundamentals of Neural Networks – Architectures, Algorithms and Applications – Laurene Fausett, Pearson
2. Introduction to Soft Computing, Neuro-Fuzzy and Genetic Algorithms – Samir Roy, Udit Chakraborty, Pearson

Reference Books:

1. Neural Networks and Learning Machines – Simon Haykin, Pearson
2. Neuro-Fuzzy & Soft Computing – J.-S. R. Jang, C. -T. Sun, E. Mizutani, Pearson



Department of Computer Science and Engineering

C431 **CS1669** **(2L + 1 T hrs/week)**

DESIGN THINKING

Questions to be set having equal weightage/marks from each unit: SIX
TWO from UNIT I, TWO from UNIT II, and TWO from both UNIT I and UNIT II combined.
Questions to be answered: FIVE
Compulsory TWO Questions from UNIT I and UNIT II, and ANY ONE from the combination Question.

Objective: Design Thinking is a systematic approach to innovation and creative problem-solving that can be used in many disciplines. Design Thinking applies the methodologies of design to challenges in business and society—which makes it central to innovation and creativity.

Pre-requisites: Innovative Problem-Solving ability, design and design theory, organizational behavior, and social psychology.

Course Outcomes: On successful completion of this course, students will be able to:

1. Express the design process as a tool for innovation
2. Understand the unique needs of a company around specific challenges
3. Demonstrate the value of developing a local network and assist students in making lasting connections with the business community.
4. Develop communication skills necessary to facilitate high performance team formation and maintenance and build empathy for target audiences from different "cultures".
5. Develop and test innovative ideas through a rapid iteration cycle.

UNIT I

Introduction [5 Hrs]
Introduction to design thinking, History, creativity, innovation and design, Design Thinking Mindset, Various approaches to design thinking i.e. Empathy, Analysis, Solution, Testing.

Design thinking in practice [5 Hrs]
Process Stages of Designing for Growth, Empathy and Understanding, Clarify, Aim of empathize in design thinking process, purpose, importance and its use in design thinking, Customer journey Map, Case Study 4-stage Karmic Design Thinking process, Interviewing & Empathy-building Techniques.

Analysis [5 Hrs]
5 whys, Use of multi-whys method in design thinking- an Example, Conflict of interest, Principles of a design sprint and how to make it happen, Create a Set of Scenarios for the Case Study

Solution [5 Hrs]
TRIZ (Theory of Inventive Problem Solving), Exercise on Tea-cup story, Business Model Canvas and Design Research.

UNIT II

Prototype and Testing [5 Hrs]
Types of Prototypes, Target Audience Testing, Customer reactions to prototype, Forms of testing in Design Thinking, testing as an iterative process, Developing and Testing Prototypes, case study on ReMotion Knee by D-Rev, Story on elephant and blind men, Defining & Testing Business Models & Business Cases.

General Design Thinking Practices [5 Hrs]
Visualization Techniques and Diagrams, Use of Diagrams and Maps in Design Thinking, Exercise: Create an Empathy Map, Create a Mind Map, Create a Journey Map

Adopt and Adapt Design Thinking [5 Hrs]
Cautions and Pitfalls, Assumptions, Exercise: Assumptions, Pitfalls and Cautions in Design Thinking Workgroups, Final Words and Best Practices, Exercise: Take the Practices Back to the Office


Design Thinking for strategic innovations [5Hrs]

Story telling - Predictability – Strategic Foresight - Change – Sense Making -Extreme Competition – experience design - Standardization – Humanization - Creative Culture – Rapid prototyping, Strategy and Organization – Business Model design.

Text Books:

1. Change by Design: How Design Thinking Transforms Organizations and Inspires Innovation by Tim Brown Kindle Edition
2. HBR's 10 Must Reads on Design Thinking (with featured article "Design Thinking" By Tim Brown) Paperback by Harvard Business Review (Author), Tim Brown (Author), Clayton M. Christensen (Author), Indra Nooyi (Author), Vijay Govindarajan (Author)

Reference Books:

1. Design Thinking: Understanding How Designers Think and Work , Kindle Edition by Nigel Cross (Author) Format: Kindle Edition.
2. Solving Problems with Design Thinking: Ten Stories of What Works (Columbia Business School Publishing) Kindle Edition by Jeanne Liedtka (Author), Andrew King (Author), Kevin Bennett (Author)
3. Idris Mootee, "Design Thinking for Strategic Innovation: What They Can't Teach You at Business or Design School", John Wiley & Sons 2013. (Unit IV).
4. Book - Solving Problems with Design Thinking - Ten Stories of What Works (Columbia Business School Publishing) Hardcover – 20 Sep 2013 by Jeanne Liedtka (Author), Andrew King (Author), Kevin Bennett (Author).

Department of Computer Science and Engineering

C432 **CS1670** **(2L + 1 T hrs/week)**

HASKELL PROGRAMMING

Questions to be set having equal weightage/marks from each unit: SIX
TWO from UNIT I, TWO from UNIT II, and TWO from both UNIT I and UNIT II combined.
Questions to be answered: FIVE
Compulsory TWO Questions from UNIT I and UNIT II, and ANY ONE from the combination Question

Objective: To introduce functional programming which is a powerful programming paradigm that encourages breaking up programming tasks into logical units. Using Haskell programming students will be able to bring best feature of functional programming which is been increasingly used in the industry.

Pre-requisites: Basics Knowledge about C Language.
Course Outcome: After completing the course successfully, students should be able to:

1. Write substantial, well-typed programs using a purely functional programming language such as Haskell.
2. Apply functional programming techniques such as recursion, higher order functions, and pattern matching to solve problems and build data structures
3. Define and use types that make use of type classes and polymorphism
4. Explain functional constructs such as functors and monads to build powerful, reusable abstractions
5. Develop formal, equational reasoning to software development

UNIT I

Introduction [4hrs]

GHCi interpreter, Functional Programming Paradigm, The Haskell programming language, Characteristics of Haskell, basics Haskell declaration, variables, comments, indentation.

Datatypes and Pattern Matching [6hrs]

Predefined types- boolean, character and strings, lists, list comprehension, tuples, unit datatypes, Type a, Type t, operators. Pattern matching in Haskell- analysis, connection with connectors.

Haskell Control Structure [4hrs]

If and guards, Embedding if expressions, case expressions, controlling actions.

Function [5hrs]

Higher order function, Higher order function on list: map, filter, list comprehension, Recursion, Lambda expression, head function, tail function, init function, Reverse function, function composition, Monads, Zippers.

UNIT II

Polymorphism [4hrs]

Introduction, Parametric polymorphism, Adhoc polymorphism, condition polymorphism and type classes, Type classes Vs. Object oriented classes.

User defined datatypes [10hrs]

Abstract datatype, array, stack, queue, lists, tree, datatype implementation in Haskell.

Input/Output [4hrs]

Input/Output and GHCi compiler, the I/O type, Files and streams, Command line arguments, combining functions and I/O actions.

Application [3hrs]

Haskell in industry, Advantages of Functional Programming, Different Haskell uses, Pros and Cons of Haskell.

Text Books:

1. Lipovaca, Miran. Learn you a haskell for great good!: a beginner's guide. No Starch Press; 1st edition, ISBN-10: 9781593272838, 2011.
2. Madhavan Mukund, SP Suresh, Functional Programming in Haskell, Chennai Mathematical Institute. (Available Online)

Reference Books:

1. O'Sullivan, Bryan, John Goerzen, and Donald Bruce Stewart. Real world haskell: Code you can believe in. " O'Reilly Media, Inc.", ISBN-10 : 0596514980, 1st edition, 2008.
2. Simon Marlow. Parallel and concurrent programming in Haskell: Techniques for multicore and multithreaded programming. Shroff/O'Reilly; First edition, ISBN-10:9351102335, 2013.
3. Simon Thompson, "Haskell: The Craft of Functional Programming" Addison-Wesley; 3rd edition, ISBN-10: 0201882957, 2011.
4. Kees Doets, Jan van Eijck,. "The Haskell Road to Logic, Maths and Programming", King's College Publications, ISBN 0-9543006-9-6, 2004.
5. Graham Hutton, Programming in Haskell, "Cambridge University Press", ISBN-10: 316626229, 2nd edition 2016.

Department of Computer Science and Engineering

C342 **CS 1634** **(2L +1T hrs/week)**

DATA WAREHOUSING AND DATA MINING

Questions to be set having equal weightage/marks from each unit: SIX
TWO from UNIT I, TWO from UNIT II, and TWO from both UNIT I and UNIT II combined.
Questions to be answered: FIVE
Compulsory TWO Questions from UNIT I and UNIT II, and ANY ONE from the combination Question.

Objectives: This course is indent for understanding the techniques behind the recent development in data warehousing and data mining. The data warehousing part of the module aims to give students a good overview of the ideas and the techniques, which are behind recent developments in the data warehousing and On-Line Analytical Processing (OLAP) fields, in terms of data models, query languages, conceptual design methodologies, and storage techniques. The data mining part discusses various tools and techniques used to find out the interesting patterns from data.

Pre-requisites: Data structures, Concepts of Algorithms, Fundamentals of probability & statistics and programming skills

Course Outcomes: On successful completion of this course, students will be able to:

1. Distinguish the concepts of data warehousing and data mining
2. Illustrate the dimensional modelling technique for designing a data warehouse and data warehouse architectures and OLAP
3. Explain the knowledge discovery process.
4. Deduction of data mining tasks and study their well-known techniques
5. Apply various data mining techniques in varied problem scenarios.

UNIT-I

Data Warehousing [5 Hrs]
Introduction, Definition, Multidimensional data transformation, OLAP operations, Warehouse schema, Ware house Server, Meta data, OLAP engine.

Data Mining [5 Hrs]
Introduction, Definition, KDD vs. DM, DBMS vs. DM, DM techniques, Issues and challenges in DM, DM applications.

Association Rules [5 Hrs]
A prior algorithm, Partition, Incremental, Dynamic item set counting, FP-tree growth, Incremental and border algorithms.

Classification: Parametric and Non-Parametric Technology [6 Hrs]
Bayesian classification, Two class and generalized class classification, Classification error, Decision boundary, **Discriminant functions, Non-parametric methods for classification.**

UNIT-II

Clustering [7 Hrs]
Clustering analysis, Types of data in cluster analysis, Partitioning algorithms, Hierarchical, Density based, Grid based, Model based algorithms, **High dimensional & Categorical data clustering.**

Decision Trees [7 Hrs]
Decision tree induction, Tree pruning, Extracting classification rules from decision trees, Decision tree construction algorithms, **Decision tree construction with presorting.**

Unstructured Data Mining [5 Hrs]
Text mining, Web mining, Spatial data mining, **Multimedia data mining.**

Text Books:

1. Jiawei Han, MichelineKamber, "Data Mining: Concepts and Techniques", Elsevier.
2. A K Pujari, "Data Mining Concepts", University Press.

Reference Books:

1. Ian H. Witten, Eibe Frank, "Data Mining Practical Machine Learning Tools and Techniques with JavaImplementations", Morgan Kaufmann Publishers.
2. Alex Berson, Stephen J. Smith, "Data Warehousing, Data Mining and OLAP", Tata McGrawHill.
3. Richard O. Duda, Peter E. Hart, "Pattern Recognition and Scene Analysis", Wiley.
4. VikramPudi, P. Radha Krishna, "Data Mining", Oxford University Press.

Department of Computer Science and Engineering

C362 **CS 1637** **(2L +1T hrs/week)**

SOFTWARE QUALITY MANAGEMENT

Questions to be set having equal weightage/marks from each unit: SIX
TWO from UNIT I, TWO from UNIT II, and TWO from both UNIT I and UNIT II combined.
Questions to be answered: FIVE
Compulsory TWO Questions from UNIT I and UNIT II, and ANY ONE from the combination Question.

Objectives: This course presents a comprehensive study of software quality assurance, including software quality control management, processes, systems, methods, standards, certification, and reliability measurement.

Pre-requisites: Software engineering.

Course Outcomes: On successful completion of this course, students will be able to:

1. Explain the requirements of ISO 9000 Certification and other process evaluation models
2. Discuss the role of software quality measures, quality assurance and quality control in improving the software development process.
3. Prepare a software quality plan for a software project - to include sections on change management, configuration management, defect elimination, validation, verification and measurement.
4. Apply the techniques learned to improve the quality of their own software development.
5. Employ the latest software quality tools.

UNIT – I

Fundamentals of Software Quality Engineering [07 Hrs]
Concepts Software Quality, Hierarchical models of Boehm and McCall Quality measurement, Metrics measurement and analysis, Gilb's approach, GQM Model, Quality tasks ,SQA plan, **teams characteristics**, **implementation,** **documentation, reviews and audits, tools for Quality, Ishikawa's basic tools, CASE tools,** concepts of Quality improvement, concepts of process maturity, improving process maturity.

Software Quality Measurements [05 Hrs]
Selecting quality goals And measures, principles of measurement, measures and metrics of Quality Function Deployment, goal/question/measure paradigm for quality characteristics tree, The FURPS model And FURPS+ model, Gilb Approach, Quality Prompts.

Software Quality Management System[08 Hrs]
Elements Of A Quality Engineering Program, quality control, assurance and engineering reliability, maintainability, verifiability, testability, safety and supportability, historical perspective elements of QMS, **Human Factors**, time management in QMS, **Software Quality Assurance – ISO9000 Series– A Generic Quality Management Standard Tools For Quality.**

UNIT - II

Principles and practices in Software Quality Management System[10 Hrs]
Process, product, project, people in software development and management spectrum, principle and critical practices in QMS, **ISO 9001** and capability maturity models, six sigma, zero defects and statistical quality control.

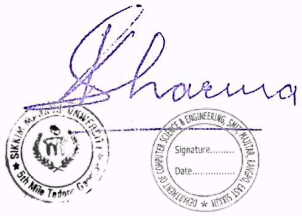
Measures and Metrics in Process and Project domains[10 Hrs]
Key measures for software engineers, defects, productivity and quality, measuring and improving the development process, assigning measures to process elements and events, Isikawa Diagrams, metrics for software quality, integrating metrics within **software engineering process, metrics for small organizations.**

Text Books:

1. Brian Hambling, "Managing Software Quality", Tata McGraw Hill.
2. Alcon Gillies, "Software Quality: Theory and Management", International Thomson, Computer Press.

Reference Books:

1. Juran. J.M.Frank, M.Gyrna, "Quality Planning and Analysis (from product developmement through use)",Tata McGraw Hill.
2. Stephen H.Kan, "Metrics and Models in Software Quality Engineering", Addison Wesley.
3. Roger S. Pressman, "Software Engineering - A Practitioner's Approach", Fifth Edition, McGraw Hill.
4. Humphrey Watts, "Managing the Software Process", Addison Wesley.



Department of Computer Science and Engineering

C363 **CS 1639** **(2L +1T hrs/week)**

REAL TIME SYSTEMS

Questions to be set having equal weightage/marks from each unit: SIX
TWO from UNIT I, TWO from UNIT II, and TWO from both UNIT I and UNIT II combined.
Questions to be answered: FIVE
Compulsory TWO Questions from UNIT I and UNIT II, and ANY ONE from the combination Question.

Objectives: The objective of this course is to provide a general understanding of the Real Time Systems (RTS). It covers the scheduling aspects of tasks with emphasis on timing constraints and scheduling principles. By the end of the course, the students shall be able to differentiate the scheduling, database and communication aspects of Real Time Systems from those of traditional Operating Systems (OS). Students will also be familiar with different programming platforms for developing Real Time Operating Systems (RTOS)

Pre-requisites: Operating System, Computer Network and DBMS.

Course Outcomes: On successful completion of this course, students will be able to:

1. Discuss the concepts of Real-Time systems and interpret its model.
2. Recognize the characteristics of a real-time system
3. Develop and document on an architectural design of a real-time system
4. Express an ability to select appropriate algorithms for task scheduling and resource management in Real Time System.
5. Illustrate Real-time Operating Systems and Fault Tolerant applications of Real-Time Systems

UNIT- I

Introduction [5 Hrs]
Definition and concepts of RTS, Issues in Real Time Computing, Broad categories and characteristics of Real Time (RT) systems, RT tasks classification, Modeling of Time constraints, **Task Assignment and Scheduling, Mode changes and Fault Tolerant Scheduling.**

Real Time task scheduling [10 Hrs]
Basics on RT task scheduling, RT task scheduling algorithms, Preemptive RT algorithms (Earliest deadline first, RMA), Static priority scheduling protocols, Resource sharing among RT Tasks, Priority inversion, Priority inheritance protocol (PIP), HLP, PCP, Different types of priority inversion under PCP, Scheduling RT tasks in multiprocessor and distributed systems.

Real Time Operating System [5 Hrs]
RTOS definition and characteristics, comparison with general-purpose OSs, light-weight vs. heavy-weight RTOSs, Commercial RTOS: UNIX V, UNIX based RTOS, RT POSIX, **RT capabilities of Windows NT, Windows CE, Performance benchmarking of RTOS**.

UNIT- II

Real time communication [6 Hrs]
Characteristics of RT traffic, Models for traffic characterization, Applications requiring RT communication, Soft and hard RT communication in a LAN, Network Topologies, Fault tolerant Routing, **Fault Error containment Redundancy, Bounded access protocols for LANs, Performance comparison, QoS framework, QoS models.**

Real time databases [6 Hrs]
Definition, , Real time vs General Purpose Databases, Transaction priorities, Transaction Aborts, Concurrency control issues, Disk Scheduling Algorithms, Two phase Approach to improve Predictability, Maintaining Serialization Consistency, Commercial RT databases.

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Evaluation Techniques and Clock Synchronization [4 Hrs]
Reliability Evaluation Techniques, Software error models, Clock Synchronization, **Fault Tolerant Synchronization in hardware and software.**
Programming languages and tools [4Hrs]
Programming Languages and Tools, Desired language characteristics, Data typing, Control Structures, **Facilitating Hierarchical Decomposition,** Packages, Programming Environments, Run time support.

Text Books:

1. Rajiv Mall, "Real Time Systems, Theory and Practice", 2nd Edition, Pearson Education, 2007.
2. J.W. Liu, "Real Time systems", Pearson Education, 5th Edition, 2004.

Reference Books:

1. Phillip Laplante, Prentice Hall, "Real Time Systems Design and Analysis", 3rd Edition.
2. Krishna & Shin, "Real Time systems", Tata McGraw Hill, 1999.
3. Mark H. Klein, Thomas Ralya, "Practitioner's Handbook for Real-Time Analysis", 2nd Edition, Kluwers Academic Publishers, 1994.
4. Hassan Gomaa, "Software Design Methods for Concurrent and Real-time Systems", Addison-Wesley.
5. Stuart Bennett, "Real Time Computer Control – An Introduction", Prentice Hall of India, 1998.
6. S.T. Allworth and R.N.Zobel, "Introduction to real time software design", Macmillan, 2nd Edition, 1987.
7. R.J.A Buhur, D.L Bailey, "An Introduction to Real – Time Systems", Prentice – Hall International, 1999.

Department of Computer Science and Engineering

C343

CS 1641
SOCIAL NETWORK ANALYSIS **(2L + 1 T hrs/week)**

Questions to be set having equal weightage/marks from each unit: SIX
TWO from UNIT I, TWO from UNIT II, and TWO from both UNIT I and UNIT II combined.
Questions to be answered: FIVE
Compulsory TWO Questions from UNIT I and UNIT II, and ANY ONE from the combination Question.

Objective:

- To understand how the world is connected -- socially, strategically and technologically and why it matters
- To introduce the basic notions and model used for social network analysis.

Pre-requisites: NIL

Course Outcomes: On successful completion of this course, students will be able to:

1. Explain and extend the competence in structural properties of Social Networks fundamentals
2. Illustrate the ability to formulate and interpret several Social Network models
3. Represent the mathematical representation and analyses Social Network results.
4. Compare and analyze Social Network Data to reach a valid conclusion.
5. Define competence in Social Network Analysis fundamentals.

UNIT – I

Introduction [8 Hrs]
Motivation, The Social network perspective, Different sources of network data, **Historical and Theoretical Foundation, Fundamental concepts of network analysis**. Social Network Analysis: Preliminaries and definitions, Erdos Number Project, Centrality measures, Balance and Homophily

Social Network Data [5 Hrs]
Definition, Boundary Specification and Sampling, Types of networks – One mode networks, Two mode networks, Ego-centered and Specific Dyadic networks, Network data, Measurement, Collection, Datasets.

Mathematical Representation of Social Network [7 Hrs]
Notation for Social network data, Graph Theory, Sociometri Notation, Algebraic Notation, Graphs, Directed Graph, Signed graph, Valued graph, Multigraph, Hypergraph, Matrices of graph, digraph, hypergraph, Random graphs and alternative models, **Models of network growth, Navigation in social Networks.**

UNIT-II

Structural Properties of Networks [6 Hrs]
Cohesiveness of subgroups, roles and positions, Multidimensional Scaling, Ego networks, Weak ties, Structural equivalence, Structural hole, Equitable partitions, Stochastic block models.

Cascading Properties of Networks [6 Hrs]
Information/influence diffusion on networks, Maximizing influence spread, Power Law and Heavy tail distributions, Preferential attachment models, Small world experiments, Small world models, Origins of small world, **Heavy tails, Small Diameter, Clustering of connectivity**

Models of Network Formation [5 Hrs]
Erdos-Renyi Model- The Model & Threshold Phenomenon, Clustering Models – The Model, Programming Clustering, Clustering Coefficient, Preferential Model - Preferential Attachment

Mining Graphs [3 Hrs]

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Community and cluster detection: random walks, spectral methods; **link analysis for web mining.**

Text Books:

1. S. Wasserman and K. Faust. Social Network Analysis: Methods and Applications, Cambridge University Press, 1994
2. D. Easley and J. Kleinberg, Networks, Crowds and Markets: Reasoning about a highly connected world, Cambridge University Press, 2010

Reference Books:

1. Peter R. Monge, Noshir S. Contractor, Theories of communication networks. Oxford University Press, 2003.
2. Duncan Watts. Six degrees: the science of a connected age. Norton, 2004.

Department of Computer Science and Engineering

C364 **CS 1643** **(2L +1T hrs/week)**

VLSI DESIGN

Questions to be set having equal weightage/marks from each unit: SIX
TWO from UNIT I, TWO from UNIT II, and TWO from both UNIT I and UNIT II combined.
Questions to be answered: FIVE
Compulsory TWO Questions from UNIT I and UNIT II, and ANY ONE from the combination Question.

Objectives: The main objective of this course is to introduce the technology, design concepts and testing of Very Large Scale Integrated Circuits. This course is designed to give clear idea about the basics of VLSI design and its importance. This also highlights the operating principles of MOS transistor, CMOS and nMOS based logic gates and its construction.

Pre-requisites: Basic Electronics, Digital Circuits and Logic Design and Computer Organization and Architecture.

Course Outcomes: On successful completion of this course, students will be able to:

1. Identify the various IC fabrication methods
2. Discuss the Layout of simple MOS circuit using Lambda based design rules
3. Apply the Lambda based design rules for subsystem design
4. Design an application using Verilog HDL
5. Evaluate a digital system using Hardware Description Language.

UNIT I

VLSI Physical Design Automation [4 Hrs]
VLSI design cycle, New trends in VLSI design cycle, Physical design cycle, **New trends in Physical design cycle**, Design styles: Full custom, Standard cell based, Gate Array based, Field programmable gate array based, Sea of gates, **Comparison of different design styles.**

Fabrication of VLSI Devices [4 Hrs]
Fabrication materials, Fabrication process flow, nMOS fabrication process, The CMOS n-well process, **Issues related to fabrication process**, Layout design rules, Full custom mask layout design, Layout of basic devices.

Design of VLSI Devices [8 Hrs]
The MOS structure and operation, Gradual channel approximation method, Channel length modulation, MOSFET scaling and small geometry effects, The Level 1 model equations, Level 2 model equations, Level 3 model equations, **Characteristics of various MOS inverters,** Power and Area considerations of MOS inverters, Design of CMOS inverters, Supply voltage scaling in CMOS inverters, **Delay-time definitions, Calculation of delay times, Inverter design with delay constraints, Calculation of interconnect delay** , Switching power dissipation of CMOS inverters, Power-delay product, Super buffer design.

Power Design of VLSI Circuits [2 Hrs]
Overview of power consumption, Low power design through voltage scaling, Estimation and optimization of switching activity, **Adiabatic logic circuits.**

UNIT II

CAD Tools for VLSI Design [2 Hrs]
Introduction to CAD tools, Overview of VHDL/Verilog, Modeling concepts, Logic synthesis, Technology mapping, High level synthesis.

Partitioning [4 Hrs]
Problem formulation, Design style specific partitioning problems, Classification of Partitioning algorithms, Kernighan-Lin algorithm, Fiduccia-Mattheyses algorithm, Ratio-Cut algorithm, **Simulated annealing and evolutionary based algorithms,** Performance driven partitioning.

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Floorplanning and Pin Assignment [6 Hrs]
Problem formulation, Design style specific issues, Slicing floorplan, Non-slicing floorplan, Classification of Floorplanning algorithms, Constraint based floorplanning, Integer programming based floorplanning, Rectangular dual graph approach, Hierarchical tree based methods, Simulated annealing based approach, **Theoretical advancement in floorplanning, Recent trends, Pin Assignment : Problem formulation and design style specific issues, Pin assignment algorithms.**

Placement [5 Hrs]
Problem formulation and design style specific issues, Interconnection topologies, Estimation of wire length, classification of placement algorithms, Simulation based placement algorithms, Partitioning based placement algorithms, Cluster growth algorithm, **Performance driven placement.**

Routing [4 Hrs]
Global routing : Problem formulation, Classification of global routing algorithms, Steiner tree based algorithms, Integer programming based approach. Detailed routing: Routing considerations, routing models, Channel routing problems, Design style specific detailed routing problems, Detailed routing algorithms.

Text Books:
1. Naveed A. Sherwani, "Algorithms for VLSI Physical Design Automation", Kluwer Academic Publishers.
2. Sung-Mo Kang, Yusuf Leblebici, "CMOS Digital Integrated Circuits – Analysis and Design", Tata McGraw-Hill.

