Sanjivani Rural Education Society's

Sanjivani College of Engineering, Kopargaon

(An Autonomous Institute Affiliated to Savitribai Phule Pune University, Pune)

TY B. Tech. Computer Engineering

2021 Pattern

Curriculum

(T Y B. Tech. Sem-V & VI with effect from Academic Year 2023-2024)

At. Sahajanandnagar, Post. Shingnapur Tal. Kopargaon Dist. Ahmednagar,

Maharashtra State, India PIN 423603

Sanjivani College of Engineering, Kopargaon

(An Autonomous Institute affiliated to SPPU, Pune)

D E C L A R A T I O N

We, the Board of Studies (Computer Engineering), hereby declare that, we have designed the Curriculum of Third Year Computer Engineering Program Curriculum Structure and Syllabus for semester V & VI of Pattern 2021 w.e.f. from A.Y 2023-24 as per the guidelines. So, we are pleased to submit and publish this FINAL copy of the curriculum for the information to all the concerned stakeholders.

Submitted by

(Dr.D.B.Kshirsagar)
BoS Chairman

Approved by

Dean Academics   Director

Vision

- To develop world class engineering professionals with good moral characters and make them capable to exhibit leadership through their engineering ability, creative potential and effective soft skills which will improve the quality of life in society.

Mission

- To impart quality technical education to the students through innovative and interactive teaching and learning process to acquire sound technical knowledge, professional competence and to have aptitude for research and development.
- Develop students as excellent communicators and highly effective team members and leaders with full appreciation of the importance of professional, ethical and social responsibilities.

Program Educational Objectives (PEOs)

1 To prepare the committed and motivated graduates by developing technical competency, research attitude and life-long learning with support of a strong academic environment.

2. Train graduates with strong fundamentals and domain knowledge, update with modern technology to analyse, design & create novel products to provide effective solutions for social benefits.

3. Exhibit employability skills, leadership and right attitude to succeed in their professional career.

Engineering Graduates will be able to:

1. **Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

2. **Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

3. **Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

4. **Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

5. **Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

6. **The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

7. **Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

8. **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

9. **Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

10. **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

11. **Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

12. **Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Program Specific Outcomes (PSOs)

1. **Professional Skills:** The ability to apply knowledge of problem solving, algorithmic analysis, software Engineering, Data Structures, Networking, Database with modern recent trends to provide the effective solutions for Computer Engineering Problems.

2. **Problem-Solving Skills:** The ability to inculcate best practices of software and hardware design for delivering quality products useful for the society.

3. **Successful Career:** The ability to employ modern computer languages, environments, and platforms in creating innovative career paths.

Sanjivani College of Engineering, Kopargaon
(An Autonomous Institute)
Department of Computer Engineering
COURSE STRUCTURE- 2021 PATTERN

THIRD YEAR B. TECH: COMPUTER ENGINEERING (A.Y. 2023-24)
SEMESTER V

Cat.	Code	Design and Analysis of Algorithms	Teaching Scheme				Evaluation Scheme					
			L (hrs)	T (hrs)	P (hrs)	Credits	Theory		Practical			Grand Total
							CIA	ESE	TW	OR	PR	
PCC	CO301	Design and Analysis of Algorithms	3	1	-	4	40	60	-	-	-	100
PCC	CO302	Computer Network	3	-	-	3	40	60	-	-	-	100
PCC	CO303	Web Technology	3	-	-	3	40	60	-	-	-	100
PCC	CO304	Theory of Computation	3	1	-	4	40	60	-	-	-	100
PEC	CO305	Professional Elective - I	3	-	-	3	40	60	-	-	-	100
LC	CO306	Design and Analysis of Algorithms Laboratory	-	-	2	1	-	-		50	-	50
LC	CO307	Computer Network Laboratory	-	-	2	1	-	-	25	-		25
LC	CO308	Web Technology Laboratory	-	-	2	1	-	-	-	-	50	50
PROJ	CO309	Seminar and Communication Skills		-	2	1			25	-	-	25
PROJ	CO310	Corporate Readiness-II			2	01			50			50
MLC	MC311	Mandatory Learning Course-V	1	-	-	NC	-	-	-	-	-	Pass/ Fail
		Total	16	2	10	22	200	300	100	50	50	**700**

Mandatory Learning Course-V: Learning an Art Form (Music: vocal or instrumental, dance, painting, claymodeling, etc.):

Code	Professional Elective-1
CO305 A	Advanced Databases
CO305 B	Software Testing and Quality Assurance
CO305 C	Cloud Computing

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HOD   Dean Academics   Director

Sanjivani College of Engineering, Kopargaon
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COURSE STRUCTURE- 2021 PATTERN
THIRD YEAR B. TECH: COMPUTER ENGINEERING (A.Y. 2023-24)
SEMESTER VI