Reference Books:
1. Douglas A. Pucknell, Kamran Eshraghian, "Basic VLSI design", Prentice Hall.
2. Wayne Hendrix Wolf, "Modern VLSI Design", Prentice Hall.
3. David Money Harris, Neil H. E. Weste, "CMOS VLSI design: A Circuits and Systems Perspective", Addison Wesley
4. Neil West, Kamran Eshraghian, Michael John Sebastian Smith, "Principles of CMOS VLSI design: A Systems Perspective with Verilog/VHDLManual", Addison Wesley.

Department of Computer Science and Engineering

C345 **CS 1645/CS 1605** **(2L + 1 T hrs/week)**

UNIX INTERNALS AND SHELL PROGRAMMING

Questions to be set having equal weightage/marks from each unit: SIX
TWO from UNIT I, TWO from UNIT II, and TWO from both UNIT I and UNIT II combined.
Questions to be answered: FIVE
Compulsory TWO Questions from UNIT I and UNIT II, and ANY ONE from the combination Question.

Objective: This course focuses on the principles and techniques of UNIX Operating System's concepts and terminologies, including file system programming and shell programming which includes advance UNIX commands and utilities, process management, signal management, Inter-process Communication issues and techniques.

Pre-requisites: Data Structures, Operating Systems and Programming language concepts**.** This course assumes that the student is familiar with C language and has some exposure to program writing in C language.

Course Outcomes: On successful completion of this course, students will be able to:

1. Describe the function of the basic UNIX commands
2. Identify various useful UNIX commands on a standard UNIX based Operating System
3. Write shell programming on UNIX based Operating System
4. Select suitable system calls for file handling
5. Choose appropriate algorithms for process control and synchronization

UNIT I

Introduction [4 Hrs]
Evolution of UNIX Operating System, Introduction to Multi-user System, Features and benefits of UNIX, Versions of UNIX, System Structure of UNIX, User perspective services, Operating System perspective services, Assumptions about hardware, Kernel architecture of UNIX Operating System.

Introduction to Shell scripts and Awk programming [6 Hrs]
Bourne Shell, C Shell, Shell Variables, Scripts, Meta characters and environment, if and case Statements, for, while and until Loops, Awk pattern scanning and processing, begin and end Patterns, Awk arithmetic and variables, Built-in functions and operators, Arrays, Strings.

The Buffer Cache and Internal Representation of Files [6 Hrs]
Buffer Headers, Structure of Buffer Pool, Scenarios for Retrieval of Buffer, Reading and writing Disk Blocks, Advantages and disadvantages of Buffer Cache, System calls for file system, Inodes, Structure of a regular file, Directories, Conversions of a pathname to an Inode, Super Block, Inode assignment to a new file, **Allocation of Disk Blocks.**

System calls for file systems [4 Hrs]
Open, Close, File creation, Special files creation, Read, Write, File and record locking, Adjusting the position of file I/O, lseek, Change Directory, Change Root, Change Owner and Change Mode, stat, fstat, Pipes, Dup and Dup2, **Mounting and un-mounting the file system, Link, Unlink, File System abstraction and maintenance.**

UNIT II

The Structure of Processes and Process control [6 Hrs]
Process States and Transitions, Layout of system memory, The Context of a Process, Manipulation of Process address space, Sleep Process creation and termination, User-ID of a Process, Changing the size of a Process, The Shell, System Boot and INIT process.

Process scheduling and memory management policies [6 Hrs]
Process scheduling with round robin multilevel feedback scheduler, Memory management policies, **Swapping, Demand Paging, Data structures for Demand Paging,** Page Stealer Process, Page faults, **Hybrid system with Swapping and Demand Paging.**

I/O Sub-systems and Inter-process Communications [8 Hrs]
Driver interfaces, Disk Drivers, Terminal Drivers, Streams, Process tracing, **System V Inter-process Communication, Network Communications and Sockets.**

Text Books:
1. Bach, Maurice J., "The Design of the Unix Operating System", PHI, 2004.
2. Karee Christian, "The Unix Operating System", John Wiley & Sons.

Reference Books:
1. Vahalia, "UNIX Internals: The New Frontiers", Pearson Education Inc, 2003.
2. Uresh Vahalia, "UNIX Internals: The New Frontiers", Prentice Hall, 2000.
3. M. Beck, et.al, "Linux Kernel Programming", Pearson Education Asia, 2002.
4. Sumitabha Das, "UNIX Concepts and Applications", McGraw Hill.

Department of Computer Science and Engineering

C353 **CS 1646** **(2L +1T hrs/week)**

SPEECH AND NATURAL LANGUAGE PROCESSING

Questions to be set having equal weightage/marks from each unit: SIX
TWO from UNIT I, TWO from UNIT II, and TWO from both UNIT I and UNIT II combined.
Questions to be answered: FIVE
Compulsory TWO Questions from UNIT I and UNIT II, and ANY ONE from the combination Question.

Objectives:
Natural language generation systems convert information from computer databases into readable human language. Natural language understanding systems convert samples of human language into more formal representations that are easier for computer programs to manipulate
Pre-requisites: computer languages (such as C++, Java or LISP)

Course Outcomes: On successful completion of this course, students will be able to:

1. Define the concepts used for describing and analyzing language
2. Explain semantics related to the language
3. Construct language models for understanding pragmatics of the language
4. Illustrate modeling concepts using programming languages like Python
5. Evaluate basic language modeling techniques using some standard dataset

UNIT I

Introduction [3 Hrs]
Human languages, models, ambiguity, processing paradigms; Phases in natural language processing, applications. Text representation in computers, encoding schemes.

Linguistics resources [3 Hrs]
Introduction to corpus, elements in balanced corpus, TreeBank, PropBank, WordNet, VerbNet etc. Resource management with XML, Management of linguistic data with the help of GATE, NLTK.

Expressions and Automata [6 Hrs]
Regular expressions, Finite State Automata, **word recognition, lexicon. Morphology, acquisition models,** Finite State Transducer. N-grams, smoothing, entropy, HMM, ME, SVM, CRF.

Speech [8 Hrs]
Part of Speech tagging- Stochastic POS tagging, HMM, Transformation based tagging (TBL), Handling of unknown words, named entities, multi word expressions. A survey on natural language grammars, lexeme, phonemes, phrases and idioms, word order, agreement, tense, aspect and mood and agreement, Context Free Grammar, spoken language syntax.

UNIT II

Parsing [4 Hrs]
Parsing- Unification, probabilistic parsing, TreeBank.

Semantics [4 Hrs]
Meaning representation, semantic analysis, lexical semantics, WordNet
Word Sense Disambiguation- Selectional restriction, machine learning approaches, dictionary-based approaches.

Discourse [6 Hrs]
Reference resolution, constraints on co-reference, algorithm for pronoun resolution, text coherence, discourse structure. Applications of NLP- Spell-checking, Summarization.

Information Retrieval [6 Hrs] Vector space model, term weighting, homonymy, polysemy, synonymy, improving user queries. Machine Translation– Overview.

Text books:

1. Daniel Jurafsky and James H Martin. Speech and Language Processing, 2e, Pearson Education, 2009

Reference Books:

1. James A.. Natural language Understanding 2e, Pearson Education, 1994
2. Bharati A., Sangal R., Chaitanya V.. Natural language processing: a Paninian perspective, PHI, 2000
3. Siddiqui T., Tiwary U. S.. Natural language processing and Information retrieval, OUP, 2008

Department of Computer Science and Engineering

C365 **CS 1648** **(2L +1T hrs/week)**

SIGNALS AND NETWORKS

Questions to be set having equal weightage/marks from each unit: SIX
TWO from UNIT I, TWO from UNIT II, and TWO from both UNIT I and UNIT II combined.
Questions to be answered: FIVE
Compulsory TWO Questions from UNIT I and UNIT II, and ANY ONE from the combination Question.

Objectives:

- To understand the basic properties of signal & systems and the various methods of classification
- To learn Laplace Transform &Fourier transform and their properties
- To know Z transform & DTFT and their properties
- To characterize LTI systems in the Time domain and various Transform domains

Pre-requisites: Digital Circuits, Embedded Systems.
Course Outcomes: On successful completion of this course, students will be able to:

1. Compute mathematical description and representation of continuous and discrete time signals and networks
2. Illustrate input output relationship for linear shift invariant system and understand the convolution operator for continuous and discrete time system
3. Measure the signals in frequency domain using Fourier series and Fourier transforms
4. Predict the limitations of Fourier transform and need for Laplace transform
5. Develop the ability to analyze the system in S- domain and Z- domain

UNIT I

Classification of signals and systems [12 Hrs]
Continuous time signals (CT signals) - Discrete time signals (DT signals) - Step, Ramp, Pulse, Impulse, Sinusoidal, Exponential, Classification of CT and DT signals - Periodic & Aperiodic signals, Deterministic & Random signals, Energy & Power signals - CT systems and DT systems-Classification of systems – Static & Dynamic, Linear & Nonlinear, Time-variant & Time-invariant, Causal & Noncausal, Stable & Unstable.

Analysis of continuous time signals [8 Hrs]
Fourier series analysis-spectrum of Continuous Time (CT) signals- Fourier and Laplace Transforms in CT Signal Analysis - Properties.

UNIT II

Linear time invariant- continuous time systems [6 Hrs]
Differential Equation-Block diagram representation-impulse response, convolution integrals-Fourier and Laplace transforms in Analysis of CT systems

Analysis of discrete time signals [6 Hrs]
Baseband Sampling - DTFT – Properties of DTFT - Z Transform – Properties of Z Transform

Linear time invariant-discrete time systems [8 Hrs]
Difference Equations-Block diagram representation-Impulse response - Convolution sum- Discrete Fourier and Z Transform Analysis of Recursive & Non-Recursive systems

Text Books:

1. Allan V.Oppenheim, S.Wilsky and S.H.Nawab, "Signals and Systems", Pearson, 2007.
2. B. P. Lathi, "Principles of Linear Systems and Signals", Second Edition, Oxford, 2009.

Reference Books:

1. R.E.Zeimer, W.H.Tranter and R.D.Fannin, "Signals & Systems - Continuous and Discrete", Pearson, 2007.
2. John Alan Stuller, "An Introduction to Signals and Systems", Thomson, 2007.
3. M.J.Roberts, "Signals & Systems Analysis using Transform Methods & MATLAB", Tata McGraw Hill, 2007.

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Date.....

Department of Computer Science and Engineering

C346 **CS 1650** **(2L + 1 T hrs/week)**

AGILE METHODOLOGY

Questions to be set having equal weightage/marks from each unit: SIX
TWO from UNIT I, TWO from UNIT II, and TWO from both UNIT I and UNIT II combined.
Questions to be answered: FIVE
Compulsory TWO Questions from UNIT I and UNIT II, and ANY ONE from the combination Question.

Objective: The main objective of this course is to help one to understand the meaning of agile, its importance and when it is best suited in software industry. As software industry is going crazy on agile methods to software development and agile is rapidly becoming the choice for software development this course prepares students to understand the concept of agile and working of agile tools for software development.

Pre-requisites: Knowledge of software life cycle and software development and management.

Course Outcomes: On successful completion of this course, students will be able to:

1. Explain the philosophy and historical context of agile methods
2. Enumerate the common agile practices and principles based on the contemporary scientific discourse
3. Analyze the strengths and weaknesses of an agile approach within a particular development context
4. Modify selected agile practices and principles based on own experience from project
5. Employ the latest tools in agile methodology

UNIT I

Introduction to Agile methodology [6 Hrs]

Introducing to agile – Origin of methodologies, the agile framework – history, principles, values, and methodologies, Agile Manifesto, Agile versus traditional method, Agile lifecycle, Benefits and challenges of Agile

User Stories, Agile Estimation and Planning [2 Hrs]

Gathering Requirements: The agile way, User Stories: gathering user needs, Characteristics of user stories, generating user stories, Agile Estimation and planning: velocity, release planning and tracking.

Agile development methods [6 Hrs]

Scrum – Introduction and key principles, Scrum – sprints, requirements, product backlog, Scrum roles – Product Owner, ScrumMaster, Team and Project Manager, Sprint planning and tracking-Burndown charts, Sprint Review, Retrospective and Sprint Execution, Value Delivery in Scrum Delivery

People and their roles [6 Hrs]

Managing the Agile approach, Monitoring progress, Targeting and motivating the team, Managing business involvement, Escalating issues, Empowerment Team Size, Skills availability motivation.

UNIT II

Introduction to Devops [7 Hrs]

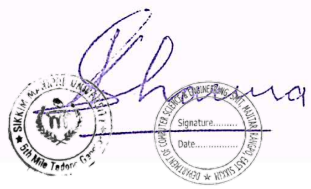
Introduction to DevOps, Agile vs Devops, Benefits for using DevOps, Combining DevOps with agile, Understanding DevOps and its evolution.

DevOps tools [8 Hrs]

GIT, JENKINS, SELENIUM, DOCKER, PUPPET, CHEF, ANSIBLE, NAGIOS, SPLUNK and ELK STACK

DevOps Engineers roles and responsibilities [5 Hrs]

DevOps Roles, DevOps Engineers, the skills & responsibilities of a DevOps Engineer, VMWare



Text Books:

1. Shore, James, and Shane Warden. "The Art of Agile Development O'Reilly Media Inc." (2008): 354.
2. Kim, Gene, et al. The DevOps Handbook: How to Create World-Class Agility, Reliability, and Security in Technology Organizations. IT Revolution, 2016.

Reference Books:

1. Martin, Robert C. Agile software development: principles, patterns, and practices. Prentice Hall, 2002.
2. Shore, James. The Art of Agile Development: Pragmatic guide to agile software development. " O'Reilly Media, Inc.", 2007.
3. Kim, Gene, et al. "The DevOps Handbook: How to Create World-Class Agility." Reliability, and Security in Technology Organizations (2016).
4. Schwaber, Ken, and Mike Beedle. Agile software development with Scrum. Vol. 1. Upper Saddle River: Prentice Hall, 2002.

Department of Computer Science and Engineering

C347 **CS 1651** **(2L +1T hrs/week)**

LATEST TRENDS IN COMPUTER SCIENCE

Questions to be set having equal weightage/marks from each unit: SIX
TWO from UNIT I, TWO from UNIT II, and TWO from both UNIT I and UNIT II combined.
Questions to be answered: FIVE
Compulsory TWO Questions from UNIT I and UNIT II, and ANY ONE from the combination Question.

Objectives: This course provides students with:

- Introduction to deep learning, a branch of machine learning concerned with the development and application of modern neural networks.
- An opportunity to explore the research issues in augmented Reality and Virtual Reality (AR &VR).
- It also acquaints the learners with basic concept and framework of virtual reality.
- It addressed to overview of intelligent robotics systems including the algorithms for the analysis of the data obtained by vision and range sensors, basic principles of modeling kinematics and dynamics and design of basic control strategies.

Pre-requisites: Design and Analysis of Algorithms, Basics of Soft computing and AI will be preferable.

Course Outcomes: On successful completion of this course, students will be able to:

1. Discuss various recent technologies used in computer science associated with research and application.
2. Select optimal design scheme suitable for data analytics techniques and tools for extraction of knowledge
3. Identify modern engineering tools, techniques and resources to solve various Computer Vision, Big Data, Block chain Problems, etc
4. Classify machine learning algorithms for sovling Artificial Intelligence problems or other related problems.
5. Decide the individual specialization from the recent trends in computer science of their interest.

UNIT I

Data Science [5 Hrs]
Introduction, Data Science project lifecycle, Statistics, Data Preparation, Model Building, Machine learning models, Performance measurement of a model, Communicating results, Python for Data Science.

Internet of Things (IoT) [5 Hrs]
Introduction to IoT, IoT Technologies and Architectures: Devices and Gateways, Local and wide area networking, Data management, Applications of Internet of Things, Opportunities and Challenges in the Internet of Things.

Computer Vision [6 Hrs]
Fundamentals of vision: Image Formation and Representation – Intensity and Range Images– Camera models – Camera Parameters – Light and color – Image noise – Image filtering – Image smoothing-Sharpening, Image features: point and line detection – Hough Transform – Edge detection – corner detection – Harris Detecter – Textures – Principal component analysis – feature descriptors – SIFT and SURF, High level vision: Geometric methods – Model based vision – Obtaining hypothesis by pose consistency – pose clustering using invariants – verification, Linear discriminant based classifiers and tree classifiers.

Machine Learning [5 Hrs]
Learning- Supervised and Unsupervised learning, adaptive Learning, Reinforcement learning, Linear classification, Loss minimization, Stochastic gradient descent, K-Means Algorithm, The perceptron. Learning by gradient descent. Multilayer perceptron and the back propagation algorithm, Deep learning, Auto-encoders, CNNs, RNNs, Introduction to Natural Language Processing.

UNIT II

Artificial Intelligence [6 Hrs]

Overview of Artificial intelligence, Problems and techniques, Problem solving agents, searching for solutions; various uniform search strategies, Introduction to Heuristic search strategies, Hidden Markov models, Learning Bayesian networks, Fuzzy sets & fuzzy logics

Block Chain Coding [6 Hrs]

Introduction: trustless system, Why blockchain, Decentralized transactions. History: How and when blockchain/bitcoin started, Milestones on the development of bit coin: creation, exchanges. Overview of blockchain technology: What is blockchain, Transactions: Recording transactions, Digital signature, Verifying and confirming transactions; Blocks, Hashes, Consensus: Distributed consensus, Byzantine generals problem, Proof of work; Verify and confirm blocks. Blockchain applications : Government, Identity management, Auto executing contracts, Three signature escrow, Triple entry accounting, Elections and voting?

Augmented Reality[7 Hrs]

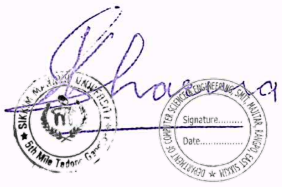
Introduction of Virtual Reality: Fundamental Concept and Components of Virtual Reality. Primary Features and Present Development on Virtual Reality. What is Augmented Reality? History of Augmented Reality. Augmented and Mixed Reality, Mixed Reality. Mixed Reality continuum, Taxonomy, technology and features of augmented reality, difference between AR and VR, Challenges with AR, AR systems and functionality, Augmented reality methods, visualization techniques for augmented reality, wireless displays in educational augmented reality applications.

Text Books:

1. Data Science from Scratch: First Principles with Python, Joel Grus, O'Reilly Media Publication
2. Bernd Jahne and Horst HauBecker, Computer vision and Applications, Academic Press, 2000
3. David A. Forsyth & Jean Ponce, Computer vision-A modern Approach, Prentice Hall, 2002
4. Introductory techniques for 3D computer vision, Prentice Hall, 1998
5. Arvind Narayanan, Joseph Bonneau, Edward Felten, "Bitcoin and Cryptocurrency Technologies: A Comprehensive Introduction", Kindle Edition.
6. Andreas M. Antonopoulo,"Mastering Bitcoin: Programming the Open Blockchain",2nd Edition, Kindle Edition.

Reference Books

1. Andries P. Engelbrecht , "Computational Intelligence: An Introduction", Wiley 2nd Edition, 2007
2. Robin R. Murphy, "Introduction to AI Robotics", MIT Press, 2000
3. Leandro N. de Castro and Jonathan Timmis, "Artificial Immune system: A new Computational Intelligence Approach", Springer-Verlag, Germany 2002.



Department of Computer Science and Engineering

C348 **CS 1653** **(2L +1T hrs/week)**

NEURAL NETWORKS AND DEEP LEARNING

Questions to be set having equal weightage/marks from each unit: SIX
TWO from UNIT I, TWO from UNIT II, and TWO from both UNIT I and UNIT II combined.
Questions to be answered: FIVE
Compulsory TWO Questions from UNIT I and UNIT II, and ANY ONE from the combination Question.

Objectives:
This course is an introduction to deep learning, a branch of machine learning concerned with the development and application of modern neural networks. Deep learning algorithms extract layered high-level representations of data in a way that maximizes performance on a given task.

Pre-requisites: Calculus, Linear Algebra, Probability & Statistics, Ability to code in Python

Course Outcomes: On successful completion of this course, students will be able to:

1. Discuss the computational complexity of most neural network problems requires us regularly to deal with approximate techniques
2. Evaluate the basic problem solving methods based on AI-based search, knowledge representation, reasoning, planning, and machine learning algorithms.
3. Develop a set of alternative design solutions to problems for which standard algorithmic solutions do not exist.
4. Classify the different technical issues related to Deep Architectures consistent with their level of knowledge and understanding.
5. Construct neural network models and make these models work on practical problems in Deep Learning

UNIT I

Foundations of Neural Networks [7 Hrs]
Definitions and history of neural networks, Traditional neural networks, learning rules, Introduction to deep learning, Neural networks basics, Shallow neural networks, Deep neural networks, Neuro architectures as necessary building blocks for the DL techniques

Improving Deep Neural Networks [6 Hrs]
Recurrent Networks and Back Propagation, associative memories, Practical Aspects of deep learning, Optimization algorithms, Hyperparameter tuning, Batch Normalization and Programming Frameworks, Deep Learning & Neocognitron

Structuring Machine Learning Projects [6 Hrs]
ML Strategy, Setting up your goal, human level performance, Error Analysis, Mismatched training and dev/test distributions, learning for multiple tasks, endto-end deep learning

UNIT II

Convolutional models [8 Hrs]
Convolutional neural networks, Computer vision applications Deep Convolutional Neural Networks, feature extraction, Deep Belief Networks, Restricted Boltzman Machines, Autoencoders Training of Deep Neural Networks

Sequence models [6 Hrs]
RNN, LSTM, GRU models, Application to NLP, Application to Speech recognition

Case studies [6 Hrs]
In-depth discussion of DL examples, **Applications and examples (Google, image/speech recognition, NLP)**

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Text Books:

1. Ian Goodfellow, Yoshua Bengio, Aaron Courville. Deep Learning.
2. Duda, R.O., Hart, P.E., and Stork, D.G. Pattern Classification. Wiley-Interscience. 2nd Edition. 2001.
3. Theodoridis, S. and Koutroumbas, K. Pattern Recognition. Edition 4. Academic Press, 2008.

Reference Books:

1. Russell, S. and Norvig, N. Arti cial Intelligence: A Modern Approach. Prentice Hall Series in Artificial
Intelligence. 2003.
2. Bishop, C. M. Neural Networks for Pattern Recognition. Oxford University Press. 1995.
3. Hastie, T., Tibshirani, R. and Friedman, J. The Elements of Statistical Learning. Springer. 2001.

Department of Computer Science and Engineering

C366 **CS 1654/ CS 1623** **(2L+1T hrs/week)**

REMOTE SENSING

Questions to be set having equal weightage/marks from each unit: SIX
TWO from UNIT I, TWO from UNIT II, and TWO from both UNIT I and UNIT II combined.
Questions to be answered: FIVE
Compulsory TWO Questions from UNIT I and UNIT II, and ANY ONE from the combination Question.

Objective:
Introduce the principles of remote sensing to students who are beginners in this field. Much as the text book has laid out, fundamental knowledge on the physics of remote sensing, aerial photographic techniques, photogrammetric, multispectral, hyperspectral, and thermal imaging, and RADAR and LIDAR image analysis will be introduced. The newest technology in the field will also be discussed. The subject will be synthesized by developing an overall application of the discipline, not just knowledge in one aspect. The course will be taught with an emphasis on the geographical applications of remote sensing; however, in certain instances other disciplines will be introduced as well. Lab assignments will supplement classroom discussion and reading assignments. At the end of the semester students should have a good understanding and basic skills of remote sensing

Pre-requisites: NIL.

Course Outcomes: On successful completion of this course, students will be able to:

1. Enumerate methods used in preprocessing, image analysis and information extraction from different types of imageries.
2. Select and apply appropriate data manipulation and visualization methods for a number of earth science applications.
3. Explain the use of geographical applications in remote sensing
4. Focus photographic techniques, photogrammetric, multispectral, hyper spectral, thermal imaging, and RADAR/ LIDAR images.
5. Differentiate between contemporary data manipulation and visualization tools in remote sensing

UNIT-I

Physics of Remote Sensing [5 Hrs]
Introduction of Remote Sensing- Electromagnetic spectrum, physics of remote sensing-Effects of atmosphere- scattering- Different types- Absorption- Atmospheric Window- Energy interaction with surface features- Spectral Reflectance of vegetation, soil and water- atmospheric influence on spectral response patterns- multi concept in Remote Sensing.

Data Acquisition [7 Hrs]
Types of platforms- Different types aircraft- Manned and Unmanned space crafts – sun synchronous and geo synchronous satellites- Types and characteristics of different platforms – LANDSAT, SPOT, IRS, INSAT, IKONOS, QUICKBIRD, etc – Photographic products, B/W, colour, colour IR film and their characteristics – resolving power of lens and film – Opto mechanical electro optical sensors – across track and along track scanners – multi spectral scanners and thermal scanners – geometric characteristics of scanner imagery – calibration of thermal scanners. **Aerial photography/aerial cameras/photographic process.**

Scattering System [7 Hrs]
Microwave scatterometry – types of RADAR – SLAR – resolution – range and azimuth – real aperture and synthetic aperture RADAR. Characteristics of Microwave images- topographic effect – different types of Remote Sensing platforms –air borne and space borne sensors – ERS, JERS, RADARSAT, RISAT – Scatterometer, Alimeter- LiDAR Remote Sensing, principles, applications.

UNIT-II

Multi Spectral & Hyper Spectral Remote Sensing [5 Hrs]
Sensors characteristics – principle of spectroscopy – imagine spectroscopy – field conditions, compound spectral curve, Spectral library, radiative models, processing procedures, derivative spectrometry, thermal remote sensing – thermal sensors, principles, thermal data processing, applications.

Thermal Radiation Principles And Thermal Imaging [4 Hrs]
Thermal remote sensing– thermal sensors, principles, thermal data processing, applications.

Data Analysis [7 Hrs]
Resolution- Spatial, Spectral, Radiometric and temporal resolution- signal to noise ratio- data products and their characteristics – visual and digital interpretation –Basic principles of data processing –Radiometric correction –Image enhancement –Image classification – Principles of LiDAR, Aerial Laser Terrain mapping.

Applications of Remote Sensing [5 Hrs]
Remote sensing of soils and geomorphology, Remote Sensing of vegetation, Remote sensing of water resources and Urban applications using remote sensing imagery.

Text Books:

1. Jensen, John R., 2000, Remote Sensing of the Environment: An Earth Resource Perspective, New Jersey: Prentice Hall, 544 pages. ISBN 0-13-489733-1.

Reference:

1. Lillsand T.M. and Keifer, R.W. Remote sensing and Image Interpretation, VI edition of John Wiley & Sons-2000.
2. John R. Jesen, Introductory Digital Image Processing: A Remote Sensing Perspective, 2nd Edition, 1995.
3. John A.Richards, Springer-Verlag, Remate Sensing Digital Image Analysis 1999.
4. Paul Curran P.J. Principles of Remote Sensing, ELBS, 1995.
5. Charles Elachi and JakobJ.vanZyl, Introduction to the Physics and Techniques of Remote Sensing, Wiley Series in Remote Sensing and Image Processing, 2006.
6. Sabins, F.F.Jr, Remote Sensing Principles and Image Interpretation, W.H. Freeman &co, 1978.

Department of Computer Science and Engineering

C349 **CS 1655/CS 1624** **(2L +1T hrs/week)**

AUTONOMOUS MOBILE ROBOTICS AND COMPUTATIONAL INTELLIGENCE

Questions to be set having equal weightage/marks from each unit: SIX
TWO from UNIT I, TWO from UNIT II, and TWO from both UNIT I and UNIT II combined.
Questions to be answered: FIVE
Compulsory TWO Questions from UNIT I and UNIT II, and ANY ONE from the combination Question.

Objectives: The course will cover basic principles of design and practice of intelligent robotics systems including the algorithms for the analysis of the data obtained by vision and range sensors, basic principles of modeling kinematics and dynamics and design of basic control strategies. Emphasize will also be given on formulating interesting robotics tasks and show how they can be accomplished by individual robot or cooperative robot teams (such as flocking, foraging as well as robotic soccer).
Pre-requisites: Design and Analysis of Algorithms, Basic Mathematics (linear algebra, calculus and probability), Soft computing.
Course Outcomes: On successful completion of this course, students will be able to:

1. Identify application of Robots
2. Describe the evolution, kind of robots and basics of design of a Robotics System
3. Choose correct choices of Locomotion, Kinematics, Perception techniques
4. Apply Intelligent Algorithms for decision making in Motion Planning and path optimization
5. Develop simple robot control systems integrating perception, planning, and action

UNIT-I

Introduction [4 Hrs]
Definition, Applications of mobile robotics, History of mobile robotics.

Design of system and navigation architecture [7 Hrs]
Reference control scheme of a mobile robotics environment, Temporal decomposition of architecture, Control decomposition, Hybrid architecture, Mobile architecture, Perception, **Representation and the mapping process**.
Locomotion [6 Hrs]
Issues for locomotion, Legged mobile robots, Wheeled mobile robots.
Kinematics [6 Hrs]
Kinematics introduction, Forward and reverse kinematics, Wheeled kinematics and its constraints, Mobile system locomotion, Human biped locomotion as a rolling polygon, **Representation of robot position through the reference frame.**

UNIT-II

Perception [4 Hrs]
Sensors for mobile robots, Sensor classification, Characterization and sensor performance, Wheeled motor sensor, Ground bases beacon, **Active ranging, Motion/Speed sensor, Vision based sensors.**

Navigation [3 Hrs]
Localization overview, Path planning.

Computational intelligence [5 Hrs]
Swarm intelligence, Evolutionary computation, **Artificial immune system, Ant algorithm.**

Mobile robot programming [7 Hrs]
This chapter is included to provide hands on introduction to the field of mobile robotics and various issues in designing and planning of robot work environment. It includes construction and programming of robotic agents using robotic kits and microcontrollers applying concepts of locomotion, perception, navigation and computational intelligent algorithms.

Text Books:

1. Ronald Siegwart, Illah R. Nourbakhsh, "Introduction to Autonomous Mobile Robots", MIT Press,
2. Andries P. Engelbrecht , "Computational Intelligence: An Introduction", Wiley 2nd Edition, 2007

Reference Books:

1. Ronald C. Arkin , "Intelligent Robotics and Autonomous Agents", MIT Press, 1997
2. Ulrich Nehmzow, "Mobile Robotics: A practical Introduction", Springer-Verlag London, 2003
3. Robin R. Murphy, "Introduction to AI Robotics", MIT Press, 2000
4. Leandro N. de Castro and Jonathan Timmis, "Artificial Immune system: A new Computational Intelligence Approach", Springer-Verlag, Germany 2002.

Department of Computer Science and Engineering

C339 **CS 1656/CS 1625** **(2L+1T hrs/week)**

GEOGRAPHICAL INFORMATION SYSTEM

Questions to be set having equal weightage/marks from each unit: SIX
TWO from UNIT I, TWO from UNIT II, and TWO from both UNIT I and UNIT II combined.
Questions to be answered: FIVE
Compulsory TWO Questions from UNIT I and UNIT II, and ANY ONE from the combination Question.

Objective: To provide an understanding of the basic concepts and uses of GIS technology so that spatial analysis can be incorporated as an additional aspect of student research and studies. In this class you will learn about basic GIS concepts including spatial data structures, data sources and transfer methods, projections and co-ordinate systems, geo-referencing, Meta data, supporting software and Global Positioning Systems, the integration of Remote Sensing and GIS, as well as fundamental spatial analysis techniques such as overlay, extraction, an interpolation. Concepts presented in lecture will be put into practice through hands-on laboratory exercises utilizing the GIS software product ERDAS8.4.

Pre-requisites: It is expected that students will have a general knowledge and familiarity with personal computers, computer terminology, files and directories, and the window XP Operating System.

Course Outcomes: On successful completion of this course, students will be able to:

1. Define appropriate data manipulation and visualization method for a number of Earth Science applications in GIS
2. Operate PC-based visualization software effectively.
3. Illustrate earth science data and present the result in an organized and concise fashion.
4. Connect the hand-held GPS units for demarking geographical location/ latitude /longitude/etc.
5. Compare different contemporary methods used in earth science data interpretation

UNIT-I

Introduction and over view of Geographic Information Systems [6Hrs]
Definition of GIS, feature and functions of GIS, Importance & Applications of GIS; GIS and cartography; GIS data feeds; Cartography Vs GIS; **Map Projections - coordinate systems; precision and error.**

Data Sources, Data Input, Data Quality, and Database Concepts [8Hrs]
Major data feeds to GIS and their characteristics : maps, basic concepts of geo–positioning, GPS, **Measurement for accuracy of GPS data**, **images, databases, commercial data**; locating and evaluating data; data formats; data quality; meta data.

Making Maps [7Hrs]
Maps and their characteristics; classification of map and map projection; parts of a map; map functions in GIS; Map design and map elements; choosing a map type; producing a map formats, plotter and media; interactive maps and the Web GIS.

UNIT-II

Spatial Analysis [10Hrs]
Spatial, thematic, and temporal dimensions of geographic data; GIS analytical functions; vector analysis including topological overlay; Raster analysis; Statistics; Integrated Spatial analysis, process of GIS- data capture, data source, encoding methods, Terrain mapping and analysis.

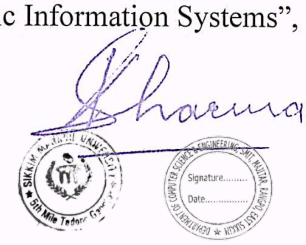
Transportation Network Development- Algorithms And Applications [9Hrs]
Network development and management: Network properties; **Path analysis: and its application**; **Shortest path algorithms**; Transit network and paths: Transportation and land-use Model: Linear and Network Models.

Text Books:
David JM, "Michael FG & David WR 1991: Geographical Information System", Prentice Hall
Ian Heywood, Sarah Cornelius, Steve Carver, SrinivasaRaju, "An Introduction to Geographical

Information Systems", 2nd Edition, Pearson Education.

Reference

B. Bhatta, "Remote Sensing and GIS", Oxford University Press.
Kang-tsung Chang, "An Introduction to Geographical Information Systems", 4th Edition, Tata McGraw-Hill.
Canada Centre for Remote Sensing: Tutorial on RS.
Chrisman NR, "Exploring Geographic Information Systems", John Wiley & Sons.



Department of Computer Science and Engineering

C354 **CS 1657** **(2L +1T hrs/week)**

SOFT SKILLS AND INTERPERSONAL COMMUNICATION

Questions to be set having equal weightage/marks from each unit: SIX
TWO from UNIT I, TWO from UNIT II, and TWO from both UNIT I and UNIT II combined.
Questions to be answered: FIVE
Compulsory TWO Questions from UNIT I and UNIT II, and ANY ONE from the combination Question.

Objectives:
To enhance holistic development of students and improve their employability skills.

Pre-requisites: NIL.

Course Outcomes: On successful completion of this course, students will be able to:

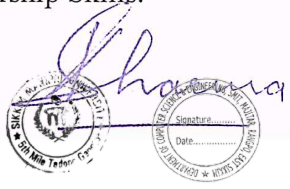
1. Define and describe personality types, communication styles, low/high context cultures and other terms and concepts important for interpersonal and communication skills
2. Apply principles of negotiations to persuade and negotiate with idealistic and practical moral values
3. Analyze, explain and solve conflicts using principles of conflict resolution
4. Describe and explain principles of behavioral psychology
5. Manage time, stress, criticism, and team by formulating strategies appropriate for the situation and type of people.

UNIT I

Professional Communication [5 Hrs]
An Overview of Professional Communication – Communication Principles - 5 Essential Professional Communication Skills –Visual Communication – Communication Networks - Behavioral Styles – Being Assertive – Saying No – Dealing with the Rambler – Responding to Criticism – Leader vs Manager - Case studies and discussions.
Business Writing [5 Hrs]
What and why of Business Writing - Business Vocabulary - Giving and Writing Instructions - Delivering Good / Bad News - Media Communication – Multi Channel Communication - Professional Writing and Editing - Email Etiquette - Writing Executive Summary – Report Writing – Progress Reports – Investigative Reports.
Corporate Communication [5 Hrs]
Neo Professionalism - Telephone Etiquette - Teleconferencing - Face to Face Communication - Managing Social Networking as Interpersonal Communication - Effective human relations at workplace - Time Management - Multi tasking - SMART Goal setting - Planning - Prioritization - Effective Execution - Importance of Interviewing - Types of Interviews - Structuring Effective Interviews - Corporate Branding - Advanced Presentational Speaking. Case studies and discussions.
Cross Cultural Communication [5 Hrs]
An Overview - High and Low Context Cultures - Understanding Cultural Diversity- Awareness of Individual Cultures and Cultural Tolerance – Importance of Non Verbal Communication Across Cultures-Tactics and Timing - Dozen Rules of Thumb for Avoiding Inter Cultural Misunderstandings - Managing Conflict - Negotiation - Culture as Context for Communication - Case studies and discussions.

UNIT II

Gratitude [5 Hrs]
Understanding the relationship between Leadership Networking & Team work. Assessing Interpersonal Skills Situation description of Interpersonal Skill. Team Work: Necessity of Team Work Personally, Socially and Educationally.
Leadership [2 Hrs]
Skills for a good Leader, Assessment of Leadership Skills.



Stress Management [5 Hrs]
Causes of Stress and its impact, how to manage & distress, Circle of control, Stress Busters. Emotional Intelligence
What is Emotional Intelligence, emotional quotient why Emotional Intelligence matters, Emotion Scales. Managing Emotions.

Conflict Resolution [4 Hrs]
Conflicts in Human Relations – Reasons Case Studies, Approaches to conflict resolution.

Decision Making [4 Hrs]
Importance and necessity of Decision Making, Process and practical way of Decision Making, Weighing Positives & Negatives.

Text Books:
1. Business Communication for managers: An advanced approach, by Penrose, Cengage learning.
2. SOFT SKILLS, 2015, Career Development Centre, Green Pearl Publications.
3. Covey Sean, Seven Habit of Highly Effective Teens, New York, Fireside Publishers, 1998.

Reference Books:
1. Carnegie Dale, How to win Friends and Influence People, New York: Simon & Schuster, 1998.
2. Inter cultural communication for business by O'Rourke & Tuleja, Cengage learning
3. Professional Communication in Engineering. by H.E. Sales. Palgrave Macmillan 2009.

Department of Computer Science and Engineering

C367 **CS 1658** **(2L +1T hrs/week)**

HUMAN RESOURCE DEVELOPMENT AND ORGANIZATIONAL BEHAVIOR

Questions to be set having equal weightage/marks from each unit: SIX
TWO from UNIT I, TWO from UNIT II, and TWO from both UNIT I and UNIT II combined.
Questions to be answered: FIVE
Compulsory TWO Questions from UNIT I and UNIT II, and ANY ONE from the combination Question.

Objectives: The objective of the course is to familiarize the students about the different aspects of managing people in the organizations from the stage of acquisition to development and retention. In order to be successful, today's organizations must integrate organizational behavior and HRD. Organizations are dependent upon their employees to obtain the goals of the organization. It is through the employees that organizations can overcome the challenges with which organizations are faced today. Employees have to be motivated as a way of making them increase their productivity which is accomplished through the examination of organizational behavior and implementation of human resource development initiatives.

Pre-requisites: NIL

Course Outcomes: On successful completion of this course, students will be able to:

1. Determine the concept of organizational behavior principles and their influence in workplace.
2. Analyze the complexities associated with management of individual human behavior as well as group behavior in the organization.
3. Evaluate management styles of self and others and also able integrate in understanding the motivation (whys) behind behavior of people in the organization.
4. Express and defend opinions through the use of management case studies.
5. Infer critical thinking and apply in research, writing and presentation skills.

UNIT I

Introduction [5 Hrs]
Conceptual foundations; Human aspect of management, Human Relations; Human Resource Management- Concept, Scope and Importance; Competencies of HR Manager: Employer branding and Competency mapping; Changing role of HRM- Workforce diversity, Technological change, Restructuring and rightsizing, Empowerment; TQM, Managing ethical issues.

Human Resource Planning, Job Analysis, and Job Design [5 Hrs]
Assessing Human Resource requirements; Human resource forecasting; Work load analysis ;Job analysis; Job description and specifications; Job design; Job characteristic approach to job design.

Recruitment, Selection, Training, and Development [5 Hrs]
Factors affecting recruitment; Sources of recruitment (internal and external); Basic selection model; Psychological tests for selection; Interviewing; Placement and Induction; Job Changes- Transfers, Promotions, and Separations; An overview of Training and Development; Emerging trends in Recruitment, Selection, and development.

Compensation Management, Performance Appraisal, and Audit [5 Hrs]
Compensation Management-Job Evaluation, Base Compensation and Supplementary Compensation; Innovations in Compensation Management- Pay Band System, ESOP, Flexi-time Schedules, etc. Performance Appraisal- Concept, Objectives and Methods; Traditional and Modern Methods- MBO, 360 Degree Appraisal, Behaviourally Anchored Rating Scale, Potential Appraisal, Human Resource Audit.

UNIT II

The Evolution of Organizational Behavior [5 Hrs]
Foundations of Individual Behavior, Personality and Behavior in Organizations, Emotions and Moods in the Workplace, Attitudes and Values in the Workplace, Ethics in the Workplace

Perception and Attribution [5 Hrs] Learning in the Workplace, Employee Motivation, **Individual Decision Making in Organizations**, Workforce Diversity, Organizational Communication in Business

Groups and Work Teams [5 Hrs]
Group Decision Making, Conflict in the Workplace, Leadership in Organizational Behavior
Leadership Theory in Organizational Behavior, Organizational Structure and Design

Job Design [5 Hrs]
Organizational Culture, Organizational Change and Behavior, Managing Workplace Stress, Career Management Global Implications of Organizational Behavior

Text Books:

1. Swati Sharma, Handbook of Organizational Behaviour and Human Resources 1 Edition
2. Mirza Saiyadain, Jag Sodhi, Cases in Organisational Behaviour and Human Resource Management Paperback – 18 Mar 2009

Reference Books:

1. Sanjeev Kumar Singh, Human Resource Development : HRD—IR Interface Approach
2. G G Jadhav, Human Resource Management And Organisational Behaviour

Department of Computer Science and Engineering

C416 **CS 1741** **(2L +1T hrs/week)**

MACHINE LEARNING

Questions to be set having equal weightage/marks from each unit: SIX
TWO from UNIT I, TWO from UNIT II, and TWO from both UNIT I and UNIT II combined.
Questions to be answered: FIVE
Compulsory TWO Questions from UNIT I and UNIT II, and ANY ONE from the combination Question.

Objectives: It reflects recent developments while providing a comprehensive introduction to the fields of pattern recognition and machine learning. It is aimed at advanced undergraduates assuming no previous knowledge of pattern recognition or machine learning concepts.
Pre-requisites: Knowledge of multivariate calculus and basic linear algebra and basic probability theory

Course Outcomes: On successful completion of this course, students will be able to:

1. Display sufficient understanding of mathematical and engineering fundamentals in the perspective of machine learning theory.
2. Identify problems that can be solved using machine learning techniques.
3. Appreciate the importance of tolerance of imprecision and uncertainty for design of robust and low-cost intelligent machines.
4. Investigate a problem to identify technical issues and solve the problems using various machine learning techniques.
5. Design real-life applications using machine learning techniques.

UNIT-I

Introduction [4 Hrs]
Polynomial Curve Fitting, Probability Theory: Expectations and Co-variances, Bayesian probabilities, The Gaussian distribution, Curve fitting re-visited.

Linear Models for Regression [6 Hrs]
Linear Basis Function Models: Maximum likelihood and least squares, Sequential learning,Regularized least squares, The Bias-Variance Decomposition: **Bayesian Linear Regression, Parameter distribution, Predictive distribution.**

Linear Models for Classification [6 Hrs]
Discriminant Functions: Two classes, Multiple classes, Least squares for classification, Probabilistic Generative Models: Continuous inputs, **Maximum likelihood solution, Probabilistic Discriminative Models: Fixed basis functions, Logistic regression.**

Sparse Kernel Machines [5 Hrs]
Maximum Margin Classifiers: Overlapping class distributions, Relation to logistic regression, Multiclass SVMs

UNIT-II

Kernel Methods [4 Hrs]
Dual Representations, Constructing Kernels,Radial Basis Function Networks.

Neural networks [6 Hrs]
Basic concepts: The artificial neuron, The McCulloch- Pitts neural model, The perceptron neural network architectures: Single layer feed forward ANNs, **Multi-layer feed forward ANNs, Activation function, Generalized delta rule, The Back propagation Algorithm: Learning, Parameter optimization,Convolutional networks: Auto-sparse encoders.**

Mixture Models and EM [5 Hrs]
K-means Clustering, Mixtures of Gaussians, Maximum likelihood, **EM for Gaussian mixtures.**

Continuous Latent Variables [2 Hrs]
Principal Component Analysis: Maximum variance formulation, **Applications of PCA,PCA for high-dimensional data.**

Sequential Data [3 Hrs]
Markov Models, Hidden Markov Models, Maximum likelihood for the HMM, **The forward-backward algorithm.**

Text Books:
1. Christopher M. Bishop, "Pattern Recognition and Machine Learning", Springer.

2. David J.C. Mackay, "Information Theory, Inference and Learning Algorithms", Cambridge University Press, 2003.

Reference Books:
1. Andrew Ng, " Lecture Notes on Machine Learning"

Department of Computer Science and Engineering

C351 **CS 1659** **(2L +1T hrs/week)**

ETHICAL HACKING

Questions to be set having equal weightage/marks from each unit: SIX
TWO from UNIT I, TWO from UNIT II, and TWO from both UNIT I and UNIT II combined.
Questions to be answered: FIVE
Compulsory TWO Questions from UNIT I and UNIT II, and ANY ONE from the combination Question.

Objective: The course is focussed at understanding and analysing the behaviour of hackers to learn and evaluate their thought and actions which is aimed at harnessing information and hardware that they are not authorised to use. It also helps the learner understand the architecture of modern communication tools and protocols to apprehend their limitations, vulnerability and places of security issues and concerns. The course introduces the modern practices used by hackers and also reflects on the countermeasures taken by the system to keep a check on the vulnerabilities it is being exposed to.

Pre-requisites: Basics of Computer Network, Operating System, Web technology.

Course Outcomes: On successful completion of this course, students will be able to:

1. Examine competence in applying acquired expertise in computer networks
2. Determine an ability to interpret and evaluate behaviour of malwares and their countermeasures
3. Evaluate the approaches used by hackers and work on its countermeasures to reach a valid conclusion
4. Describe an ability to identify the limitation of tools used to break an insecure web application
5. Decide the problem in the decision-making process between possible options using tools

UNIT – I

Introduction [5 hrs]

Fundamentals of computer networking. TCP/IP protocol stack, Understanding security goals and services, Introduction to hacking: Threat, Exploit, What is Penetration test? Vulnerability Vs Penetration testing, Categories of Penetration test. Phases involved in hacking, Foot printing, Scanning, System Hacking, Session Hijacking. Writing Reports, Structure of a Penetration Testing Report, Vulnerability Assessment Summary, Risk Assessment, Methodology, Linux Basics: File Structure, Cron Job, Users, Common Applications, BackTrack, Services.

Information Gathering, Target Enumeration and Port Scanning Techniques [7 Hrs]

Active, Passive and Sources of information gathering, Copying Websites Locally, NeoTrace, Intercepting a Response, WhatWeb, Netcraft, Interacting with DNS Servers, Fierce, Zone Transfer with Host Command and Automation, DNS Cache Snooping- Attack Scenario, Automating Attacks, SNMP - Problem, Sniffing Passwords. Target enumeration and Port Scanning Techniques.

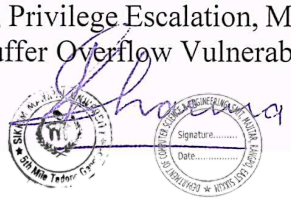
Vulnerability Assessment & Network Sniffing [8 Hrs]

Basics, Pros and cons of Vulnerability Assessment, NMap, Testing SCADA Environments with Nmap, Nessus, Sniffing: Active and passive sniffing, Man in the middle attacks, ARP Protocol Basics- working, Attacks, DoS Attacks, Dsniff tool: Using ARP Spoof to Perform MITM Attacks, Sniffing Pictures with Drifnet, Sniffing with Wireshark, Ettercap- ARP Poisoning, Hijacking Session with MITM Attack, ARP Poisoning with Cain and Abel, Sniffing Session Cookies with Wireshark, Automating Man in the Middle Attacks, DNS Spoofing, DHCP Spoofing.

UNIT – II

Basics Of Exploitation [7 Hrs]

Understanding Network Protocols, Attacking Network Remote Services, Common Target Protocols, Attacking SMTP, Attacking SQL Servers, Client Side Exploitation Methods: E-Mails Leading to Malicious Attachments & Malicious Links, Compromising Client Side Update, Malware Loaded on USB Sticks, Social engineering attacks. Malware threats, penetration testing by creating backdoors Post exploitation: Acquiring Situation Awareness, Privilege Escalation, Maintaining Access, Windows exploit basics: Buffer Overflows, Significance of Buffer Overflow Vulnerability.



Wireless & Web Hacking [7 Hrs]

Wireless Hacking : Requirements , Aircracking , Hidden SSIDs , Monitor Mode , Monitoring Tool-Beacon Frames on Wireshark ,Airodump-ng , Wireless Adapter in Monitor Mode , Determining the Target , Cracking a WPA/WPA2 Wireless Network Using Aircrack-ng , Capturing Packets and Four-Way Handshake , Web Hacking : Attacking the Authentication , Brute Force and Dictionary Attacks. Attacking Authentication: Attacking Session Management, Design Flaws in AuthenticationMechanisms Attacking Forgotten Password Functionality, attacking Password change functions. Countermeasures to authentication attacks. SQL Injection: Attacking SQL Servers, Sniffing, Brute Forcing and finding Application Configuration Files, Input validation attacks. Preventive Measures. Web Application Threats, Web Application Hacking, Cross Site Scripting / XSS Flaws / Countermeasures Correct Web Application Set-up.

Information security [6 Hrs]

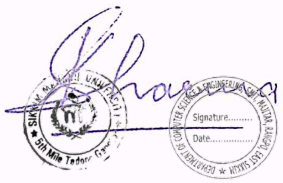
Introduction to cryptography, private-key encryption, public-key encryption. Key exchange protocols, cryptographic hash functions, applications. Steganography, biometric authentication, lightweight cryptographic algorithms. Elements of hardware security: side-channel attacks, physical unclonable functions.

Text Books:

1. Rafay Baloch,"Ethical Hacking and Penetration Testing Guide", CRC Press, 2015.
2. Patrick Engebretson,"The Basics of Hacking and Penetration Testing: Ethical Hacking and Penetration Testing Made Easy", Syngress Media, Second Revised Edition, 2013.
3. William Stallings, "Cryptography and Network Security", Sixth Edition, Prentice-Hall, 2014 ISBN-13: 9780133354690

Reference Books:

1. Michael T. Simpson, Kent Backman, James E. Corley, "Hands On Ethical Hacking and Network Defense", Cengage Learning, 2012.
2. Ankit Fadia, Manu Zacharia, "Network intrusion alert: an ethical hacking guide to intrusion detection", Thomson Course Technology PTR- 2007.
3. Thomas Mathew, "Ethical Hacking", OSB Publisher, 2003.
4. Stuart McClure, Joel Scambray and George Kurtz, "Hacking Exposed: Network Security Secrets & Solutions", McGraw-Hill, 2005.



Department of Computer Science and Engineering

C431 **CS 1745** **(2L + 1 T hrs/week)**

HIGH PERFORMANCE COMPUTING

Questions to be set having equal weightage/marks from each unit: SIX
TWO from UNIT I, TWO from UNIT II, and TWO from both UNIT I and UNIT II combined.
Questions to be answered: FIVE
Compulsory TWO Questions from UNIT I and UNIT II, and ANY ONE from the combination Question.

Objective: The overall goal is to acquaint students with parallel computations in current hardware and software tools, and trends in parallel scientific computing, to provide an opportunity to build and execute sample parallel codes, program in multicore and cluster architectures.
The theoretical and practical mix of the HPC Software development programs has the following objectives:

1. To explore the fundamental concepts of Parallel programming and HPC Solutions and their applications.
2. To develop in-depth knowledge and understanding of HPC domain.
3. To understand the various search methods and visualization techniques.
4. To learn to use various HPC tools.
5. To understand the applications using Map Reduce Concepts, OpenMP, CUDA, MPI, Xeon Phi programming.

Pre-requisites: Programming in C/C++, basic knowledge of UNIX/Linux shell, familiarity with basic numerical algorithms and computer architecture.

Course Outcomes: On successful completion of this course, students will be able to:

1. Define the fundamental concepts and techniques in parallel computation structuring and design
2. Describe several parallelization methodologies and paradigms
3. Choose various mathematical paradigms describing parallel computing systems
4. Explain the architectures of high-performance computing systems
5. Select appropriate application/platform for algorithm implementation

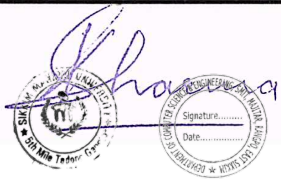
UNIT I

Introduction [6 Hrs]
High performance computing: Why, and why now? Concepts and scientific applications, Parallel decomposition, basic architecture and OS concepts, Multi-core CPUs, High-speed interconnects, High performance file systems, GPU systems, **High performance clusters**.

Categories of machines [2 Hrs]
Multicore and many core shared memory machines via the work-span model, distributed memory machines like clusters and supercomputers via network models, and sequential or parallel machines with deep memory hierarchies.

Parallel computing [4 Hrs]
Parallel computer architecture and parallel software, processor and memory systems of parallel computers, different types of parallelism (on instruction level, on computational task level and data parallelism), **performance models for parallel systems.**

Programming of multicore systems [8 Hrs]
Shared memory multiprocessing programming (OpenMP). OpenMP Programming Model, OpenMP API Overview, Compiling OpenMP Programs, OpenMP,Synchronization Constructs, Directives, Data Scope Attribute Clauses, Directive Binding and Nesting Rules, Run-Time Library Routines, Environment Variables, Thread Stack Size and Thread Binding, Monitoring, Debugging and Performance Analysis Tools for OpenMP, **Case-Studies (Algorithms and Parallelization Approaches), Matrix –Matrix-multiplication.**



UNIT II

Programming of cluster systems [8 Hrs]
Message Passing Interface (MPI) and approaches for the parallelization of programs: General Introduction, Point-to-Point Communication, Blocking vs. Non-blocking sends, Collective Communication, MPI hybrid models, profiling, and debugging, **Case Studies (Algorithms and Parallelization Approaches).**

MPI Implementations [4 Hrs]
Compilers, Environment Management Routines: Point to Point Communication Routines, MPI Message Passing Routine Arguments, Blocking Message Passing Routines, Non-blocking Message Passing Routines, **Collective Communication Routines,** Derived Data Types Group and Communicator Management Routines, **Virtual Topologies.**

Hybrid programming (OpenMP and MPI) [4 Hrs]
Numerical libraries & high performance I/O libraries, Introduction to multi-threading accelerators, **A Brief introduction on MPI-2 and MPI-3.**

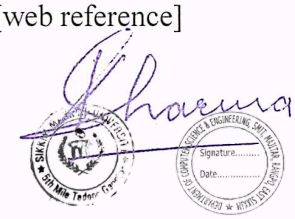
HPC tools [4 Hrs]
Profiling and Debugging of codes tools: gprof, Vtune, **gdb**, Performance library like mkl, **lapack**, fft , **Analysis tools like : ITAC , MPI libraries.** Demo of the sample code by using the above tools.

Text Books:

[1] Michael J Quinn, "Parallel Programming in C with MPI and OpenMP", McGraw-Hill Higher Education.
[2] Ananth Grama, Anshul Gupta, George Karypis and Vipin Kumar,"Introduction to Parallel Computing", Pearson Education India.
[3] Rohit Chandra,Ramesh Menon, Leo Dagum,, David KohrDror Maydan, Jeff McDonald, "Parallel .Programming in OpenMP", Morgan Kaufmann
[4] V. Rajaraman and C. Siva Ram Murthy, "Parallel Computers – Architecture and Programming", Prentice-Hall of India, 2003.

Reference Books:

[1] Georg Hager, Gerhard Wellein, "Introduction to High Performance Computing for Scientists and Engineers", Chapman & Hall / CRC Computational Science series, 2011.
[2] Selim G. Akl, "The Design and Analysis of Parallel Algorithms", Prentice-Hall of India, 1999.
[3] https://computing.llnl.gov/tutorials [web reference]



Department of Computer Science and Engineering

C432 **CS 1746** **(2L+1T hrs/week)**

HUMAN-COMPUTER INTERACTION

Questions to be set having equal weightage/marks from each unit: SIX
TWO from UNIT I, TWO from UNIT II, and TWO from both UNIT I and UNIT II combined.
Questions to be answered: FIVE
Compulsory TWO Questions from UNIT I and UNIT II, and ANY ONE from the combination Question.

Objectives: The course explores the design of computer interfaces that are based on the abilities, limitations and goals of the users. The students would be introduced to the underlying principles of useable interface design through a review of theories and current research in HCI.
It is expected that the successful completion of this course will:

- Provide the student with a solid background in basic concepts in human computer interaction.
- Allow the student to apply these concepts to analyse interface design from the perspective of the user.
- Prepare the student for more advanced study in human computer interaction.

Pre-requisites: Data Structures.

Course Outcomes: On successful completion of this course, students will be able to:

1. Describe and apply core theories, models, and methodologies from the field of HCI
2. Analyze one after another the main features of interactive systems, and explain how to gauge the usability of digital environments, tools, and interfaces
3. Identify the various tools and techniques for interface analysis, design, and evaluation.
4. Identify the impact of usable interfaces in the acceptance and performance utilization of information systems.
5. Apply theories and concepts associated with effective work design to real-world application

UNIT I

Introduction [3 Hrs]
Definition, Concerns of HCI, Goals of HCI, History, Introduction to basic issues and process of designing usable interfaces.

Vision [5 Hrs]
Basic capabilities of the visual system as they relate to HCI, will be discussed. **Visual anatomy**, Light models, Camera Geometry, Colour Perception, Perceptual Processes of Pattern Recognition, Feature Extraction, Shape Analysis, and Object Tracking.

Cognitive Processes [3 Hrs]
Limitations in memory and decision making and the implications they have on HCI design. Space Time and Temporal Methods, Effect of Response Time and Feedback on performance.

Motor Control [3 Hrs]
Basics of bio-mechanics of the human body. Fitt's Law, Interaction with Computer through motor activities like mouse movement, keyboard press etc.

Command Language [2 Hrs]
Study of CLI. Command organization, names, abbreviations and use of symbols.

Menus [2 Hrs]
Semantic Organization, sequence, types of menus, selection alternatives, response time and screen design.

UNIT II

Forms [3 Hrs]
Screen layout design, sequencing information, perceptual organization, error correction and asthetics.

Graphical user Interface [4 Hrs]
Direct manipulation, visual languages, methods of direct manipulation, visual display design and virtual reality.

Interaction Devices [2 Hrs]
Design of interaction devices like keyboard, pointing devices, specialized controls, speech recognition and displays.

Natural Language [4 Hrs]
Natural language interaction. Appropriateness of HCI using Natural Languages. Issues in Natural Language interaction.

Design Process [4 Hrs]
Process and methodologies of designing user interfaces. User-centered design, user input, task analysis, design tools.

Evaluation [3 Hrs]
Methodologies of evaluating user interface design.

Text Book:

1. Alan Dix, Janet E. Finlay Gregory, D. Abowd, Russell Beale, Human Computer Interaction, Pearson.

Reference:

1. Don Norman, The Design of Everyday Things, Basic Books.
2. Steve Krug, Don't Make Me Think-A Common Sense Approach to Web Usability, New Riders, Berkeley, California.
3. ACM Sigchi Curriculla for Human Computer Interaction , Chapter 2.

Department of Computer Science and Engineering

C415 **CS 1756** **(2L + 1 T hrs/week)**

R PROGRAMMING

Questions to be set having equal weightage/marks from each unit: SIX
TWO from UNIT I, TWO from UNIT II, and TWO from both UNIT I and UNIT II combined.
Questions to be answered: FIVE
Compulsory TWO Questions from UNIT I and UNIT II, and ANY ONE from the combination Question.

Objective:

- This course will teach to program in R and how to use R for effective data analysis.
- The students will learn how to install and configure R necessary for an analytics programming environment and gain basic analytic skills via this high-level analytical language.
- The course covers fundamental knowledge in R programming.
- Popular R packages for data science will be introduced as working examples.

Prerequisite: Some basic knowledge of programming, probability and statistics.
Course Outcomes: On successful completion of this course, students will be able to:

1. Choose various mathematical techniques for the data analysis.
2. Describe the process, solution and analyse the results.
3. Develop/create different models and experiment with it.
4. Apply appropriate tools, techniques, algorithms etc.
5. Examine the case study of the different available models.

UNIT – I

Introduction to R programming [3 Hrs]
Introduction to R, installing R, commands & syntax, packages and libraries, workspace in R, History of R, Applications of R Programming, Features of R, Useful R Packages. Advantages of using R programming, Character , Numeric (Real Numbers), Integer (Whole Numbers) , Complex , Logical (True / False), R Basic Syntax , R Script File

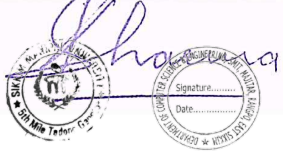
Data Types ,Variables in R, R Operators R Matrices and Arrays [6 Hrs]
Vector ,Matrices, Arrays, List, Factors, Data frames, Data import & export & data types Continuous and Categorical variables, Variable Assignment, Finding Variables, Deleting Variables. Arithmetic Operators, Relational Operators, Logical Operators, Assignment Operators, Miscellaneous Operators. Matrix syntax, Accessing Elements of a Matrix, Matrix Computations, Array Operations

R Functions , R Strings and Vectors [6 Hrs]
Function Definition, Function Components, Built-in Function, User-defined Function, Lazy Evaluation of Function. Rules Applied in String Construction, String Manipulation, Formatting numbers & strings - format function, Counting number of characters in a string - nchar function, Changing the case **- toupper & tolower functions, Extracting parts of a string - substring function, Single Element Vector, Multiple Elements Vector**, Using sequence operator, Using the c function, Accessing Vector Elements, Vector Manipulation

R Factors and Data Frames [5 Hrs]
Factor function, Factors in Data Frame, Create Data Frame,Get the Structure of the Data Frame,Summary of Data in Data Frame,Extract Data from Data Frame, Expand Data Frame. R Data Reshaping :Joining Columns and Rows in a Data Frame, Merging Data Frames R CSV files: Getting and Setting the Working Directory, Input as CSV File, Reading a CSV File, Analyzing the CSV File,Writing into a CSV File,R Excel File :Install xlsx Package, Verify and Load the "xlsx" Package, Input as xlsx File, Reading the Excel File.

UNIT- II

Statistical measures in R [4 Hrs]
Descriptive and inferential statistics, R Mean, Median Mode,R Regression,



Steps to Establish a Regression,Simple linear regression ,Multiple linear regression, lm Function predict Function,Trees Decision tree Random Forests, R Normal Distribution : dnorm, pnorm, qnorm, rnorm. Analysis of Covariance :Introduction to hypothesis testing, Chi square test :ANCOVA Analysis,Comparing Two Models,Sample Test:Introduction to one sample and paired sample test, Understanding correlation & regression

Time Series [4 Hrs]

Understanding time series data & their graphical presentation, Different Time Intervals, Multiple Time Series, Missing data imputation using Amelia package in R

Data analysis [4 Hrs]

Data analysis using rattle(),acf(),pacf(),Building C5 ,Building CART decision tree,The k-Means Clustering ,Clustering Knn – K-nearest neighbour SVM – support vector machines(Case Study)

Neural Network & Predictive analysis [4 Hrs]

Building Neural network using R,Predictive analysis using R

R Databases and Graphical Representation [4 Hrs]

RMySQL Package ,Connecting R to MySql ,Querying the Tables; Graphical Representation of Variables :Creating simple graph,pie diagram, barplot, boxplot, histogram,modifying axis of graph,R line graph,scatterplots

Text Books:

1. Hands-On Programming with R: Write Your Own Functions and Simulations by By Garrett Grolemund, O 'Reily publishers
2. R Packages: Organize, Test, Document, and Share Your Code,by Book by Hadley Wickham, O 'Reily publishers

Reference Books:

1. R PROGRAMMING FOR BEGINNERS , by Sandip Rakshit, publisher Mc Graw Hill
2. Beginning R : The Statistical Programming Language 1 Edition (English, Paperback, Dr. Mark Gardener)
3. Efficient R Programming : A Practical Guide to Smarter Programming, by Colin Gillespie, Robin Lovelace), O 'Reily publishers

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Department of Computer Science and Engineering

C419 **CS 1757** **(2L +1T hrs/week)**

INTERNET OF THINGS

Questions to be set having equal weightage/marks from each unit: SIX
TWO from UNIT I, TWO from UNIT II, and TWO from both UNIT I and UNIT II combined.
Questions to be answered: FIVE
Compulsory TWO Questions from UNIT I and UNIT II, and ANY ONE from the combination Question.

Objectives:

- To provide students with a foundation in computing, communication and information technologies.
- To make student to realize the revolution of Internet in Mobile Devices, Sensor Networks and Cloud technology.
- To develop the teamwork skills, multidisciplinary approach, and an ability to relate information technology to overcome real world and social issues.
- To induce students with good computing and communication knowledge so as to understand, analyze, design, and innovate a new system.

Pre-requisites: Computer Networks, knowledge of basic Wireless & Wired Networking, Wireless Sensor Networks and programming language.

Course Outcomes: On successful completion of this course, students will be able to:

1. Show competence in engineering fundamentals through solutions to real world problems Using Networking Technologies
2. Identify solutions to complex engineering problems pertaining to real world.
3. Formulate a solution plan and methodology for an engineering problem using IoT.
4. Plan investigation of technical issues and requirements pertaining to IoT applications.
5. Select and apply discipline specific tools, techniques and resources for IoT applications for various domains.

UNIT I

Introduction to Internet of Things (IoT) [5hrs]

Fundamentals of Internet of Things, IoT Definition, Characteristics of IoT, IoT Vision, IoT Functional View, Application Areas.

Domain Specific IOTs [4 hrs]

Home Automation, Cities, Environment, Energy, Retail, Logistics,Agriculture, Industry, Health & Life Style.

IoT Technology Fundamentals [12 Hrs]

Architectural overview, Components of IoT system, Devices and gateways, Local and wide area networking, Data management, Business processes in IoT, IoT analytics, Knowledge management.

UNIT II

Design principle for IoT [12 hrs]

Design principle for connected devices, IoT system layers and design standardization, Networks and Communication: Networking Technology and Communication Technology, Protocols in IOT, Security, Privacy & Trust in IoT.

Hands-on-IoT [10]

IoT Physical Devices & Endpoints: What is an IoT Device, Exemplary Device, Board, Linux on Raspberry Pi, Interfaces, Types of sensors.

IoT opportunity and challenges [2 hrs]

Various case studies, opportunity and challenges in IoT.

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Text Books:

4. Ovidiu Vermesan,Peter Friess"Internet of Things –From Research and Innovation to market Deployment",River Publishers.
5. Jan Ho¨ ller, Vlasios Tsiatsis, Catherine Mulligan, Stamatis Karnouskos, Stefan Avesand, David Boyle "From Machine-to-Machine to the Internet of Things Introduction to a New Age of Intelligence",Academic Press Elsevier.
6. Vijay Madisetti and ArshdeepBahga, "Internet of Things (A Hands-onApproach)", 1 st Edition, VPT, 2014.

Reference Books:

8. "Internet of Things" Copyright 2016 by Tutorials Point (I) Pvt. Ltd.
9. Tim O'Reilly & Cory Doctorow "Opportunities and Challenges in the IoT",O'Reilly publication.
10. Pethuru Raj , Anupama C.Raman,"The Internet of Things, Enabling Technologies,platforms and use cases", CRC Press.

Department of Computer Science and Engineering

C421 **CS 1760** **(2L +1T hrs/week)**

BLOCK CHAIN CODING

Questions to be set having equal weightage/marks from each unit: SIX
TWO from UNIT I, TWO from UNIT II, and TWO from both UNIT I and UNIT II combined.
Questions to be answered: FIVE
Compulsory TWO Questions from UNIT I and UNIT II, and ANY ONE from the combination Question.

Objectives: The syllabus is aimed at giving a basic understanding of cryptocurrency, its importance and the use of blockchain technology. It is focused on defining the technological backbone of Bitcoin fundamentals and expands the concepts to building the blockchain technology. It guides us to understand the history of digital currency, the polices involving laws and organizations, the latest trends, and the communities involved; which facilitates us to construct, visualize and understand the ecosystem of blockchain technology and its environment on which it is deployed.

Pre-requisites: Basics of Cryptography and Economics.

Course Outcomes: On successful completion of this course, students will be able to:

1. Describe crypto currencies and blockchain fundamentals
2. Explain individual building blocks and understand the working mechanism of any blockchain technology.
3. Discover the modern engineering tools, techniques and resources in the field of blockchain technology.
4. Differentiate between different version of Blockchain technology
5. Illustrate use of blockchain technology in a broader context like health, banking sector and identify security concerns in blockchain technology

UNIT–I

.Introduction [4 Hrs]

Need for Distributed Record Keeping, Modeling faults and adversaries, Byzantine Generals problem, Consensus algorithms and their scalability problems, Why Nakamoto Came up with Blockchain based cryptocurrency? Technologies Borrowed in Blockchain – hash pointers, consensus, byzantine fault-tolerant distributed computing, digital cash etc.

Basic Distributed Computing [4 Hrs]

Atomic Broadcast, Consensus, Byzantine Models of fault tolerance

Basic Crypto primitives [4 Hrs]

Hash functions, Puzzle friendly Hash, Collison resistant hash, digital signatures, public key crypto, verifiable random functions, Zero-knowledge systems

Blockchain 1.0 [5 Hrs]

Bitcoin blockchain, the challenges, and solutions, Proof of work, Proof of stake, alternatives to Bitcoin consensus, Bitcoin scripting language and their use. Pools : CPUS and GPUs, Revenue at a Protocol Level : Block Rewards/Fees/ETC, Public and Private Blockchains.

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UNIT–II

Blockchain 2.0 [8 Hrs]

Ethereum and Smart Contracts, The Turing Completeness of Smart Contract Languages and verification challenges, Using smart contracts to enforce legal contracts, comparing Bitcoin scripting vs. Ethereum Smart Contracts

Blockchain 3.0[8 Hrs]

Hyperledger fabric, the plug and play platform and mechanisms in permissioned blockchain

Privacy, Security issues in Blockchain [7 Hrs]

Pseudo-anonymity vs. anonymity, Zcash and Zk-SNARKS for anonymity preservation, attacks on Blockchains – such as Sybil attacks, selfish mining, 51% attacks -advent of algorand, and Sharding based consensus algorithms to prevent these.

Text Books

1. "Bitcoin and Cryptocurrency Technologies", Arvind Narayanan, Joseph Bonneau, Edward Felten, Andrew Miller, Steven Goldfeder, Princeton University Press in 2016.
2. "Ethereum Smart Contract Development", Mayukh Mukhopadhyay, Packt Publishing Ltd. in February 2018
3. "Mastering Blockchain", Imran Bashir, Packt Publishing Ltd in March 2018
4. "Building Blockchain Projects Develop real-time practical DApps using Ethereum and JavaScript", Narayan Prusty, Packt Publishing Ltd. in April 2017
5. "Mastering Bitcoin: Programming the Open Bloackchian", Andreas M. Antonopoulo, O'Reilly Media in 2017

References

1. https://bitcoin.org/bitcoin.pdf
2. http://scet.berkeley.edu/wp-content/uploads/BlockchainPaper.pdf.
3. http://chimera.labs.oreilly.com/books/1234000001802/ch07.html#_introduction_2
4. https://www.evry.com/globalassets/insight/bank2020/bank-2020---blockchain-powering-the-internet-of-value---whitepaper.pdf.

Department of Computer Science and Engineering

C412 **CS 1730** **(2L +1T hrs/week)**

AUGMENTED REALITY

Questions to be set having equal weightage/marks from each unit: SIX
TWO from UNIT I, TWO from UNIT II, and TWO from both UNIT I and UNIT II combined.
Questions to be answered: FIVE
Compulsory TWO Questions from UNIT I and UNIT II, and ANY ONE from the combination Question.

Objectives: The syllabus is aimed to provide students with a solid background in alternative 3D compositing techniques using computer vision with applications in interactive interfaces – most notably augmented reality interfaces on mobile devices. It also provides students with a comprehensive knowledge in 3D vision and develop skills in the design and development of interactive augmented reality games

Pre-requisites: Students must have successfully completed a course in computer graphics.

Course Outcomes: On successful completion of this course, students will be able to:

1. Develop interactive augmented reality applications for both PC based mobile devices using a variety of novel input devices.
2. Describe a knowledge of the research literature in Augmented Reality for both compositing and interactive applications.
3. Create environment using AR/VR technology which can help us in our life.
4. It is easy to use this kind of technology to illustrate applications with AR toolkit and mobile AR.
5. Estimate the knowledge of the research literature in Augmented Reality for both compositing and interactive applications.

UNIT I

Introduction to Augmented Reality[6 Hrs]
Definition of Augmented Reality, History of Augmented Reality, AR Systems Overview · Input and Output Devices for AR · Optical vs. Video See-Through AR · Sample Applications – medical, military, manufacturing · Research Directions – tracking, interaction techniques, outdoor AR

Tracking for Augmented Reality[7 Hrs]
The Importance of Accurate Head Tracking / The Tracking Problem · The Choice of the Tracking Technologies · Registration + Calibration – static and dynamic · Real Time Performance Characteristics - spatial, temporal, system robustness · Scheduling and Fusing Sensor Information · Approaches to head motion prediction.

Interaction Techniques for Augmented Reality[7 Hrs]
The Importance of Effective AR Interface Design · Basic Properties of AR Environments used in Designing AR Interfaces · Interaction Techniques Based on Traditional Tracking Techniques – magnetic, etc · Novel Input Devices - InfoPoint device from Sony CSL · Tangible and Graspable Interaction Approaches - ARgroove · Augmented Reality Information Browsers · AR Widgets and Graphical Interface Elem ents · Evaluating AR Interfaces.

UNIT II

Collaborative Augmented Reality [5 Hrs]
Introduction to Computer Supported Collaboration · AR Collaboration vs. Traditional Computer Supported Collaborative Work · Methods for Developing Collaborative AR Interfaces · Case Studies: - Face-to-Face Collaboration – Shared Space - Remote Collaboration – AR Conferencing, Wearable AR Conferencing - Seamless Collaboration – The MagicBook ·

Heterogeneous AR User Interfaces [5 Hrs]

Flavors of augmented reality: video mixing, optical blending, projection devices, spatially augmented reality, Combining AR with other user interface metaphors: Immersive virtual reality, desktop metaphor, mobile/wearable computing, ubiquitous computing, tangible user interfaces, computer supported collaborative work · Distributed graphics · Sample Application Areas ·

Mobile AR [5 Hrs]

Introduction to Wearable and Situated Computing · AR in a Mobile Setting · Current Implementations/Examples – Outdoor AR · Tracking a Mobile User · Mobile Display and Computing Hardware · Environmental Modeling · User Interface Issues · Example Solutions for Mobile Applications

Developing Applications with ARToolKit [5 Hrs]

Overview of ARToolKit · Computer Vision Based Tracking and Registration Methods used in ARToolKit · Steps for Developing a Simple AR Application · ARToolKit-based Interaction Methods · Future Developments with ARToolKit · Demonstrations: MagicBook, VOMAR, ExView, SimpleTest

Text Books:

1. Burdea, G. C. and P. Coffet. Virtual Reality Technology, Second Edition. Wiley-IEEE Press, 2003/2006.
2. Alan B. Craig, Understanding Augmented Reality, Concepts and Applications, Morgan Kaufmann, 2013.

References Books:

1. Alan Craig, William Sherman and Jeffrey Will, Developing Virtual Reality Applications, Foundations of Effective Design, Morgan Kaufmann, 2009.

Department of Computer Science and Engineering

C417 **CS 1742** **(2L +1T hrs/week)**

DATA ANALYTICS

Questions to be set having equal weightage/marks from each unit: SIX
TWO from UNIT I, TWO from UNIT II, and TWO from both UNIT I and UNIT II combined.
Questions to be answered: FIVE
Compulsory TWO Questions from UNIT I and UNIT II, and ANY ONE from the combination Question

Objective: Data Analytics is the science of analyzing data in order to come up with some decision making useful knowledge. The course presents wide range of data analytics techniques and tools for extraction of knowledge.

Pre-requisites: Database Systems.

Course Outcomes: On successful completion of this course, students will be able to:

1. Apply data analytics techniques and tools to produce knowledge from a given dataset.
2. Analyze and apply statistical and probabilistic approach for the development of a model using large dataset.
3. Create and evaluate the model using suitable machine learning algorithms.
4. Formulate statistical hypothesis testing and inference for the model development.
5. Explain the dataset using different data representation tools.

UNIT I

Introduction [4 Hrs]
Introduction to data analytics (DA), data preparation, and data cleaning, Big Data Overview, What is data sciences, The rising and importance of data sciences, **Big data analytics in industry**.

Data Analytics Lifecycle and methodology [4 Hrs]
Understanding Business Data, Data Preparation, Data Modelling, Data Evaluation, Communicating results, **Deployment of Data**.

Statistical Analysis [6 Hrs]
Basic statistical concepts. Mean, standard deviation. **Rank statistics and percentiles**, Distributions, Covariance, correlation, analysis of variance, Statistical tests, confidence and hypothesis testing, Tools such as R.

Probabilistic Analysis [6 Hrs]
Dependence and Independence, Conditional Probability, Bayes's Theorem, **Random Variables** Continuous Distributions, The Normal Distribution, The Central Limit Theorem.

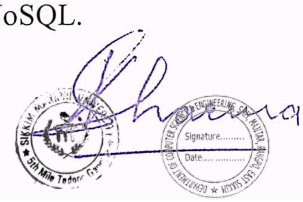
UNIT II

Data Analytics: Theory & Methods [6 Hrs]
Data features, Classification, Supervised and unsupervised learning, Supervised learning - Linear/Logistic regression, Decision trees, Naïve Bayes, Unsupervised learning - K-means clustering, Association rules, Clustering algorithms, **Knowledge discovery**, **Anomaly detection**.

Hypothesis and Inference [4 Hrs]
Statistical Hypothesis Testing, Example: Flipping a Coin, Confidence Intervals, **P-hacking**, Example: Running an A/B Test, **Bayesian Inference**.

Tools for Data Analytics [4 Hrs]
Globally distributed data stores, Tools for big data, Introduction to Hadoop, HDFS, MapReduce, **YARN**, HBase, Hive, Pig, **Sqoop**, **Zookeeper**, **Flume**, NoSQL.

Data Representation and Analysis [6 Hrs]



Log Data Analysis – HDFS scenario: Write once & Read often, **Data Warehouse**, Fraud Detection, Risk Modeling, Social Sentiment Analysis, Image Classification, **Graph Analysis**.

Text Books:

1. Daniel T. Larose & Chantal D. Larose, "Discovering Knowledge in Data: An Introduction to Data Mining", Wiley 2nd Edition.
2. Ron Klimberg and B. D. McCullough, "Fundamentals of Predictive Analytics with JMP" SAS Institute Publishers, 2013.

Reference:

1. EMC Education Services, "Data Science and Big Data Analytics: Discovering, Analyzing, Visualizing and Presenting Data" Wiley Publications.
2. Joel Grus, "Data Science from Scratch First Principles with Python", O'Reilly Media, 2015.

Department of Computer Science and Engineering

C411 **CS 1723** **(2L +1T hrs/week)**

BIG DATA

Questions to be set having equal weightage/marks from each unit: SIX
TWO from UNIT I, TWO from UNIT II, and TWO from both UNIT I and UNIT II combined.
Questions to be answered: FIVE
Compulsory TWO Questions from UNIT I and UNIT II, and ANY ONE from the combination Question

Objectives: This course presents a detailed study of various aspects of Big Data and its Industrial applications. The course covers technologies associated with Big Data with a comprehensive approach in dealing with it, including real time data analysis.

Pre-requisites: Computer Network, Basics of Algorithms, Data Base Management Systems
Course Outcomes: On successful completion of this course, students will be able to:

1. Demonstrate competence in statistics and mathematical modelling to solve big data problems.
2. Apply research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
3. Solve problems associated with batch learning and online learning, and the big data characteristics such as high dimensionality, dynamically growing data and in particular scalability issues.
4. Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations for solving big data problems.
5. Demonstrate an ability to recognize ethical dilemmas between Transparency, Identity and Power.

UNIT-I

Introduction to Big Data [2 Hrs]
What is big data? 4 V's of Big Data (Volume, Velocity, Variety, Value) explained.

Big data approaches in companies[4 Hrs]
Google, Amazon and Facebook - Big data Analytics vs. Classical Statistical Analysis - Techniques and Challenges. Introduction to Big Business around **Big data and its scopes: 2011 McKinsey's report, IDC Report on Big Data, Cuckier's Talk.**

Introduction to Distributed Computing [4 Hrs]
Map Reduce - Explaining Map and Reduce steps, write pseudo-codes on some well-known problems in Map-Reduce like Word frequency Algorithm, **Distributed Sorting, Count of URL Access .**

Big Data technologies [5 Hrs]
Eventually Consistent Transaction explained, CAP Theorem explained. Eventual Consistency continued, CAP Theorem. Amazon's Dynamo DB and Key-Value store. **Storage and Big Table of Google.**

Machine Learning Techniques in Big Data [4 Hrs]
Introduction to ML, Overview of Item based Collaborative Filters, Amazon's Recommendation System. Understanding the issues in Collaborative Filtering. Recommendation System - convergence, **Recommendation System of Youtube**

Cloud Computing [3 Hrs]
Introduction to cloud computing - How various components fit together, Simplified Search Engine Architecture. Search Engines: Introduction to Page Ranking algorithm: Explanations and **Google Page Ranking algorithm.**

UNIT-II

Introduction to Hadoop core architecture [6 Hrs]
Apache. Load balancing in Hapdoop: Implementation .In depth discussion on Hadoop and HIVE: **How HIVE and Hadoop work together.**

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Introduction to Data Mining and ARM [6 Hrs]

Basic concepts and related technologies.APriori Algorithm in ARM: Fast Algorithms for Mining Association Rules - Paper by Agrawal and Srikant. Bridging the gap: ML Techniques and ARM - How we can take Machine learning and Data mining technologies closer to build integrated solution for Big Data, Machine Learning and Data Mining in the Cloud.

The Future of Big Data [3 Hrs]

Next Generation techniques for Big Data: Quantum Computing, Topological Data Analysis, Application of TDA in Big Data.

Criticism over Big Data [2 Hrs]

Concluding note - The three paradoxes of Big Data namely Transparency, Identity and Power, Big Security on Big Data - **The HP business White paper.**

Text Books:

[1] Big Data: A Revolution That Will Transform How We Live, Work, and Think.Viktor Mayer-Schönberger, Kenneth Cukier,Houghton Mifflin Harcourt.

[2] Big Data Now: Current Perspectives from O'Reilly Radar,O'Reilly Radar Team, O'Reilly

References

[1] S. Burckhardt, D. Leijen, M. F¨hndrich and M. Sagiv.Eventually Consistent Transactions.

[2] S. Gilbert and N. A. Lynch. Perspectives on the CAP Theorem.

[3] D. Bermbach and S. Tai. Eventual Consistency: How soon is eventual?.

[4] J. Dean and S. Ghemawat. MapReduce: Simplified Data Processing on Large Clusters.

[5]G.DeCandia,D.Hastorun,M.Jampani,G.Kakulapati,A.Lakshman,A.Pilchin,S.Sivasubramanian, P. Vosshall and W. Vogels. Dynamo: Amazons Highly Available Key-value Store.

[6] F. Chang, J. Dean, S. Ghemawat, W. C. Hsieh, D. A. Wallach, M. Burrows, T. Chandra, A. Fikes, R. E. Gruber. Bigtable: A Distributed Storage System for Structured Data.

[7] B. Sarwar, G. Karypis, J. Konstan and J. Riedl.Item-Based Collaborative Filtering Recommendation Algorithms.

[8] G. Linden, B. Smith, and J. York. Amazon.com Recommendations: Item-to-Item Collaborative Filtering.

[9] J. Davidson, B. Liebald, J. Liu, P. Nandy and T. Van Vleet.The YouTube Video Recommendation System.

[10] D. Nemirovsky. Web Graph and PageRank algorithm.

[11] D. Borthakur. The Hadoop Distributed File System: Architecture and Design.

[12] T. W. Brenner. Load-Balancing Implementation in Hadoop.

[13] A. Thusoo, J. SenSarma, N. Jain, Z. Shao, P. Chakka, N. Zhang, S. Antony, H. Liu and R. Murthy. Hive A Petabyte Scale Data Warehouse Using Hadoop.

[14] R. Fujimaki and S. Morinaga.The Most Advanced Data Mining of the Big Data Era, NEC TECHNICAL JOURNAL 7(2), 2012.

[15] Y. Low, J. Gonzalez, A. Kyrola, D. Bickson, C. Guestrin, J. M. Hellerstein. Distributed Grap

[16]D. Bacon. CSE 599d - Quantum Computing Winter 2006.

[17] A. Zomorodian. Topological Data Analysis.

[18] Big security for big data.

Department of Computer Science and Engineering

C413 **CS 1732** **(2L+1T hrs/week)**

CLOUD COMPUTING

Questions to be set having equal weightage/marks from each unit: SIX
TWO from UNIT I, TWO from UNIT II, and TWO from both UNIT I and UNIT II combined.
Questions to be answered: FIVE
Compulsory TWO Questions from UNIT I and UNIT II, and ANY ONE from the combination Question

Objectives: This course gives an introduction to cloud computing and its techniques - Infrastructure as a Service (IaaS), Platform-as-a-Service (PaaS), Software as a Service (SaaS), issues, ecosystem and case studies.

Pre-requisites: Operating Systems and Computer Network.
Course Outcomes: On successful completion of this course, students will be able to:

1. Explain competence in using engineering fundamentals to visualize solutions using knowledge of software engineering skills.
2. Determine a solution plan and methodology for an engineering problem using software engineering.
3. Interpret a model for project management as well as define complex problem, also find and analyses requirements
4. Develop modern engineering tools, techniques and resources to solve software related problems.
5. Demonstrate an ability to identify/create modern engineering tools, techniques and resources to solve cloud architecture and storage solution.

UNIT–I

Understanding Cloud Computing [5 Hrs]
Cloud computing, History of cloud computing, Cloud architecture, Cloud storage, **Why cloud computing matters**, Advantages of cloud computing, Disadvantages of cloud computing, Companies in the cloud today.

Privacy and Security in Cloud computing [7 Hrs]
Federation in the cloud, Presence in the cloud, Privacy and its relation to cloud-based information systems, Security in the cloud, Common standards in the cloud, End-user access to the cloud computing.

Developing Cloud Services [7 Hrs]
Web-based application, Pros and cons of cloud service development, Types of cloud service development, Software as a service, Platform as a service, Web services, On demand computing, Discovering cloud services, Development services and tools, Amazon Ec2, Google app engine, IBM clouds.

UNIT-II

Cloud Utility and Business profit [7 Hrs]
Software utility application architecture, Characteristics of a SaaS, Software utility applications, Cost versus value, Software application services framework, Common enablers, **Conceptual view to reality, Business profits**, Implementing database systems for multitenant architecture.

Cloud Computing for Everyone [7 Hrs]
Centralizing email communications, **Collaborating on schedules**, **Collaborating on To-Do Lists**, Collaborating contact lists, Cloud computing for the community, Collaborating on group projects and events, Cloud computing for the corporation.

Using cloud services [7 Hrs]
Collaborating on calendars, Schedules and task management, Exploring online scheduling applications, **Exploring online planning and task management**, Collaborating on event management,

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Collaborating on contact management, Collaborating on project management, Collaborating on word processing, **Collaborating on databases**, Storing and sharing files.

Text Books:

1. Michael Miller, "Cloud computing: Web based applications that change the way you work and collaborate online", Pearson.
2. Haley Beard, "Cloud computing best practices for managing and measuring processes for on demand computing, Applications and data centers in the cloud with SLAs", Emereo.

Reference Books:

1. Guy Bunker and Darren Thomson, "Delivering Utility Computing", John Wiley & Sons.
2. George Reese, "Cloud Application Architectures", O'Reilly.
3. Lee Gillam, "Cloud Computing: Principles, Systems and Applications", Springer.
4. Brian J. S. Chee, Curtis Franklin, Jr., "Cloud Computing: Technologies and Strategies of the Ubiquitous Data Center", CRC Press.

Department of Computer Science and Engineering

C350 **CS 1631** **(2L + 1 T hrs/week)**

DEEP LEARNING

Questions to be set having equal weightage/marks from each unit: SIX
TWO from UNIT I, TWO from UNIT II, and TWO from both UNIT I and UNIT II combined.
Questions to be answered: FIVE
Compulsory TWO Questions from UNIT I and UNIT II, and ANY ONE from the combination Question

Objective: Deep Learning has received a lot of attention over the past few years and has been employed successfully by companies like Google, Microsoft, IBM, Facebook, Twitter etc. This course is an introduction to deep learning, a branch of machine learning concerned with the development and application of modern neural networks. Deep learning algorithms extract layered high-level representations of data in a way that maximizes performance on a given task.

Pre-requisites: Machine Learning, Calculus, Linear Algebra, Probability & Statistics
Course Outcomes: On successful completion of this course, students will be able to:

1. Describe deep learning techniques and computing environment that are suitable for the applications under consideration.
2. Discuss various solution plans and methodologies for an engineering problem using Deep Learning.
3. Develop a set of alternative design solutions to problems for which standard algorithmic solutions do not exist.
4. Classify the different technical issues related to Deep Architectures consistent with their level of knowledge and understanding.
5. Apply Deep Learning techniques to solve real-life problems which directly or indirectly benefits to the society

UNIT I

Introduction [5 Hrs]
History, success stories, Basic Perceptron, linear and nonlinear reparability, Linear Regression, Learning Algorithms: Hebb Rule, Perceptron learning. Pitfalls: overfitting, underfitting, bias, estimators and variance.

Deep Feed Forward Networks [5 Hrs]
Multilayer Perceptrons (MLPs), Activation Functions: Sigmoid, Hyperbolic Tangent and ReLU. Gradient Descent, Backpropagation Algorithm.

Regularization for Deep Learning [4]
Regularization, Parameter noise penalties, Dataset Augmentation, Noise Robustness

Optimization for Training Deep Models [6]
Learning Vs. Optimization, Challenges in Neural Network Optimization, Stochastic Gradient Descent, Stochastic Gradient Descent with momentum, Stochastic Gradient Descent with Nesterov momentum

UNIT II

Convolution Neural Networks [6 Hrs]
Architectures, convolution /pooling layers, feature extraction, Convolution Algorithm, unsupervised features, applications of CNN in different areas.

Recurrent Neural Networks and Recursive Nets [7 Hrs]
Recurrent Neural Networks, Bidirectional Neural Networks, Encoder-Decoder sequence to sequence architecture. Deep Recurrent Networks: Recursive Neural Networks, Long-Short Term Memory.

Applications of Deep Learning [7 Hrs]

Applications of deep learning in computer vision, speech recognition, Natural Language Processing, Sentence Classification using CNN.

Text Books:

1. Ian Goodfellow, Yoshua Bengio, Aaron Courville. "Deep Learning".
2. Duda, R.O., Hart, P.E., and Stork, D.G. "Pattern Classification". Wiley-Interscience. 2nd Edition, 2001.
3. Laurene Fausett, "Fundamentals of Neural Networks".

Reference Books:

1. Theodoridis, S. and Koutroumbas, K. "Pattern Recognition". Edition 4. Academic Press, 2008.
2. Francois Chollet , "Deep Learning with Python"
3. Bishop, C. M. "Neural Networks for Pattern Recognition". Oxford University Press. 1995.
4. Hastie, T., Tibshirani, R. and Friedman, J. T"he Elements of Statistical Learning". Springer. 2001.

Department of Computer Science and Engineering

C368 **CS 1720/CS 1626** **(2L+1T hrs/week)**

INTELLECTUAL PROPERTY RIGHTS

Questions to be set having equal weightage/marks from each unit: SIX
TWO from UNIT I, TWO from UNIT II, and TWO from both UNIT I and UNIT II combined.
Questions to be answered: FIVE
Compulsory TWO Questions from UNIT I and UNIT II, and ANY ONE from the combination Question

Objective:

- Introduce fundamental aspects of Intellectual Property Rights to students who are going to play a major role in development and management of innovative projects in industries. The course introduces all aspects of the IPR Acts.
- Case studies to demonstrate the application of the legal concepts in Science, Engineering, Technology and Creative Design.
- The course is designed for raising awareness of a multidisciplinary audience and has been categorized under 'General'.

Pre-requisites: NIL.
Course Outcomes: On successful completion of this course, students will be able to:

1. Identify regulations, legislation and standards for Intellectual Property Rights
2. Describe the impact of Intellectual Property Rights on engineering and industrial practices vis a vis social, environmental and economic context
3. Apply principles of Intellectual Property Rights to sustainable design and development.
4. Analyze ethical lapses and recognize ethical dilemmas.
5. Distinguish professional issues which arise in the intellectual property law context

UNIT – I

Overview Of Intellectual Property [5 Hrs]
Introduction and the need for intellectual property right [IPR], IPR in India – Genesis and Development IPR in abroad, some important examples of IPR.

Patents [11 Hrs]
Macro-economic impact of the patent system, Patent and kind of inventions protected by a patent, Patent document, How to protect your inventions? , Granting of patent, Rights of a patent, How extensive is patent protection? , Why protect inventions by patents?, Searching a patent, Drafting of a patent, Filing of a patent, Case studies, **The different layers of the international patent system, [national, regional and international options], Utility models : Differences between a utility model and a patent?, Trade secrets and know-how agreements**

Copyright [4 Hrs]
What is copyright?, What is covered by copyright?, How long does copyright last?, Why protect copyright?, What are related rights? , Distinction between related rights and copyright?, Rights covered by copyright?

UNIT – II

TradeMarks [4 Hrs]
What is a trademark?, Rights of trademark?, What kind of signs can be used as trademarks? Types of trademark, function does a trademark perform, How is a trademark protected? How is a trademark registered?, How long is a registered trademark protected for ? How extensive is trademark protection?, **What are well-known marks and how are they protected?, Domain name and how does it relate to trademarks?**

Geographical Indications [2 Hrs]

What is a geographical indication?, **How is a geographical indication protected?, Why protect geographical indications?**

Industrial Designs [2 Hrs]

What is an industrial design?, How can industrial designs be protected?, What kind of protection is provided by industrial designs?, How long does the protection last?, Why protect industrial designs?

New Plant Varieties [2 Hrs]

Why protect new varieties of plants?, How can new plants be protected?, What protection does the breeder get?, How long do the breeder's rights last?, How extensive is plant variety protection?

Unfair Competition and Enforcement Of Intellectual Property Rights [5 Hr]

What is unfair competition?, relationship between unfair competition and intellectual property laws? Infringement of intellectual property rights, Enforcement Measures.

Intellectual Property [5 Hrs]

Overview of Biotechnology and Intellectual Property, Biotechnology Research and Intellectual Property Rights, **Management Licensing and Enforcing Intellectual Property Commercializing Biotechnology Invention Case studies of Biotechnology.**

Text Books

1. T. M Murray and M.J. Mehlman, Encyclopedia of Ethical, Legal and Policy issues in Biotechnology, John Wiley & Sons 2000.

References

1. P.N. Cheremisinoff, R.P. Ouellette and R.M. Bartholomew, Biotechnology Applications and Research, Technomic Publishing Co., Inc. USA, 1985.
2. D. Balasubramaniam, C.F.A. Bryce, K. Dharmalingam, J. Green and K. Jayaraman, Concepts in Biotechnology, University Press [Orient Longman Ltd.], 2002.
3. Bourgagaize, Jewell and Buiser, Biotechnology: Demystifying the Concepts, Wesley Longman, USA, 2000.
4. Ajit Parulekar and Sarita D' Souza, Indian Patents Law – Legal & Business Implications; Macmillan India ltd , 2006.

Department of Computer Science and Engineering

C402 **CS 1660/CS 1702** **(2L + 1 T hrs/week)**

SOFT COMPUTING

Questions to be set having equal weightage/marks from each unit: SIX
TWO from UNIT I, TWO from UNIT II, and TWO from both UNIT I and UNIT II combined.
Questions to be answered: FIVE
Compulsory TWO Questions from UNIT I and UNIT II, and ANY ONE from the combination Question

Objectives: It comprises of computational techniques like Genetic/ Evolutionary algorithms, Artificial Neural Networks, Fuzzy Systems, Machine learning and probabilistic reasoning etc. This course thoroughly discusses Genetic Algorithms, Artificial Neural Networks (major topologies and learning algorithms) and Fuzzy Logic. At the end of the course, the students will be able to solve a variety of problems in their area of interest ranging from Optimization problems to Pattern recognition and Control tasks, by using soft computing tools.

Pre-requisites: Design and Analysis of Algorithms, Programming concepts.
Course Outcomes: On successful completion of this course, students will be able to:

1. Differentiate between basic soft and hard computing models.
2. Analyze, evaluate and build fuzzy models.
3. Appreciate the importance of tolerance of imprecision and uncertainty for design of robust and low-cost intelligent systems.
4. Apply specified techniques in design and implementation of soft computing models for solving real life problems.
5. To acquire the knowledge of the fuzzy Neural network and Genetic Language.

UNIT-I

Introduction [4 Hrs]
Definition, Aspects of soft computing, Dealing with vagueness: Fuzzy systems, Rough sets, Modeling the brain-human cognition, Artificial neural networks, Modeling nature's optimization process: Natural evolution.

Fuzzy set theory [6 Hrs]
Review of crisp set theory: Sets and subsets, Definitions & notations - Universal set, Null set, Empty set, Subsets, Power set, Venn diagram, Operations on sets: Union, Intersection, Complementation, Difference Symmetric difference, Cartesian product, Properties of sets: Commutative, Associative, Distributive, DeMorgan's Law, Fuzzy sets: Fuzziness, Vagueness.

Fuzzy membership function [5 Hrs]
Crisp membership, Fuzzy membership, Membership profiles, Fuzzy sets: Definition, Notation, Features, Normality, Height, Support, Core cardinality, Transformation: Normalization, Dilation, Concentration, Contrast intensification, Fuzzification.

Fuzzy set operations [5 Hrs]
Operators – Union, Intersection, Complementation, Equality, Inclusion, Product, Difference, Disjunctive sum, Properties – Commutative, Associative, Distributive, Idempotency, De Morgan's law, Law Boundary conditions, Law of involution, Transitive law.

UNIT-II

Fuzzy logic [5 Hrs]
Propositional logic: Propositions, Propositional logic well-formed formulae, Properties of wffs, Interpretation of logical expression, Logical equivalence, Tautology, Contradiction, Consistency, Validity of an argument.

Artificial neural networks [5 Hrs]
Basic concepts: The biological neuron, The artificial neuron, Characteristics of the brain, The McCulloch-

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Pitts neural model, The perceptron neural network architectures: Single layer feed forward ANNs, Multi-layer feed forward ANNs.

Back propagation [5 Hrs]

Multilayer feed forward net- structure, Notations, Activation function, Generalized delta rule, The Back propagation Algorithm: Learning, Parameter choice, Initialization, Stopping criteria, Training set, Data representation, Hidden layers.

Advanced search algorithms [5 Hrs]

Genetic algorithms : Natural evolution, Chromosomes, Natural selection , Cross-over, Mutation, Basic GA, Encoding a solution as chromosome, decoding it, Fitness function, Population, GA operators-Selection, Tournament, Roulette wheel, Cross-over, Mutation, GA parameters , Convergence.

Text Books:

1. J. S. R. Jang, C. T. Sun, and E. Mizutani, "Neuro-Fuzzy and Soft Computing: A Computational Approach to Learning and Machine Intelligence", Prentice Hall.
2. Melanie Mitchell, "An Introduction to Genetic Algorithms", PHI.

Reference Books:

1. Simon Haykin, "Neural Networks – A Comprehensive Foundation", Prentice Hall.
2. Jerry M. Mendel, "Uncertain Rule-Based Fuzzy Logic Systems: Introduction and New Directions", Prentice Hall
3. Timothy J. Ross, "Fuzzy Logic with Engineering Applications", Wiley India.
4. Laurene Fausett, "Fundamentals of Neural Networks – Architecture, Algorithms and Applications", Pearson.

Department of Computer Science and Engineering

C433 **CS 1731** **(2L +1T hrs/week)**

AD-HOC WIRELESS NETWORKS

Questions to be set having equal weightage/marks from each unit: SIX
TWO from UNIT I, TWO from UNIT II, and TWO from both UNIT I and UNIT II combined.
Questions to be answered: FIVE
Compulsory TWO Questions from UNIT I and UNIT II, and ANY ONE from the combination Question

Objectives: This course covers all aspects of ad hoc and sensor networking from design through performance issues to application requirements. The course starts with the design issues and challenges that are associated with implementations of ad hoc network applications. This also includes the various protocols in different layers of the architecture with various security mechanisms and localization techniques.

Pre-requisites: Basics of Computer Networks.
Course Outcomes: On successful completion of this course, students will be able to:

1. Understand the involved engineering fundamentals of Ad-Hoc wireless.
2. Ability to identify the complex engineering problem relating to Infrastructure based wireless network and Ad-Hoc wireless Network.
3. Ability to formulate a solution plan and methodology by applying appropriate theory, practices and tools to the development of Ad-Hoc network for related application domain.
4. Demonstrate an ability to select optimal design scheme suitable for Ad- Hoc Network considering its inherent characteristics.
5. Understand the various routing protocols especially designed for Ad-Hoc network

UNIT – I

Wireless Network Basics and Mobile Ad Hoc Networks [6 Hrs]
Introduction, Fundamental of wireless communication: Technical Issues, Design Goals, Difference between wired and wireless network. Basics of WLAN 802.11: Network Architecture and Component in typical IEEE 802.11 Network, Services Offered by a Typical 208.11 Network. Applications of Ad Hoc wireless Networks, Characteristic of Ad Hoc wireless Network, Issues in Ad Hoc wireless Networks, Infrastructure Based versus Ad Hoc LANs, Cellular versus Ad Hoc Networks, Ad Hoc wireless Internet.

MAC Protocols for Ad Hoc Wireless Network [8 Hrs]
Introduction, Issues in Designing a MAC Protocol for Ad Hoc wireless networks, Design Goals of a MAC Protocol for Ad Hoc Wireless networks, Classification of MAC Protocol, MAC protocols: A Media Access Protocol For Wireless LAN's (MACAW), **Busy tone Multiple Access Protocol (BTMA).**

Routing Protocol for Ad Hoc Wireless Network [8 Hrs]
Introduction, Issues in Designing a Routing Protocol for Ad Hoc wireless networks, Characteristics of an ideal Routing Protocol for Ad Hoc Wireless networks, Classification of Routing Protocol. Proactive routing Protocols: DSDV, WRP, CGSR, STAR. Reactive Routing Protocol: DSR, AODV, TORA, LAR I and **LAR II**, ABR, SSA, **Hybrid routing Protocol.**

UNIT –II

Transport Layers Protocol for Ad Hoc Wireless Networks [8 Hrs]
Introduction, Issues in designing a Transport layer protocol for Ad Hoc Wireless Networks, Design Goals of a Transport layer Protocol for Ad Hoc wireless Networks, Classification of Transport Layer solution, TCP over Ad Hoc Wireless Networks, Feedback-Based TCP (TCP-F).

Security in Ad Hoc Wireless Networks [5 Hrs]
Introduction, Network Security Requirements, Issues and Challenges in Security Provisioning,

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Network security Attacks: Network layer Attacks, Transport Layer attacks, Application Layer Attacks , Multi- Layer Attacks, Key management, Secure Routing in Ad Hoc Wireless Network.

Wireless Sensor Networks [5 Hrs]

Introduction, Application of Sensor Network, and Comparison with Ad Hoc Wireless Network, Issues and Challenges in designing a sensor network, Sensor Network Architecture: Layered architecture, Clustered Architecture. Data Dissemination: Flooding, Gossiping, Rumor Routing, Sequential Assignment Routing (SAR), Direct Diffusion, sensor Protocol for information via Negotiation (SPIN). **Location Discovery: Indoor Localization, Sensor Network localization.**

Text Book:

1. C. Siva Ram Murty and B. S. Manoj, "Ad Hoc Wireless Networks- Architectures and Protocols" ,Pearson.
2. Xiuzhen Cheng, Xiao H. Huang, Dingzhu Du, "Ad Hoc wireless networking", Springer

Reference Books:

1. Charles E. Perkins "Ad Hoc Networking", Addison-Wesley, Pearson Education.
2. C. K. Toh "Ad Hoc Mobile Wireless Networks-Protocols and System", Pearson.
3. PrashantMohapatra and SrikanthKrishnamurty, "Ad Hoc Networks-Technologies and Protocols", Springer.
4. Subir KumarSarkar, T. G. Basavaraju, C. Puttamadappa, "Ad Hoc Mobile Wireless Networks: Principles, Protocols, And Applications", Auer Bach Publications.

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Department of Computer Science and Engineering

C414 **CS 1733** **(2L +1T hrs/week)**

CRYPTOGRAPHY AND NETWORK SECURITY

Questions to be set having equal weightage/marks from each unit: SIX
TWO from UNIT I, TWO from UNIT II, and TWO from both UNIT I and UNIT II combined.
Questions to be answered: FIVE
Compulsory TWO Questions from UNIT I and UNIT II, and ANY ONE from the combination Question

Objectives: This course provides an overview of computer security principles ranging from cryptography to network security. The course will help to learn the principles and practices of computer security in various computing environments. The goal of the course is to provide students with the necessary foundations to apply cryptograph analysis techniques in new and emerging fields.

Pre-requisites: Computer Networks and Number theory.
Course Outcomes: On successful completion of this course, students will be able to:

1. Define mathematical modelling of a Security services to address modern security issues and challenges.
2. Demonstrate and an ability to formulate a solution plan and methodology for security in information systems using Cryptography.
3. Analyze diverse set of alternative design solutions to meet the basic requirements and goals of a security system.
4. Recognize technical issues for existing security principles and network applications consistent with their level of knowledge and understanding.
5. Develop solutions for existing security principles and network applications.

UNIT–I

Cryptography – I [10 Hrs]
Introduction: Attacks, Services and mechanisms, Security attacks, Security services, A model of internetwork conventional encryption model, **Steganography**, Classical encryption technique, Simplified DES, Block cipher principles, The Data Encryption Standard, The strength of DES, Differential and linear cryptanalysis algorithms, Triple DES, **International data encryption algorithms, Blowfish**, Confidentiality using conventional encryption, **Placement of encryption function, Traffic confidentiality, Key distribution**, Random number generation.

Cryptography-II [10 Hrs]
Public key cryptography: Principles of Public key cryptography, The RSA algorithm, Key management, Hellman key exchange, Number theory: Prime and relatively prime numbers, Modular arithmetic, Fermat's and Euler's theorems, **Testing for primality**, Message authentication and Hash functions, Authentication requirements, Authentication functions, Message authentication codes, MD5 message digest algorithm, **Digital signatures, Digital signature standard.**

UNIT–II

Network Security- I [10 Hrs]
Authentication applications, Kerberos, **X.509 directory authentication service**, Electronic mail security, Pretty good privacy, **S/MIME**, IP security, IP security overview, IP security architecture, Authentication header, Encapsulation security, **Payload, Combining security associations, Key management.**

Network Security – II [10 Hrs]
Web security, Web security requirements, Secure socket and transport layer security, **Secure electronic transaction**, Intruders, Intruders, **Viruses, and related threats**, Firewalls, Firewall design principles, **Trusted systems**.

Text Books:

William Stallings, "Cryptography and Network Security", Pearson, 6th Edition.

1. Behrouz A Frouzan, "Cryptography and Network Security", Tata McGraw Hill, 2nd Edition.

Reference Books:

1. Richard E. Smith, "Internet Cryptography", Pearson, 1st Edition.
2. D. Chapman and E. Zwicky, "Bulding Internet Firewalls", O'Reilly, 2nd Edition.
3. Derek Atkins et al., "Internet Security, Professional Reference", Techmedia, 2nd Edition.
4. AtulKahate, "Cryptography and Network Security", McGraw Hill, 2nd Edition.

Department of Computer Science and Engineering

C434 **CS 1734** **(2L +1T hrs/week)**

DISTRIBUTED DATABASE SYSTEMS

Questions to be set having equal weightage/marks from each unit: SIX
TWO from UNIT I, TWO from UNIT II, and TWO from both UNIT I and UNIT II combined.
Questions to be answered: FIVE
Compulsory TWO Questions from UNIT I and UNIT II, and ANY ONE from the combination Question

Objectives: This course envisages the principles of distributed database systems including design and architecture, security, integrity, query processing and optimization, transaction management, concurrency control, and fault tolerance. Fundamental issues in distributed database systems that are motivated by the computer networking and distribution of processors and databases will also be addressed.

Pre-requisites: Database Management System, Computer Network and Distributed Systems.
Course Outcomes: On successful completion of this course, students will be able to:

1. Describe the various range of data models, database architectures and features supported by different database management systems.
2. Compare the procedural and non-procedural languages and use them where appropriate to process data.
3. Evaluate various types of client-side interfaces to databases using selected modern tools appropriate for the task.
4. Discuss issues underpinning distributed database administration, security and performance.
5. Define and manipulate distributed database data using Structured Query Language (SQL)

UNIT I

Introduction [4 Hrs]

Distributed data processing, what is Distributed Database System (DDBS), resembling setups which are not DDBS, examples of DDBS's, Promises of DDBs, **case studies such as airline/railway reservation system, banking sector, e-commerce etc.**

Distributed Database Architecture [5 Hrs]

DBMS Standardization, DDBS reference model, Architectural Model – Client Server Architecture and its variants, Multi-database model (MDBMs) Architecture.

Distributed Database Design [5 Hrs]

Design Strategies, Distribution Design Issues, Fragmentation – Primary Horizontal fragmentation (PHF) Derived Horizontal Fragmentation (DHF), Vertical Fragmentation, Mixed/Hybrid Fragmentation, **Acces Frequencies and patterns, Replication and Allocation – concepts and strategies.**

Overview of Query Processing [5 Hrs]

Query processing Problem, Objectives, **Complexities of Relation Algebra Operators**, Distributed query processing operators, Characterization of Query Processor, and Layers of Query Processing.

Transaction Management [3 Hrs]

Definition of Transaction, Properties, Types (Flat Tx's, Nested Tx's, and Workflows), Architectures.

UNIT II

Distributed Concurrency Control [5 Hrs]

Serializability Theory, Taxonomy, Locking Based Algorithm, Timestamp Based Algorithm, Optimistic-

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Concurrency Control algorithm, **Deadlock Management**.

Distributed DBMS Reliability [5 Hrs]

Reliability Concepts, Failures and Fault Tolerance Concepts, Failures in DDBMs, Local reliability Protocol, Distributed Reliability Protocols, **Dealing with site failures, Network Partitioning.**

Object Database Management Systems [5 Hrs]

Fundamental Object Concepts, Object Distribution Design, Object Management.

Current Issues [5 Hrs]

Push-Based technology, Mobile Databases, **soft computing applications in distributed database system design.**

Text Books:

1. M. Tamer Oezsu, Patrick Valduriez "Principles of Distributed Database Systems", Prentice Hall
2. Bell and J. Grimson, "Distributed Database Systems", Addison-Wesley.

Reference Books:

1. Coulouris, Dollimore and Kindberg, "Distributed Systems: Concepts and Designs", Addisson-Wesley
2. Ceri, Pellagati, "Distributed Database Systems", McGraw Hill
3. M. Stonebraker, "Readings in Database Systems", San Mateo, California: Morgan Kaufmann.
4. Ray, "Distributed Database Systems", Pearson.

Department of Computer Science and Engineering

C435 **CS 1739** **(2L +1T hrs/week)**

WIRELESS SENSOR NETWORKS

Questions to be set having equal weightage/marks from each unit: SIX
TWO from UNIT I, TWO from UNIT II, and TWO from both UNIT I and UNIT II combined.
Questions to be answered: FIVE
Compulsory TWO Questions from UNIT I and UNIT II, and ANY ONE from the combination Question

Objectives: This course provides an introduction to the area of wireless sensor networks. A detailed study on related technologies and standards ranging from networking, OS support and algorithms, to security will constitute the syllabus. Its primary concern will be on protocol design, communication and computational challenges posed by Wireless Sensor based networking systems.

Pre-requisites: Data Communication, Computer Networks, Knowledge of Ad Hoc Wireless Networks desirable.

Course Outcomes: On successful completion of this course, students will be able to:

1. Understanding the engineering fundamentals of wireless communication applied in sensor network.
2. Ability to identify and relate the complex engineering problem relating to sensor network architectures and functions.
3. Formulate a solution plan and methodology by Applying appropriate theory, practices and tools to the development of wireless sensor network with respect to its applications area.
4. Ability to differentiate and select optimal design scheme suitable for wireless sensor network
5. Discuss and compare the design principles and implementation of a variety of key sensor networking protocols and algorithms

UNIT – I

Motivation for a Network of Wireless Sensor Nodes and Its Applications [6 Hrs]

Definitions and background- sensing and sensors-sensor classification, wireless sensor networks; applications of wireless sensor networks; Difference between WSNs and Ad Hoc Wireless Networks challenges and constraints- energy, self-management, wireless networking, decentralized management, design, constraints, security, **other challenges**

Node Architecture and Operating System [4 Hrs]

Sensing subsystem, the processor subsystem, communication interfaces, the IMote node architecture, **operating systems - functional aspects, nonfunctional aspects;** prototypes- TinyOS

Physical Layer [3 Hrs]

Basic components, **source encoding, channel encoding, modulation, signal propagation**

Medium Access Control [7 Hrs]

Overview, wireless MAC Protocols - **Carrier Sense Multiple Access,** Multiple Access with Collision Avoidance (MACA) and MACAW , MACA By Invitation, IEEE 802.11, IEEE 802.15.4 and ZigBee; Characteristics of MAC Protocols in Sensor Networks, Contention-Free MAC Protocols, Contention-Based MAC Protocols, Hybrid MAC Protocols.

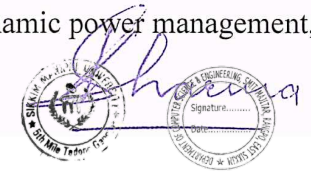
UNIT – II

Network Layer [7 Hrs]

Overview, categories of routing protocol, routing metrics, flooding and gossiping, data-centric routing- sensor protocols for information via negotiation, directed diffusion, rumor routing, gradient-based routing; proactive routing-destination sequenced distance vector, optimized link state routing; on-demand routing-ad hoc on-demand distance vector, dynamic source routing; hierarchical routing, location-based routing

Node and Network Management [3 Hrs]

Power management- local power management, dynamic power management, **architectural overview; time**



synchronization- clocks and the synchronization problem, time synchronization in wireless sensor networks, **Sensor Database Challenges,** In Network Aggregation, and Temporal Data.

Localization [3 Hrs]

Overview, ranging techniques, range-based localization- **triangulation**, GPS-based localization; range-free localization- **ad hoc positioning system (APS)**; event-driven localization

Security [7 Hrs]

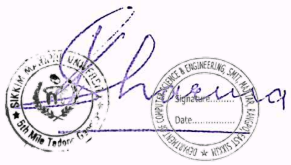
Fundamentals of network security, challenges of security in wireless sensor networks, security attacks in sensor networks, protocols and mechanisms for security, IEEE 802.15.4 and ZigBee security

Text Books:

1. WaltenegusDargie&Christian Poellabauer, Fundamentals of Wireless Sensor Networks: Theory and Practice, Wiley Publication
2. Jun Zheng&Abbas Jamalipour, Wireless Sensor Networks: A Networking Perspective, Wiley Publication.

Reference Books:

1. Feng Zhao &Leonidas Guibas, Wireless Sensor Networks: An Information Processing Approach, Elsevier Publication.
2. Holger Karl &Andreas Willig, Protocols and Architectures for Wireless Sensor Networks, Wiley Publication.
3. Robert Faludi, Building Wireless Sensor Networks, O'Reilly Publication.
4. ShahinFarahani, ZigBee Wireless Networks and Transceivers, 1st Edition, Elsevier Publication.



Department of Computer Science and Engineering

C437 **CS 1744** **(2L + 1 T hrs/week)**

MOBILE COMPUTING

Questions to be set having equal weightage/marks from each unit: SIX
TWO from UNIT I, TWO from UNIT II, and TWO from both UNIT I and UNIT II combined.
Questions to be answered: FIVE
Compulsory TWO Questions from UNIT I and UNIT II, and ANY ONE from the combination Question

Objective: To introduce the characteristics, basic concepts and systems issues in mobile computing. To illustrate architecture and protocols in mobile computing and to identify the trends and latest development of the technologies in the area. Location of mobile devices, judicious use of bandwidth, relocation of computation, are some of the key issues which will constitute the topics for further exploration. To evaluate critical design tradeoffs associated with different mobile technologies, architectures, interfaces and business models and how they impact the usability, security, privacy and commercial viability of mobile computing services and applications.

Pre-requisites: Computer network.
Course Outcomes: On successful completion of this course, students will be able to:

1. Examine fundamentals of wireless communications.
2. Analyze security, energy efficiency, mobility, scalability, and their unique characteristics in wireless networks.
3. Develop basic skills for cellular networks design.
4. Apply knowledge of TCP/IP extensions for mobile and wireless networking.
5. Measure the awareness of the life-long learning, business ethics, professional ethics and current marketing scenarios.

UNIT – I

Introduction [6 Hrs]

Introduction and evolution of mobile computing and wireless communication, mobile computing functions, mobile computing device, middleware and gateways, mobile computing architecture: 3tier design considerations for mobile computing, **multiple access techniques: FDMA, TDMA, CDMA,SDM, TDD, FDD.**

Mobile Network and Transport Layer [8 Hrs]

Mobile Network layer – mobile IP, goals, assumptions and requirement, entities, **IP packet delivery, agent discovery, registration, tunnelling and encapsulation, optimizations,** mobile Ipv6. Mobile transport layer-Traditional and classical TCP, TCP over 2.5 (3.0) G wireless networks.

GSM and GPRS [8 Hrs]

GSM: Mobile services, system architecture, radio interface, protocols, localization and calling, handover, security. GPRS: introduction, network architecture, network enhancements, channel coding, protocol architecture, network operations, data services in GPRS applications, limitations.

UNIT-II

Cellular Technology [10 Hrs]

CDMA, EDGE, UMTS, UTRAN, OFDM, HSPA, LTE, WiMax, mobile satellite communication.

Data Dissemination and Data Synchronization in Mobile Computing [5 Hrs]

Communication Asymmetry, classification of data delivery mechanism, data dissemination broadcast models, selective tuning and indexing techniques, synchronization, synchronization software for mobile devices, synchronization protocols.

Mobile Devices and Mobile Operating System [5 Hrs]

Mobile agent, applications framework, application server, gateways, service discovery, device

management, **mobile file system, Mobile Operating Systems, Characteristics, Basic functionality of Operating Systems. Case Study: Android OS.**

Text Books:

1. Raj Kamal, Mobile Computing, 2/e , Oxford University Press-New Delhi.
2. J.Schiller, "Mobile Communication", Addison Wesley, 2000.
3. Asoke K Taukder,Roopa R Yavagal, Mobile Computing, Tata McGraw Hill Pub Co., New Delhi, 2005.

Reference Books:

1. Reza B'Far (Ed), "Mobile Computing Principles", Cambridge University Press.
2. MukeshSinghal, NiranjanG.Shivaratri, "Advanced Concepts in Operating Systems", Tata McGraw- Hill.

Department of Computer Science and Engineering

C438 **CS 1747** **(2L +1T hrs/week)**

COMPUTATIONAL NUMBER THEORY

Questions to be set having equal weightage/marks from each unit: SIX
TWO from UNIT I, TWO from UNIT II, and TWO from both UNIT I and UNIT II combined.
Questions to be answered: FIVE
Compulsory TWO Questions from UNIT I and UNIT II, and ANY ONE from the combination Question

Objectives: To give students a detailed description of the main modern algorithms in computational number theory. To implement all the algorithms and methods introduced in the course on a computer using a computer algebra system

Pre-requisites: knowledge of discrete mathematical structures (groups, rings, fields), algorithms (design and analysis techniques), and probability.

Course Outcomes: On successful completion of this course, students will be able to:

1. Explain the different concepts in divisibility and modular arithmetic.
2. Develop various algorithms for polynomials
3. Acquire a fundamental understanding of computational models related to elliptic curves and Integer factoring algorithms.
4. Analyze the various methods to compute discrete logarithms.
5. Analyze the various methods to compute integer factoring algorithms.

UNIT I

Algorithms for integer arithmetic [6 Hrs]

Divisibility, gcd, modular arithmetic, modular exponentiation, Montgomery arithmetic, congruence, Chinese remainder theorem, Hensel lifting, orders and primitive roots, quadratic residues, integer and modular square roots, prime number theorem, continued fractions and rational approximations.

Representation of finite fields [6 Hrs]

Prime and extension fields, representation of extension fields, polynomial basis, primitive elements, normal basis, optimal normal basis, irreducible polynomials.

Algorithms for polynomials [8 Hrs]

Root-finding and factorization, Lenstra-Lenstra-Lovasz algorithm, polynomials over finite fields.

UNIT II

Elliptic curves [6 Hrs]

The elliptic curve group, elliptic curves over finite fields, Schoof's point counting algorithm. Primality testing algorithms: Fermat test, Miller-Rabin test, Solovay-Strassen test, AKS test.

Integer factoring algorithms [6 Hrs]

Trial division, Pollard rho method, p-1 method, CFRAC method, quadratic sieve method, elliptic curve method.

Computing discrete logarithms over finite fields [8 Hrs]

Baby-step-giant-step method, Pollard rho method, Pohlig-Hellman method, index calculus methods, linear sieve method, Coppersmith's algorithm. **Applications: Algebraic coding theory, cryptography.**

Text Books:

1. V. Shoup, A computational introduction to number theory and algebra, Cambridge University Press.
2. M. Mignotte, Mathematics for computer algebra, Springer-Verlag.
3. Niven, H. S. Zuckerman and H. L. Montgomery, An introduction to the theory of numbers, John Wiley.

Reference Books:

1. J. von zur Gathen and J. Gerhard, Modern computer algebra, Cambridge University Press.

Department of Computer Science and Engineering

C436 **CS 1748** **(2L +1T hrs/week)**

ADVANCED OPERATING SYSTEMS

Questions to be set having equal weightage/marks from each unit: SIX
TWO from UNIT I, TWO from UNIT II, and TWO from both UNIT I and UNIT II combined.
Questions to be answered: FIVE
Compulsory TWO Questions from UNIT I and UNIT II, and ANY ONE from the combination Question

Objectives: The aim of this module is to study, learn, and understand the main concepts of advanced operating systems (parallel processing systems, distributed systems, real time systems, network operating systems, and open-source operating systems); Hardware and software features that support these systems.

Pre-requisites: Operating Systems, Real Time Systems, Distributed Systems.
Course Outcomes: On successful completion of this course, students will be able to:

1. Explain and manipulate the different concepts in advanced operating systems.
2. Analyze the working of various subsystems connected to the network.
3. Select appropriate approaches for building a range of distributed systems, including some that employ middleware.
4. Apply standard design principles in the construction of these systems.
5. Select appropriate approaches for building a range of distributed systems

UNIT I

Concepts [10 Hrs]
Hardware concepts of distributed systems, Software concepts and design issues, Communication in distributed systems

Threads and Procedure Calls [10 Hrs]
Threads and thread usage, Multithreading operating system, Client – server model, Implementation of Client-server model, **Remote procedure call, Implementation of remote procedure call**

UNIT II

Synchronization [10 Hrs]
Synchronization in distributed systems, Clock synchronization, **Mutual exclusion**, Election algorithms, Transaction and concurrent control

Deadlocks [10 Hrs]
Deadlock in distributed systems, Processor Allocation, Real – time distributed systems, **Distributed file systems**

Text Books:

1. Abraham Silberschatz, Peter Baer Galvin, Greg Gagne, "Operating System Concepts", Wiley & Sons.Inc..
2. D M Dhamdhere, "Systems Programming & Operating Systems", Tata McGraw-Hill.

Reference Books:

1. Andrew S. Tanenbaum, "Modern Operating systems", PHI.
2. Mukesh Singhal, Niranjan G.Shivaratri, "Advanced Concepts in Operating Systems", TataMcGraw-Hill.
3. P. Balakrishna Prasad, "Operating Systems", Scitech Publication.
4. William Stallings, "Operating Systems-Internals and Design Principles", Pearson Education.

Department of Computer Science and Engineering

C441 **CS 1749** **(2L +1T hrs/week)**

FAULT TOLERANT COMPUTING

Questions to be set having equal weightage/marks from each unit: SIX
TWO from UNIT I, TWO from UNIT II, and TWO from both UNIT I and UNIT II combined.
Questions to be answered: FIVE
Compulsory TWO Questions from UNIT I and UNIT II, and ANY ONE from the combination Question

Objectives: The purpose of the course is to solve and understand dependability problems; the need to design computer systems which are reliable, available and safe. Dependability concerns are integral parts of engineering design. The term dependability encompasses the concepts of reliability, availability, safety, security, maintainability, testability. Implementation of Fault Tolerance Designs through Redundancy is one way to improve the dependability parameters of the system.

Pre-requisites: Basic computer architecture.
Course Outcomes: On successful completion of this course, students will be able to:

1. Manipulate different concepts in fault tolerant computing.
2. Correlate the basic knowledge of fault tolerant computing with real time situations.
3. Decide on the applicability of such tools during safety critical cases.
4. Select an appropriate tool for testability, controllability and observability.
5. Select an appropriate algorithm for resilience and self- checking.

UNIT I

Basic Concepts [8 hrs]
Background of testing, fault tolerant computing and dependable computing, Dependability Attributes, Review of fundamental dependability and security theory, basic Concepts of Reliability, Faults in Digital Circuits, The calculation of reliability, MTTF, MTBF, MTTR, Availability, Multi-state systems and decision diagrams

Fault Tolerant Design of Digital Systems [12 hrs]
Introduction to Fault Tolerant Design of Digital Systems: Fault Tolerance, Static redundancy, **Dynamic redundancy**, Fault tolerant design of Memory systems, Practical Fault Tolerant Systems: FTMP, ESS, COMTRAC

UNIT II

Self-checking and resilience [12 Hrs]
Self-checking and fail-safe logic, Replication and voting. Redundant Disk Arrays, Degradation Allowance, management, Resilient Algorithms, Software Redundancy

Design for Testability [8 Hrs]
Testability, **Controllability and Observability**, Design of testable Combinational Logic Circuits, Testable design of Sequential Circuits, The scan path technique, Designing testability into logic boards, Case studies of fault tolerant multiprocessor and distributed system.

Text Books:
1. Fault Tolerant and Fault Testable Hardware Design, Parag K. Lala, PHI, 1985

Reference:
1. Fault Tolerant Computing Theory and Techniques-Volume I, D.K. Pradhan, PHI, 1986
2. Testing of Digital Systems, Niraj jha and Sandeep Gupta, Cambridge University Press, 2003

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Date.....

Department of Computer Science and Engineering

C442 **CS 1750** **(2L +1T hrs/week)**

MULTI-AGENT INTELLIGENT SYSTEMS

Questions to be set having equal weightage/marks from each unit: SIX
TWO from UNIT I, TWO from UNIT II, and TWO from both UNIT I and UNIT II combined.
Questions to be answered: FIVE
Compulsory TWO Questions from UNIT I and UNIT II, and ANY ONE from the combination Question

Objectives:
There is no generally accepted definition of artificial intelligence "agents." But practitioners know them when they see them. In loose terms, agents are programs that (i) sense their environment, (ii) make decisions about how to act based on these sensations, and (iii) then execute these actions. Autonomous agents do all three of these steps on their own, i.e. without a human in the loop. Multi-agent systems are collections of multiple agents that interact with one another.

Pre-requisites: background in artificial intelligence is recommended, but not required. Good programming skills, preferably in C++ or Java, are required.
Course Outcomes: On successful completion of this course, students will be able to:

1. Illustrate the different agent architectures and inter agent communication with different examples
2. Represent distributed rational decision making in various applications.
3. Construct different agent modelling techniques.
4. Summarize the different multi-agent learning techniques.
5. Summarize the different ways of agent communications

UNIT I

Introduction to Multiagent Systems [4 Hrs]
Trends in computing, Definitions of "agent" and Multiagent Systems, Example systems, Some views of the field

Intelligent Agents[2 Hrs]
What is an agent? Environments, Agents as Intentional Systems, Abstract Architecture for Agents

Deductive Reasoning Agents [2 Hrs]
Agent Architectures, Symbolic Reasoning Agents, Deductive Reasoning Agents ,Planning systems, AGENT0 and PLACA METATEM and Concurrent METATEM

Reactive and Hybrid Architectures [6 Hrs]
Brooks – behavior languages, Steels' Mars Explorer, Situated Automata, Advantages of Reactive Agents, Limitations of Reactive Agents, Hybrid Architectures

Multiagent Interactions [6 Hrs]
Multiagent Systems, Utilities and Preferences, Multiagent Encounters, Rational Action, **Payoff Matrices, Dominant Strategies, Nash Equilibrium, Competitive and Zero-Sum Interactions,** The Prisoner's Dilemma, Axelrod's Tournament, The Game of Chicken and other symmetric 2 x 2 games

UNIT II

Reaching Agreements [6 Hrs]
Auctions, Negotiation, Argumentation, Mechanisms, Protocols, and Strategies, Mechanism Design, Auctions, Negotiation, Argumentation

Coalitions, Voting Power, and Computational Social Choice, Forming Coalitions [6 Hrs]
Coalitional Games4, Formalizing Cooperative Scenarios, How to Represent Characteristic Functions, Voting Power, Preference Aggregation and Social Choice Theory, Ordinal voting methods, Arrow's Impossibility Theorem, Gibbard–Satterthwaite Theorem, Manipulations

Voting Protocols, Voting Criteria

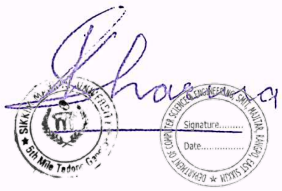
Agent Communication [4 Hrs]
Speech Acts, Plan Based Semantics, KQML, KIF – Knowledge Interchange Format, Criticisms of KQML, FIPA, Inform and Request

Benevolent Agents [4 Hrs]
Task Sharing and Result Sharing, **The Contract Net, Cooperative Distributed Problem Solving (CDPS), Distributed Sensing,** The Hearsay II architecture, The Distributed Hearsay II architecture, The Distributed Vehicle Monitoring Testbed (DVMT), Functionally Accurate/Cooperative (FA/C) systems

Text Books:
1. Artificial Intelligence: A Modern Approach (Third edition) by Stuart Russell and Peter Norvig
2. Russell, S. & Norvig, P. (2010). Artificial intelligence: a modern approach. Prentice Hall (3rd ed.).

Reference Book:

1. Elaine Rich, Kevin Knight & Shivashankar B. Nair (2008). Artificial Intelligence (Third Edition) TMH.
2. Bishop, C. M. (2006) Machine Learning and Pattern Recognition. Berlin: Springer.
3. Poole, D. L. & Mackworth, A. K. (2010). Artificial intelligence: foundations of computational agents. Cambridge University Press.



Department of Computer Science and Engineering

C443 **CS 1751** **(2L +1T hrs/week)**

PARALLEL AND DISTRIBUTED ALGORITHMS

Questions to be set having equal weightage/marks from each unit: SIX
TWO from UNIT I, TWO from UNIT II, and TWO from both UNIT I and UNIT II combined.
Questions to be answered: FIVE
Compulsory TWO Questions from UNIT I and UNIT II, and ANY ONE from the combination Question

Objectives:
To provide you with an introduction and overview to the computational aspects of parallel and distributed computing. To introduce several important parallel computing models that capture the essence of existing and proposed types of synchronous and asynchronous parallel computers. To study typical models for distributed computing. To study a few typical algorithms for each model, selected from various basic areas such as sorting, selection, graphs, matrices, numerical problems, and computational geometry. To provide an important skill for those who may work with large applications since these usually must be implemented on a parallel or distributed system, due to their memory space and speed requirements.

Pre-requisites: Multiprocessor systems, Design and Analysis of Algorithms, Parallel Computing.
Course Outcomes: On successful completion of this course, students will be able to:

1. Discuss about in-depth discourse on how to think about algorithms in a parallelized manner.
2. Select algorithms suitable for conventional, single-processor computers are not appropriate for parallel architectures.
3. Compare inherent parallel algorithms with their counterparts.
4. Justify the choice of parallel algorithms to accomplish a task.
5. Illustrate the process of synchronization.

UNIT I

The Idea of Parallelism [6 Hrs]
A Parallelised version of the Sieve of Eratosthenes. PRAM Model of Parallel Computation, Pointer Jumping and Divide & Conquer: **Useful Techniques for Parallelization**

PRAM Algorithms [6 Hrs]
Parallel Reduction, Prefix Sums, List Ranking, Preorder Tree Traversal, Merging Two Sorted Lists, Graph Coloring, Reducing the Number of Processors and Brent's Theorem

Dichotomoy of Parallel Computing Platforms [8 Hrs]
Cost of Communication, **Programmer's view of modern multi-core processors**, The role of compilers and writing efficient serial programs, Parallel Programming Languages: Shared Memory Parallel Programming using OpenMP, Parallel Complexity: The P-Complete Class

UNIT II

Scheduling [6 Hrs]
Mapping and Scheduling, Elementary Parallel Algorithms, Matrix Multiplication, Writing efficient openMP programs, Sorting

Dictionary Operations [6 Hrs]
Parallel Search, Graph Algorithms, Safety, liveness, termination, **logical time and event ordering**

Algorithms and Synchronization [8 Hrs]
Global state and snapshot algorithms, Mutual exclusion and Clock Synchronization, Distributed Graph algorithms, Distributed Memory Parallel Programming: Cover MPI programming basics with simple programs and most useful directives; Demonstrate Parallel Monte Carlo

Text Books:

1. Michael J Quinn, Parallel Computing, TMH
2. Joseph Jaja, An Introduction to Parallel Algorithms, Addison Wesley.

Reference Books:

1. Mukesh Singhal and Niranjan G. Shivaratri, Advanced Concepts in Operating Systems, TMH
2. Ananth Grama, Anshul Gupta, George Karypis, Vipin Kumar, Introduction to Parallel Computing, Pearson

Department of Computer Science and Engineering

C445 **CS 1753** **(2L +1T hrs/week)**

COMPUTATIONAL GEOMETRY

Questions to be set having equal weightage/marks from each unit: SIX
TWO from UNIT I, TWO from UNIT II, and TWO from both UNIT I and UNIT II combined.
Questions to be answered: FIVE
Compulsory TWO Questions from UNIT I and UNIT II, and ANY ONE from the combination Question

Objectives: Detailed knowledge of the fundamental problems within computation geometry and general techniques for solving problems within computational geometry and practical experience with implementation issues involved in converting computation geometry algorithms into running programs

Pre-requisites: Advanced Algorithms, a basic course in probability, Experience doing mathematical proofs.

Course Outcomes: On successful completion of this course, students will be able to:

1. Describe the divide-and-conquer paradigm and the scenario when it should be employed.
2. Construct algorithms related to computational geometry.
3. Analyze various algorithms based on certain underlying parameters.
4. Evaluate various computational geometry problems
5. Apply computational geometry in solving real world problems

UNIT I

Introduction [6 Hrs]
Algorithmic Background, Data Structures, Geometric Preliminaries, Models of Computation

Geometric Searching [6 Hrs]
Introduction, Point-Location Problems, Range-Searching Problems

Convex Hulls [12 Hrs]
Preliminaries, Problem Statement and Lower Bounds, Convex Hull Algorithms in the Plane, Graham's Scan, Jarvis's March, QUICKHULL techniques, Dynamic Convex Hull, Convex Hull in 3D

UNIT II

Proximity Problem [7 Hrs]
A Collection of Problems, A Computational Prototype: **Element Uniqueness, Lower Bounds,** The Closest-Pair Problem: A Divide-and-Conquer Approach, The Voronoi Diagram, Proximity Problems Solved by the Voronoi Diagram

Triangulation [7 Hrs]
Planar Triangulations, Greedy Triangulations, Partitioning a Polygon into Monotone Pieces, Triangulating a Monotone Polygon, Delaunay Triangulation

Intersections [6 Hrs]
Application Areas, Planar Applications: Intersection of Convex Polygons, Star-shaped Polygons; **Intersection of Line Segments, 3D Applications: Intersection of 3D Convex Polyhedra; Intersection of Half-spaces**

Textbooks:

1. Computational Geometry: An Introduction, F. P. Preparata and M.I. Shamos, Springer-Verlag, 1985.
2. Computational Geometry: Algorithms and Applications, M. de Berg, M. van Kreveld, M. Overmars, O. Schwarzkopf, Springer-Verlag, Revised Second Edition, 2000.

Reference Books:

1. Joseph O'Rourke, Computational Geometry in C, Cambridge University Press, 2nd Edition, 1998.

Department of Computer Science and Engineering

C439 **MA 1754** **(2L +1T hrs/week)**

QUEUING THEORY AND MODELING

Questions to be set having equal weightage/marks from each unit: SIX
TWO from UNIT I, TWO from UNIT II, and TWO from both UNIT I and UNIT II combined.
Questions to be answered: FIVE
Compulsory TWO Questions from UNIT I and UNIT II, and ANY ONE from the combination Question

Objectives: Introduction, Markov Chains and Markov Processes, Birth-Death Processes, Simple Queueing Models (M/M/-/- Queues), Queues with Batch Arrivals, M/G/1 Queue with Residual Life and Imbedded Markov Chain Approach, Queues with Vacations, Bulk Arrivals and Priorities, Discrete Time Queues, Delay Analysis of Queues. Fundamentals of Queueing Networks, Open and Closed Queueing Networks, Open Networks of M/M/m type queues and Jackson's Theorem, MVA and Convolution Algorithm for Closed Networks, Approximate Models for Open and Closed Queueing Networks, Queueing System Applications, Simulation Modeling of Queueing Systems.

Pre-requisites: Adequate knowledge of undergraduate mathematics.
Course Outcomes: On successful completion of this course, students will be able to:

1. Apply probability techniques, models to analyse the basics of queuing theory.
2. Identify the areas and hence apply the mathematical techniques necessary.
3. Apply knowledge of continuous time stochastic processes for deeper understanding.
4. Learn to design resources such as buffer and link capacities to meet specified required quality of service of a queueing system.
5. The students will develop ability to identify, evaluate, formulate and solve engineering problems related to resource allocation of queueing system.

UNIT I

Introduction [6 Hrs]
Introduction to Queues and Queueing Theory. Stochastic Processes, Markov Processes and Markov Chains, Birth-Death Process.
Basic Queueing Theory [6Hrs]
Basic Queueing Theory (M/M/-/- Type Queues. Departure Process from M/M/-/- Queue, Time Reversibility, Method of Stages, Queues with Bulk Arrivals.
M/G/1 Queue [8 Hrs]
Equilibrium Analysis of the M/G/1 Queue. Analyzing the M/G/1 Queue using the Method of Supplementary Variables. M/G/1 Queue with Vacations. M[x]/G/1 Queue. Priority Operation of the M/G/1 Queue.

UNIT II

M/M/n/K Queue [6 Hrs]
M/M/n/K Queue with Multiple Priorities. M/G/1/K Queue. G/M/1, G/G/1 G/G/m, and M/G/m/m Queues.
Queueing Networks [6 Hrs]
Classification and Basic Concepts, Open and Closed Networks of M/M/m Type Queues, Jackson's Theorem, **Analysis of Closed Queueing Networks using Convolution and Mean Value Algorithms.**
Queueing Networks [12 Hrs]
Norton's Theorem for Closed Queueing Networks, Mixed Queueing Networks, Queueing Network Analyzer (QNA) **Approach, Simulation Techniques for Queues and Queueing Networks.** Discrete Time Queues.
Text Books:
1. Donald Gross, James M. Thompson, John F. Shortle and Carl W. Harris, Fundamentalsof Queueing Thoery, Wiley 2008.

Reference Books:
1. Sanjay K. Bose, An Introduction to Queueing Systems, Springer 2002.

Department of Computer Science and Engineering

C440 **CS 1755** **(2L +1T hrs/week)**

QUANTUM COMPUTING

Questions to be set having equal weightage/marks from each unit: SIX
TWO from UNIT I, TWO from UNIT II, and TWO from both UNIT I and UNIT II combined.
Questions to be answered: FIVE
Compulsory TWO Questions from UNIT I and UNIT II, and ANY ONE from the combination Question

Objectives:

- Analyze the behavior of basic quantum algorithms
- Implement simple quantum algorithms and information channels in the quantum circuit model
- Simulate a simple quantum error-correcting code
- Prove basic facts about quantum information channels

Pre-requisites: Familiarity with linear algebra including concepts such as vector space, inner products, matrices, eigenvalues and eigenvectors will be assumed.

Course Outcomes: On successful completion of this course, students will be able to:

1. Describe the fundamentals of quantum information processing.
2. Illustrate the fundamentals of quantum computation, quantum cryptography, and quantum information theory.
3. Device the quantum circuit model consisting of qubits, unitary operators, measurement, entanglement
4. Represent various implementations of Quantum computers.
5. Represent various applications of Quantum computers in real life.

UNIT I

Introduction [3 Hrs]

Quantum Cryptography [10 Hrs]

Cryptography, classical cryptography, introduction to quantum cryptography. BB84, B92 protocols. Introduction to security proofs for these protocols.

Quantum Algorithm [10 Hrs]

Introduction to quantum algorithms.
Deutsch-Jozsa algorithm, Grover's quantum search algorithm, Simon's algorithm. Shor's quantum factorization algorithm.

UNIT II

Error Correction [10 Hrs]

Errors and correction for errors. Simple examples of error correcting codes in classical computation. Linear codes. Quantum error correction and simple examples. Shor code.

Quantum Entanglement [10 Hrs]

Quantum correlations, Bell's inequalities, EPR paradox. Theory of quantum entanglement. Entanglement of pure bipartite states. Entanglement of mixed states. Peres partial transpose criterion. NPT and PPT states, bound entanglement, entanglement witnesses.

Implementations [10 Hrs]

Different implementations of quantum computers. NMR and ensemble quantum computing, Ion trap implementations. Optical implementations.

Text books:

1. Quantum Computation and Quantum Information, M.A. Nielsen and I.L.Chuang, Cambridge University Press 2000.

Reference Books:

1. P. Kaye, R. Laflamme, and M. Mosca. An Introduction to Quantum Computing. Oxford, 2007.
2. M. A. Nielsen and I. L. Chuang. Quantum Computation and Quantum Information. Cambridge University Press, 2000.

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Department of Computer Science and Engineering

C639 **CS 1640 / CS 1758** **(2L+1T hrs/week)**

COMPUTER VISION

Questions to be set having equal weightage/marks from each unit: SIX
TWO from UNIT I, TWO from UNIT II, and TWO from both UNIT I and UNIT II combined.
Questions to be answered: FIVE
Compulsory TWO Questions from UNIT I and UNIT II, and ANY ONE from the combination Question

Objective: This course highlights the overview of display devices and peripherals software and techniques used in computer graphics. It also introduces graphics processing to general purpose parallel computing. Study high-definition 3D graphics, programmable graphic processor unit, multithreaded processor, multi core processor with tremendous computational horsepower and very high memory bandwidth.

Pre-requisites: Programming concepts, object oriented concept.
Course Outcomes: On successful completion of this course, students will be able to:

1. Display sufficient understanding of mathematical and engineering fundamentals in the perspective of computer vision.
2. Identify problems that can be solved using computer vision techniques.
3. Appreciate the importance of tolerance of imprecision and uncertainty for design of robust and low-cost intelligent machines.
4. Investigate a problem to identify technical issues and solve the problems using various computer vision techniques.
5. Design real-life applications using computer vision techniques.

UNIT – I

Introduction, overview of graphics systems [4 Hrs]
Display devices, Hard copy devices, Interactive input devices, Display processors.

Introduction, overview of OpenGL [2 Hrs]
Introduction to openGL, DirectX, Comparison between OpenGL and DirectX.

Output primitives [5 Hrs]
Points and lines, Line drawing algorithm, Anti aliasing lines, Circle generating algorithms (Bresenham's), Ellipse, Other curves, **Character generation.**

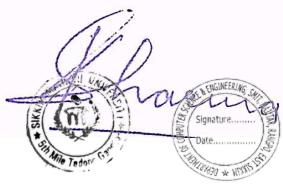
Attributes of output primitives [3 Hrs]
Line styles, Color and intensity, Solid area scan conversion, Character attributes, **Inquiry functions, Bundled attributes.**

Two dimensional transformations [4 Hrs]
Basic Transformations, Homogenous co-ordinates, Composite Transformations, Reflections, Shear.

Windowing and clipping[4 Hrs]
Windowing concepts, Clipping algorithms, Line clipping (Cohen Sutherland & Mid-point sub division), Area Clipping, Text Clipping, Window to view port transformation.

UNIT – II

Introduction to CUDA [4 Hrs]
From Graphics Processing to General-Purpose Parallel Computing, CUDA™ a General-Purpose Parallel Computing Architecture, **CUDA's Scalable Programming Model. Document's Structure.**



CUDA Programming Model [4 Hrs]
Kernels, Thread Hierarchy, Memory Hierarchy, Host and Device, Compute Capability.

CUDA Programming Interface[6 Hrs]
Compilation with NVCC, C for CUDA- Device Memory, Shared Memory, Multiple Devices, Texture Memory- Texture Reference Declaration, **Runtime Texture Reference Attributes, Texture Binding.**
Hardware Implementation: [2 Hrs]
A Set of SIMT Multiprocessors with On-Chip Shared Memory, **Multiple Devices.**

Computer Animation [4 Hrs]
Introduction, Types of animation, Principles of Animation, General Computer-Animation Functions, Computer-Animation languages, Key frame systems morphing, **Animation Tools, Animation using HTML5.**

Text books:

1. Donald Hearn & M. Pauline Baker, "Computer Graphics", PHI.
2. NVIDIA CUDA™ Programming Guide Version 2.3.1
3. NVIDIA CUDA C Programming Guide PG-02829-001_v7.0
4. Donald Hearn & M. Pauline Baker, "ComputerGraphics with OpenGL", PHI.

Reference books:

1. Steven Harington, "Interactive Computer Graphics", Tata McGraw Hill.
2. Dabod G. Rfgers, "Procedure elements for Computer Graphics", McGraw Hill.
3. A. Plastick& Gordon Kalley , "Computer Graphics, Schaum's Outline series", McGraw Hill.
4. Amarendra N Sinha and Arun D Udai , "Computer Graphics", McGraw Hill.

Department of Computer Science and Engineering

C428 **CS 1743** **(2L+1 hrs/week)**

CYBER SECURITY

Questions to be set having equal weightage/marks from each unit: SIX
TWO from UNIT I, TWO from UNIT II, and TWO from both UNIT I and UNIT II combined.
Questions to be answered: FIVE
Compulsory TWO Questions from UNIT I and UNIT II, and ANY ONE from the combination Question

Objectives: The course is designed to present the basic concepts of cyber security. It address the key issues of security vulnerabilities on software development, operating system and the web. Solutions provided by cryptography has been discussed especially based on intrusion detection system. The syllabus also gives a brief introduction to cyber forensics.

Pre-requisites: Operating Systems, Data Communication and Computer Networks.
Course Outcomes: On successful completion of this course, students will be able to:

1. Discover the concepts of Cyber security and its social, technical and political techniques.
2. Illustrate on the various Intrusion detection and prevention techniques.
3. Analyze various algorithms based on Cryptography and Network security.
4. Asses various methods of handling investigations in the field of cyber forensics
5. Asses the legal and social issues in the development and management of cyber security.

UNIT – I

Introduction to Cyber Security [5 Hrs]
Overview of Cyber Security, Internet Governance – Challenges and Constraints, Cyber Threats:- Cyber Warfare-Cyber Crime-Cyber terrorism-Cyber Espionage, Need for a Comprehensive Cyber Security Policy, Need for a Nodal Authority, Need for an International convention on Cyberspace.

Cyber Security Vulnerabilities and Cyber Security Safeguards [5 Hrs]
Cyber Security Vulnerabilities-Overview, vulnerabilities in software, System administration, Complex Network Architectures, Open Access to Organizational Data, Weak Authentication, Unprotected Broadband communications, Poor Cyber Security Awareness. Cyber Security Safeguards- Overview, Access control, Audit, Authentication, Biometrics, Cryptography, Deception, Denial of Service Filters, Ethical Hacking, Firewalls, Intrusion Detection Systems, Response, Scanning, Security policy, Threat Management.

Securing Web Application, Services and Servers [5 Hrs]
Introduction, Basic security for HTTP Applications and Services, Basic Security for SOAP Services, Identity Management and Web Services, Authorization Patterns, Security Considerations, Challenges.

Intrusion Detection and Prevention [5 Hrs]
Intrusion, Physical Theft, Abuse of Privileges, Unauthorized Access by Outsider, Malware infection, Intrusion detection and Prevention Techniques, Anti-Malware software, Network based Intrusion detection Systems, Network based Intrusion Prevention Systems, Host based Intrusion prevention Systems, Security Information Management, Network Session Analysis, System Integrity Validation.

UNIT II

Cryptography and Network Security [10 Hrs]
Introduction to Cryptography, Symmetric key Cryptography, Asymmetric key Cryptography, Message Authentication, Digital Signatures, Applications of Cryptography. Overview of Firewalls- Types of Firewalls, User Management, VPN Security Security Protocols: - security at the Application Layer- PGP and S/MIME, Security at Transport Layer- SSL and TLS, Security at Network Layer-IPSec.

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Cyberspace and the Law [5 Hrs]

Introduction, Cyber Security Regulations, Roles of International Law, the state and Private Sector in Cyberspace, Cyber Security Standards. The INDIAN Cyberspace, National Cyber Security Policy 2013.

Cyber Forensics [5 Hrs]

Introduction to Cyber Forensics, Handling Preliminary Investigations, Controlling an Investigation, Conducting disk-based analysis, Investigating Information-hiding, Scrutinizing E-mail, Validating E-mail header information, Tracing Internet access, Tracing memory in real-time.

Text Books:

1. John R Vacca, "Computer and Information Security Handbook", 3rd Edition, Elsevier, 2013,ISBN: 9780128038437.
2. Albert Marcella, Jr., Doug Menendez, "Cyber Forensics: A Field Manual for Collecting, Examining, and Preserving Evidence of Computer Crimes", Second Edition, CRC Group, Taylor & Francis, ISBN 9780849383281.
3. William Stallings, "Cryptography and Network Security", Pearson.

Reference Books:

1. George K Kostopoulus, "Cyber space and Cyber Security ", Second Edition, CRC Group, Taylor & Francis, ISBN 9781138057715
2. Behrouz A Frouzan, "Cryptography and Network Security", Tata McGraw Hill.

Department of Computer Science and Engineering

C429 **CS 1754** **(2L+1T hrs/week)**

FUTURE INTERNET ARCHITECTURE

Questions to be set having equal weightage/marks from each unit: SIX
TWO from UNIT I, TWO from UNIT II, and TWO from both UNIT I and UNIT II combined.
Questions to be answered: FIVE
Compulsory TWO Questions from UNIT I and UNIT II, and ANY ONE from the combination Question

Objectives: This course is an advanced networking course focusing on present and future Internet architecture and protocols. This course will introduce students to the basic design principles on which today's networks are based. In addition, this course will cover recent proposals to improve network performance, functionality and scalability.

Pre-requisites: Some background in computer networking.
Course Outcomes: On successful completion of this course, students will be able to:

1. Describe the basic concepts of networking.
2. Construct algorithms related to different backbone networks and Software Defined Networking (SDN)
3. Analyze various algorithms based on data centre networks and data centre virtualization
4. Evaluate various problems based on overlay networks
5. Evaluate various problems based on virtualization.

UNIT-I

Introduction of Computer Network Concepts [4 Hrs]
Device level connectivity, network protocol stack, OSI/ISO reference Model, basic TCP/IP protocol principles.

Modern Transport Protocols in the Internet [4 Hrs]
Basics of TCP and its limitations SPDY and QUIC, Multipath TCP (MPTCP).

Backbone Network [6 Hrs]
Internet Backbone Architecture Switches, Routers, Network access points and Internet Exchange Points, Internet Service Providers (ISP) and ISP connectivity, Economy of the backbone routing (BGP) and BGP route policy.

Software Defined Networking (SDN) [6 Hrs]
History and Evolution of Software Defined Networking, Management issues in present network architecture Network Virtualization and evolution of SDN, SDN architecture - data plane vs control plane Examples of SDN controllers - OpenFlow architecture, SDN Programming.

UNIT-II

Virtualization [5 Hrs]
Data Centre Networks, Data Center Virtualization, Hyperconvergence Architecture, Virtual Network managenemt and QoS, Replica Management and Geo-load balancing.

Content Delivery Network (CDN)[5 Hrs]
Web Caching, Proxy caches, Limitations of web caching, Content Distribution Network: Server Selection Policy, Server Selection Mechanism, and Case Study: How Akamai Works.

Named Data Networking (NDN)[5 Hrs]
Introduction, Challenges of Traditional Internet, Information Centric Network, Content-Centric Networks, Named Data Network: Content, Naming, Interest, Interest Forwarding, Data Retrieval, Security, Applications and challenges of NDN.

Overlay Network: [5 Hrs]

Introduction of overlay networks, Distributed Hash Tables (DHTs), Application of DHTs.

Text Books:

1. Thomas D. Nadeau, Ken Gray "SDN: Software Defined Networks: An Authoritative Review of Network Programmability Technologies", - O'Reilly Media
2. Andrew S. Tanenbaum, "Computer Networks", PHI.

References:

1. Kurose Ross, "Computer Networks – A Top-Down Approach featuring the Internet", Pearson.
2. Patricia A Morreale and James M. Anderson"Software Defined Networking: Design and Deployment"-CRC Press.

Department of Computer Science and Engineering

C423 **CS 1728 / CS 1701** **(2L + 1 T hrs/week)**

DISTRIBUTED SYSTEMS

Questions to be set having equal weightage/marks from each unit: SIX
TWO from UNIT I, TWO from UNIT II, and TWO from both UNIT I and UNIT II combined.
Questions to be answered: FIVE
Compulsory TWO Questions from UNIT I and UNIT II, and ANY ONE from the combination Question

Objectives: This course is designed to present the concepts of heterogeneous multi-computer systems and distributed operating systems. Communication in a client/server model using RPC, Message oriented communications, remote object invocation, and distributed processes and software agents are discussed. Other distributed systems concepts such as clock synchronization, data consistency and replication, fault tolerance, security and distributed component and file systems are also covered.

Pre-requisites: Operating Systems, Database Management Systems, Computer Networks – I, Computer Networks – II.

Course Outcomes: On successful completion of this course, students will be able to:

1. Observe the complexities of distributed system development.
2. Develop a strategy to overcome important issues including time, inter-process communication, and state management in distributed computing.
3. Construct systems in a constrained distributed environment by integrating several modules and validate the detailed design.
4. Illustrate the ability to apply the knowledge in analysing and designing distributed systems.
5. Summarize the middleware technologies that support distributed applications such as RPC, RMI and object-based middleware

UNIT – I

Fundamentals [5 Hrs]
Introduction to Distributed Systems, Evolution and applications of DCS, Challenges and examples of distributed systems, Distributed systems models: Architectural models and fundamental models.

Time and Global States [5 Hrs]
Logical time and event ordering, Global state and snapshot algorithms, clock synchronization.

Coordination and Agreement [6 Hrs]
Introduction, Distributed mutual exclusion, distributed shared memory: General architecture, **Design and implementation issues**, elections.

Distributed Transactions [4 Hrs]
Flat and nested distributed transactions, Atomic commit protocol, **Concurrency control in distributed transactions**, Distributed deadlocks and recovery.

UNIT – II

Fault Tolerance and Load Balancing [4 Hrs]
Fault tolerance and recovery: Fault models, Fault tolerant services, reliable communication, Resource sharing and load balancing.

Inter-Process Communication [4 Hrs]
API for the Internet protocols, external data representation and marshalling, Multicast communication, **Indirect Communication: Publish-subscribe systems.**

Remote Invocation [5 Hrs]
Request-reply protocols, Remote procedure call, Remote method invocation, **Case study: Java RMI,**

CORBA RMI.

Security and Authentication [3 Hrs]
Overview of security techniques, Digital signatures, Kerberos.

Distributed Files Systems [4 Hrs]
Features of DFS, File service architecture, **Case study: Sun Network File System, Andrew File System, Google file systems (GFS).**

Text Books:

1. George Coulouris, Jean Dollimore, Tim Kindberg, "Distributed Systems: Concepts and Design",Pearson
2. Andrew S. Tanenbaum, Maarten van Steen, "Distributed Systems: Principles and Paradigms", Pearson

Reference Books:

1. Pradeep K. Sinha, "Distributed Operating Systems", PHI.
2. Nancy A. Lynch, "Distributed Algorithms", Elsevier.
3. Kenneth P. Birman, "Reliable distributed systems: Technologies, Web services, and applications",Springer.
4. Paulo Veríssimo, Luis Rodrigues, "Distributed systems for system architects", Springer.

Department of Computer Science and Engineering

C409 **CS 1721/ CS1407 (2L + 1 T hrs/week)**

PRINCIPLES OF PROGRAMMING LANGUAGE

Questions to be set having equal weightage/marks from each unit: SIX
TWO from UNIT I, TWO from UNIT II, and TWO from both UNIT I and UNIT II combined.
Questions to be answered: FIVE
Compulsory TWO Questions from UNIT I and UNIT II, and ANY ONE from the combination Question

Objectives: The objective of this course is to identify the conceptual building blocks from which languages are assembled and specify the semantics, including common type systems, of programming languages.

Pre-requisites: Programming languages & Concepts.
Course Outcomes: On successful completion of this course, students will be able to:

1. Examine the major programming paradigms, and the principles and techniques involved in design and implementation of modern programming languages.
2. Classify notations to describe syntax and semantics of programming languages.
3. Analyse the behaviour of simple programs in imperative languages using concepts such as binding, scope, control structures, subprograms and parameter passing mechanisms.
4. Classification of the concepts of ADT and object oriented programming for large scale software development.
5. Evaluate the concepts of concurrency control and exception handling in programming language

UNIT-I

Introduction: Names, Scopes, and Bindings [7 Hrs]

The art of language design; Programming language spectrum; Why study programming languages? Evolution of programming languages – describing syntax – context-free grammars – attribute grammars – describing semantics – lexical analysis – parsing – recursive-decent – bottom up parsing. Syntactic Structure - Language representation, Abstract Syntax tree, Lexical syntax, Context Free Grammars, Variants of CFG, Issues involved and Normal Forms for CFG. Compilation and interpretation; Programming environments. Names, scope, and bindings: The notion of binding time; Object lifetime and storage management; Scope rules; Implementing scope; The meaning of names within a scope; The binding of referencing environments; Macro expansion. **High Level Languages, Issues in Programming - Case studies, Programming paradigms, Language implementation.**

Data Types & Control Structures [6 Hrs]

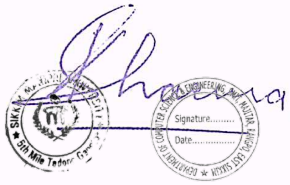
Type systems; Type checking; Records and variants; **Arrays; Strings; Sets; Pointers and recursive types; Lists; Files and Input/Output;** Equality testing and assignment. Names – variables – binding – type checking – scope – scope rules – lifetime and garbage collection – primitive data types – strings – array types – associative arrays – record types –union types – pointers and references – Arithmetic expressions – overloaded operators –type conversions – relational and boolean expressions – assignment statements – mixed mode assignments . Control structures – selection – iterations – branching – guarded statements

Subroutines and Control Abstraction [2 Hrs]

Review of stack layout; Calling sequences; Parameter passing; Generic subroutines and modules; Exception handling; Coroutines; Events.

Imperative languages [5 Hrs]

Control Flow: **Expression evaluation; Structured and unstructured flow; Sequencing; Selection; Iteration; Recursion**; Non-determinacy, Structured Programming - Need and Design issues. Block Structures (Pascal), types arrays, records, sets, pointers, procedures, parameter passing, scope rules (in C).



UNIT-II

Object oriented languages[4 Hrs]

Grouping of data and Operations - Constructs for Programming Structures, abstraction Information Hiding, Program Design with Modules, Defined types, **Object oriented programming - concept of Object, inheritance, Derived classes and Information hiding - Templates- Exception handling (Using C++ and Java as example language).**

Functional Programming[8 Hrs]

Features, Implementation, Types - values and operations, Introduction to lambda calculus Product of types.Introduction to lambda calculus. Lists and Operations on Lists, Functions from a domain to a range, Function Application, Lexical Scope. Bindings of values and functions (Using Haskell/ Lisp as example language).Reactive programming and its concepts.

Logic Programming[2 Hrs]

Formal Logic Systems, Working with relations and their implementation (Using Prolog as example).
Database query Languages, Exception handling (Using SQL as example)

Concurrency[6 Hrs]

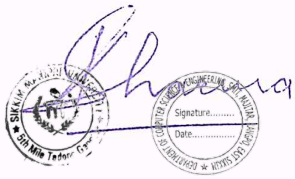
Background and motivation; Concurrency programming fundamentals; Implementing synchronization; Language-level mechanisms; Message passing. Run-Time Program Management: Virtual machines; late binding of machine code; Inspection/introspection.

Text Books:

1. Michael L. Scott: Programming Language Pragmatics, 3rd Edition, Elsevier, 2009.
2. Programming Language Design Concepts by David A. Watt, Wiley publications

Reference Books:

1. Ravi Sethi: Programming languages Concepts and Constructs, 2nd Edition, Pearson Education, 1996.
2. R Sebesta: Concepts of Programming Languages, 8th Edition, Pearson Education, 2008.
3. Allen Tucker, Robert Nonan: Programming Languages, Principles and Paradigms, 2nd Edition, Tata McGraw-Hill, 2007.
4. Programming Languages: Principles and Practice (English) 1st Edition (Paperback) by Kenneth C. Louden.



Department of Computer Science and Engineering

C422 **CS 1724 / CS 1736** **(2L +1T hrs/week)**

OPTIMIZATION TECHNIQUES

Questions to be set having equal weightage/marks from each unit: SIX
TWO from UNIT I, TWO from UNIT II, and TWO from both UNIT I and UNIT II combined.
Questions to be answered: FIVE
Compulsory TWO Questions from UNIT I and UNIT II, and ANY ONE from the combination Question

Objectives: The objective of this course is to understand the need and origin of the optimization methods and to get a broad picture of the various applications of optimization methods used in engineering. This course is indent for designing and controlling complex systems, solving hard problems of efficiently allocating scarce resources using in complete information, and developing sustainable strategies to master situations of conflict and co-operation using scientific methods and information technology.

Pre-requisites: Quantitative Analysis using C/C++, Design and Analysis of Algorithms and Probability& Statistics.

Course Outcomes: On successful completion of this course, students will be able to:

1. Demonstrate the knowledge and understanding of the basic ideas underlying optimization techniques.
2. Apply the mathematical approach to optimization problems relevant to engineering
3. Analyze the robustness of continuous linear optimization problems solutions using sensitivity analysis.
4. Ability to understand and interpret the results and information provided by a particular method.
5. Compare the robustness of continuous linear optimization problems solutions using various techniques

UNIT – I

Introduction to Operations Research [8 Hrs]
Introduction to OR modeling approach and various real life situations, Linear programming problems and applications, Solving Linear Programming problem using simultaneous equations and Graphical Method, Simplex Method and extensions, Sensitivity analysis - Duality theory. Transportation model, **Transshipment problems and Assignment problems.**

Dynamic Programming [6 Hrs]
Bellman's principle of optimality, Examples on the application on routing problem, Inventory problemSimplex problem, **Marketing problem.**

Network Analysis [6 Hrs]
PERT and CPM, Probability of achieving completion data, Cost analysis, Graph reduction theory, Updating, **Resource allocation, Resource smoothing.**

UNIT – II

Inventory Method [7 Hrs]
Inventory problem, Variables in an inventory problem, Inventory models with penalty, Storage andQuantity discount, **Safety stock**, Inventory models with probability, Demand, Multi item deterministic model. Simulation, Types of simulation models, **Applications of simulation for Inventory problems.**

Queuing Theory [7 Hrs]
Poison arrivals and Exponential service times, Waiting time and Idle time cost, Single channel and Multi-channel problem. **Applications of simulation for Queuing problems**. Monte Carlo technique applied to queuing problems, **Poisson arrivals and service time.**

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Theory of Games [6 Hrs]

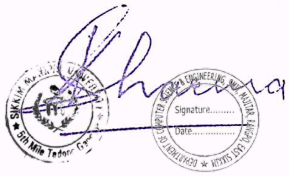
Introduction – Minimax (maximin) – Criterion and optimal strategy – Solution of games with saddle points– Rectangular games without saddle points – 2 X 2 games, Examples on the application of theory of games. – Dominance principle – mX2 & 2Xn games - Graphical method and Linear programming method for different problems. **Decision trees.**

Text Books:

1. Hamdy A. Taha, "Operations Research", Fifth edn. , Macmillan Publishing Company.
2. Kumar Gupta, Prem and Hira, D.S., "Operations Research", S Chand & Company Limited.
3. Swarup, Kanti, Gupta, P.K. and Manmohan, "Operations Research", Sultan Chand & Sons.

Reference Books:

1. Operations Research – Schaum outline series, MH
2. V.K. Kapoor-- Operations Research
3. Hiller F. and Leibermann G. J., "Operation Research", Holder Day Inc.
4. Srinath L.S., "PERT & CPM Principles and Applications", Affiliate East West Press (P).



Department of Computer Science and Engineering

C425 **CS 1725** **(2L +1T hrs/week)**

INDIAN MUSIC SYSTEM

Questions to be set having equal weightage/marks from each unit: SIX
TWO from UNIT I, TWO from UNIT II, and TWO from both UNIT I and UNIT II combined.
Questions to be answered: FIVE
Compulsory TWO Questions from UNIT I and UNIT II, and ANY ONE from the combination Question

Objectives: emphasizes that sharpening the perception of the arts through creating cultural and artistic responsiveness and consciousness in the student will generate an understanding of the arts in India, which will give students "the ability to appreciate the richness and variety of artistic traditions as well as make them liberal, creative thinkers and good citizens of the nation".

Pre-requisites: Brief Knowledge about various instruments and vocals.
Course Outcomes: On successful completion of this course, students will be able to:

1. Identify, in an oral fashion, the main melodic, rhythmic and formal characteristics of Indian classical music.
2. Identify and use the principal instruments of Indian classical music
3. To identify the names of some major composers and performers of Indian classical music.
4. Represent various applications of music in industry and household.
5. To identify the pioneers of Indian classical music.

UNIT I

Introduction [6 Hrs]
Sangeet, Swara, Saptak, Laya, Rãga, Varna, Rãga ki Jati-Audav – Shadav – Sampuran
Nãd – Nãd ki Jati – Tarta, Tivrata, Gun, Ãroha, Avroha, Pakad
Basic knowledge of the following instruments: Tãnpura/Sitar, Tabla/Harmonium

Biographies & Contributions [6 Hrs]
Amir Khusro, Swami Haridas, Tansen, Maseet Khan, Raza Khan, Faiyaz Khan, Ameer Khan

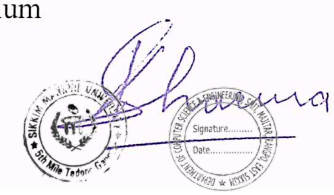
Study of Prescribed Rãgas & Tãlas [7 Hrs]
Rãga – Alhaiya Bilawal, Kafi, Bhairav Tãla – Teentãl, Dadra
Rãga –
1.Alhaiya Bilaval
2.Kafi
3.Bhairav

UNIT II

Vocal Music [6 Hrs]
a.Five Alankars in all the Rãgas.
b.Swarmallika in all the Rãgas
c.Lakshangeet or Drut Khyãl in all Rãgas.

Instrumental Music [6 Hrs]
a.Five Alankars in all the Rãgas.
b.Razakhanigat in all the Rãgas
c.Basic technique of Jhala Playing.

Vocal & Instrumental [7 Hrs]
Ability to recite the following Thekas with Tãli & Khãli Teentãla, Dadra
Vocal - Playing of Tanpura is compulsory
Basic knowledge of Playing Harmonium



Text Books:

1. Bhatkhande Sangeet Shastra- V. N. Bhatkhande
2. Sangeet Visharad- Basant
3. Kramik Pustak Mallika- Part II V. N. Bhatkhande

Reference Books:

1. Raag Vigyan – V. N. Patwardhan
2. Sangeet Bodh – Sharad Chandra Pranjpayee
3. Hamare Sangeet Ratna- Laxmi Narayan Garg
4. Tantri Naad Part-I – Pt. Lal Mani Mishra
5. Kramik Pustak Mallika, Part-III –V. N. Bhatkhande
6. Ragini Trivedi - Ragvibodha Mishrabani, Vol. I & II

Department of Computer Science and Engineering

C426 **CS 1726** **(2L +1T hrs/week)**

HISTORY OF SCIENCE

Questions to be set having equal weightage/marks from each unit: SIX
TWO from UNIT I, TWO from UNIT II, and TWO from both UNIT I and UNIT II combined.
Questions to be answered: FIVE
Compulsory TWO Questions from UNIT I and UNIT II, and ANY ONE from the combination Question

Objectives:

- Explain the reaction of Renaissance society to the heliocentric solar system.
- Describe the scientific innovations of Isaac Newton
- Explain how the personality of scientists can influence their discoveries.
- Describe how scientists can negatively interact with each other.
- Describe the impact of the Industrial Revolution on science and society.
- Explain the difference between the Industrial and Scientific Revolution.
- Explain the philosophy of Classic Greek Science
- Explain the philosophy of the Industrial Revolution.
- Describe the influence of religion and politics on early science.
- Describe the forces which brought about the Scientific Revolution.
- Describe the forces which brought about the Industrial Revolution.
- Compare and contrast beliefs associated with early and Renaissance science.
- Explain how the benefits and risks of future science can be compared.
- Discuss how past predictions about the future can be used to explain difficulties in successfully predicting future science.
- Identify how methods of scientific study have changed.

Pre-requisites: NIL
Course Outcomes: On successful completion of this course, students will be able to:

1. Define science and the scientific method.
2. Describe the possible future of science
3. Explain the difficulties involved in predicting the future of science
4. Explain some of the effects of technology on modern society
5. Compare modern and past examples of science.

UNIT I

Prehistory to the Renaissance [10 Hrs]
Introduction to the History of Science, Early Science I: The Roots of Science, Early Science II: Greece, Early Science III: Arabia, Early Science IV: The Dark Ages, The Dawn of the Renaissance

Copernicus to Darwin [10 Hrs]
The Scientific Revolution, Great Scientists I: Moving the Earth, Great Scientists II: Apples, Optics, and Orbits, Science During the Industrial Revolution, Great Scientists III: The Origin of Life, Anticipating the Twentieth Century

UNIT II

Einstein to the Twenty-First Century [10 Hrs]
Great Scientists IV: The Theory of Relativity, Great Scientists V: Genes and Genetics, Great Scientists VI: Secrets of the Atom, Great Scientists VII: Medical Pioneers, Great Scientists VIII: The Information Age, Science at the end of the 20th Century

Unit 4: Perspectives on Past, Present, and Future Science [10 Hrs]
Politics and Philosophy of Early Science, Politics and Philosophy of Renaissance Science, Politics and Philosophy of Modern Science, The Future I: Responsibilities for the Future?, The Future II: Dreams and Nightmares

Text Books:

1. Frederick Gregory, History of Science 1700-1900 CDs - The Teaching Company (The Great Courses)
2. Joy Hakim, The Story of Science: Aristotle Leads the Way.

Reference Books:

1. Joy Hakim,The Story of Science: Einstein Adds a New Dimension
2. Adam Rutherford A Brief History of Everyone Who Ever Lived: the Human Story Retold Through Our Genes

Department of Computer Science and Engineering

C427 **CS 1727** **(2L +1T hrs/week)**

INTRODUCTION TO ART AND AESTHETICS [OPEN ELECTIVE]

Questions to be set having equal weightage/marks from each unit: SIX
TWO from UNIT I, TWO from UNIT II, and TWO from both UNIT I and UNIT II combined.
Questions to be answered: FIVE
Compulsory TWO Questions from UNIT I and UNIT II, and ANY ONE from the combination Question

Objectives:

- Demonstrate coherent and detailed knowledge of central historical and contemporary issues in aesthetics and the philosophy of art;
- Deploy capacities for critical explication and presentation of arguments;
- Demonstrate a conceptual understanding which enables the development and sustaining of an argument;
- Describe and comment on particular aspects of recent research and/or scholarship;
- Appreciate the uncertainty, ambiguity and limitations of knowledge in the discipline;
- Make Appropriate use of scholarly reviews and primary sources.

Pre-requisites: NIL
Course Outcomes: On successful completion of this course, students will be able to:

1. Focus on the range of questions based on philosophy and science.
2. Apply the history of aesthetics, and the contemporary state of the subject in various problem domains
3. facilitate the application of philosophical thought on aesthetics to students' own engagements with art and the aesthetic.
4. Develop philosophical skills.
5. Practice the appropriate usage of scholarly reviews and primary sources

UNIT I

The cosmological perspective and the theory of mimesis [7 Hrs]
Introduction: Aesthetics -- Philosophy of Art or Philosophy of Beauty?, The meaning of the beautiful, The ancient quarrel between philosophy and art, Art and nature Mimesis, meaning, and metaphor: truth in art?, The destiny of the cosmological perspective: the Renaissance

The turn to the subject and the theory of taste [6 Hrs]
Aesthetic judgment, Art, genius, and aesthetic ideas

Art, Metaphysics, and History (Romanticism) [6 Hrs]
The priority of art over nature and the demand for philosophical reflection, Beauty as truth: the essence of appearance, History and the end of art: toward art's autonomy.

UNIT II

The Autonomy of Art: Phenomenological Approaches [10 Hrs]
Ontological phenomenology: thing and work, Ontological phenomenology: work and truth, Midterm recess, Ontological phenomenology: truth and art, Hermeneutic phenomenology: presentation, representation, and play, Hermeneutic phenomenology: structure, event, and the increase in being, Hermeneutic phenomenology: interpretation and reintergration, Existential phenomenology: embodiment and vision (the flesh of the world), Existential phenomenology: brute meaning and the enigma of depth
The Autonomy of Art: Analytic Perspectives [10 Hrs]

Evaluative approaches to art: aesthetic experience and aesthetic attitude, Evaluative approaches to art: taste, discrimination, and aesthetic concepts , Classificatory approaches to art: the institutional theory , Works and things, Aesthetics and the metaphysics of representation, Interpretation, identification, representation Thanksgiving Recess, Metaphor, expression, and life transfigured, After the end of art?

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Text Books:

1. Barrett, Terry. Why is that Art? Oxford University Press, 2007. ISBN: 0195167422
2. Barrett, Terry. Criticizing Art, 2d ed. McGraw Hill, 2001. ISBN: 7115034X
3. Barrett, Terry. Interpreting Art. McGraw-Hill, 2002. ISBN: 0767416481
4. Beardsley, Monroe. Aesthetics from Classical Greece to the Present: A Short History. MacMillan, 1966.
5. Bosanquet. Bernard. A History of Aesthetic. Cosimo Classics, 2005. ISBN: 1596053240
6. Eaton, Marcia. Basic Issues in Aesthetics. Waveland Press, 1999. ISBN: 157766034X
7. Farris-Dufrene, Phoebe. Voices of Color: Art and Society in the Americas. Humanities Press, 1997. ISBN: 039103992X

Reference Books:

1. Kelly, Michael, ed. Encyclopedia of Aesthetics. Oxford University Press, 1998. ISBN: 0195113071
2. Kieran, Matthew. Contemporary Debates in Aesthetics. Blackwell Publishing, 2005. ISBN: 1405102403
3. Kivy, Peter, ed. Blackwell Guide to Aesthetics. Blackwell Publishing, 2005. ISBN: 063122131X
4. Levinson, Jerrold. Oxford Handbook of Aesthetics. Oxford University Press, 2005. ISBN: 0199279454
5. Sheppard, Anne. Aesthetics: An Introduction to Philosophy of Art. Oxford University Press, 1987. ISBN: 0192891642
6. Stewart, Marilyn G. Thinking through Aesthetics. Davis Publishing, 1997. ISBN: 0871923629

Department of Computer Science and Engineering

C424 **CS 1729** **(2L+1T hrs/week)**

ENGINEERING RESEARCH METHODOLOGY

Questions to be set having equal weightage/marks from each unit: SIX
TWO from UNIT I, TWO from UNIT II, and TWO from both UNIT I and UNIT II combined.
Questions to be answered: FIVE
Compulsory TWO Questions from UNIT I and UNIT II, and ANY ONE from the combination Question

Objective: This course covers the various stages of research work in engineering sciences and highlights the importance, scope, functioning and procedures to be followed for successful research outcomes and its documentation and presentation. It also intends to give students the tools to conceptualize their theses in terms of research questions and design, methodology, data collection and qualitative as well as quantitative analysis.

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Pre-requisites: No Departmental prerequisites.

Course Outcomes: On successful completion of this course, students will be able to:

1. Apply appropriate procedure/algorithm, dataset and test cases and choose appropriate hardware/software tools to conduct the experiment.
2. Identify gaps in knowledge and a strategy to complete this gap enhancing knowledge.
3. Select discipline-specific tools, techniques and resources based on strengths and limitations of tools and techniques.
4. Create/develop comprehend technical literature and document project work to produce well formulated written document for supporting logical progression of ideas.
5. Analyze the experimental data and ethical issues.

UNIT-I

Research Methodology [8 Hrs]

Objectives and Motivation of Research, Types of Research, Research Approaches, Significance of Research, Research Methods versus Methodology, Research and Scientific Method, Importance of Research Methodology, Research Process, Criteria of Good Research, Problems Encountered by Researchers in India, Benefits to the society in general. Definition of Research Problem, Problem Formulation, Necessity of Defining the Problem, Technique Involved in Defining a Problem.

Literature Survey [5 Hrs]

Importance of Literature Survey, Sources of Information, Assessment of Quality of Journals and Articles, Information through Internet Literature Review, **Need of Review**, **Guidelines for Review**, **Record of Research Review.**

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Research Design [7 Hrs]

Meaning of Research Design, Need of Research Design, Features of a Good Design, Important Concepts Relating to Research Design, **Different Research Designs**, **Basic principles of Experimental Designs,** Developing a Research Plan, Design of Experimental Set-up, Use of Standards and Codes

UNIT-II

Statistical Data Analysis [7 Hrs]

Exploration of the data. **Description and Analysis of Data**. Sample Design and Sampling. Role ofStatistics for Data Analysis. Functions of Statistics, Estimates of Population. Parameters. Parametric V/s Non Parametric methods. Descriptive Statistics, Points of Central tendency, Measures of Variability, Measures of relationship. Inferential Statistics- Estimation, Hypothesis Testing. Use of Statistical software. Deterministic and random data, uncertainty analysis, tests for significance: Chi-square, student's 't' test. Regression modeling, direct and interaction effects. ANOVA, F-test. Time Series analysis, Autocorrelation and autoregressive modeling.

Research Report Writing [6 Hrs]
Format of the Research report. Style of writing report. **Reference Books / Bibliography / Webliography, Technical paper writing /Journal report writing**.

Research Proposal preparation [3 Hrs]
Writing a Research Proposal and Research Report, Writing a Research Grant Proposal.

Grammar and Editing [4 Hrs]
English Grammar, **Punctuation and Mechanics**, MS Style Guides & Proof Reading, Introduction of Latex style and documentation, MLA referencing style, contextual correctness of technical writing, Achieving clarity in technical communication.

Text Books:
1. C.R. Kothari, Research Methodology Methods & Technique, New age international publishers .
2. R. Ganesan, Research Methodology for Engineers, MJP Publishers.

Reference Books:
1. Y.P. Agarwal, Statistical Methods: Concepts, Application and Computation, Sterling