Cat.	Code	Course Title	L (hrs)	T (hrs)	P (hrs)	Credits	CIA	ESE	TW	OR	PR	Grand Total
							Theory		**Practical**			
PCC	CO312	Internet of Things	4	-	-	4	40	60	-	-	-	100
PCC	CO313	System Software	4	-	-	4	40	60	-	-	-	100
PCC	CO314	Data Mining and Warehousing	3	1	-	4	40	60	-	-	-	100
PCC	CO315	Professional Elective - II	4			4	40	60				100
PROJ	PR316	IPR and EDP	2	-	-	2	20	30	-	-		50
LC	CO317	Internet of Things Laboratory	-	-	2	1	-	-	-	50	-	50
LC	CO318	System Software Laboratory	-	-	2	1	-	-	25	-	50	75
LC	CO319	Data Mining and Warehousing Laboratory	-	-	2	1			25	-	50	75
PROJ	CO320	Creational Activity Lab			2	1			50			50
MLC	MC321	Mandatory Learning Course-VI	1	-	-	NC	-	-	-	-	-	Pass/ Fail
		Total	18	1	08	22	180	270	100	50	100	**700**

Mandatory Learning Course-VI: Behavioral and Interpersonal skills (non-verbal skills / behaviors,nonaggression)

Code	Professional Elective-II
CO315 A	Digital Forensics
CO315 B	Digital Image Processing
CO315 C	Advanced Java Programming

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SEMESTER V

CO301: Design and Analysis of Algorithms

Teaching Scheme		Examination Scheme	
Lectures:	3Hrs. / Week	Continuous Assessment:	40 Marks
Credits:	3	End Sem:	60 Marks
		Total:	100 Marks

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Prerequisite Course: Fundamentals of Data Structures Advanced Data Structures, Discrete Mathematics.

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Course Objectives:

1. To study and understand problem solving & basics of algorithm.

2. To study how to solve problems using greedy strategy.

3. To study how to solve problems using dynamic programming.

4. To study how to solve problems using backtracking and branch-n-bound strategies

5. To understand computational complexity theory.

6. To study parallel algorithms.

Course Outcome (COs): On completion of the course, students will be able to-

Course Outcomes	Bloom's Taxonomy	
	Level	Descriptor
1. **Understand** basics of problem solving and algorithm designing.	2	Understand
2. **Solve** problems using divide & conquer and greedy strategy.	3	Apply
3. **Solve** problems using dynamic programming strategy.	3	Apply
4. **Solve** problems using backtracking and branch-n-bound strategies.	3	Apply
5. **Understand** computational complexity theory.	2	Understand
6. **Understand** parallel algorithms.	2	Understand

Mapping of Course Outcomes to Program Outcomes (POs) & Program Specific Outcomes (PSOs):

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	3	2	3	-	1	2	1	-	-	-	1	3		-
CO2	2	-	1	3	-	1	1	1	-	-	-	1	3	2	-
CO3	2	-	1	3	-	1	1	1	-	-	-	1	3	2	2
CO4	2	-	1	3	-	1	1	1	-	-	-	1	3	2	2

CO5	-	2	2	3	-	1	1	1	-	-	-	1	3		2
CO6	1	-	2	3	-	1	1	1	-	-	-	1	2	1	-

COURSE CONTENTS

Unit I	Problem Solving &Basic of Algorithm	No. of Hours	Cos
	Problem Solving: Definition of Problem, Problem solving principles, Classification & Strategies to solve problems, **Algorithm:** Definition, Asymptotic Notations, Time Complexities, Best, Worst & Average Case Analysis. **Types of algorithms:** Randomized, Approximate & Exact. **Case study**: Brute Force Method. **Application:** Medical Domain Problem (MRI Scanner) and Algorithm for the MRI Scanner.	6	CO1
Unit II	**Divide-&-Conquer and Greedy Strategy**	No. of Hours	Cos
	Divide and Conquer Strategy: Principle, Control Abstraction, Time complexity Analysis, Binary search algorithm. **Case study**: Merge Sort. **Application**: Google's Binary Search to Identify Malware. **Greedy Strategy:** Principle, Control Abstraction, Time Complexity Analysis, Knapsack Problem, **Case study**: Scheduling Algorithms-Job Scheduling. **Application**: Finding the Shortest Path on Google Map	6	CO2
Unit III	**Dynamic Programming**	No. of Hours	Cos
	Dynamic Programming: Principle, Control Abstraction, Time Complexity Analysis, Binomial Coefficients, 0/1 Knapsack, **Case study**: Optimal Binary Search Tree (OBST) **Application** of DP: Path Finder GPS Application-Uber.	6	CO3
Unit IV	**Backtracking and Branch & Bound**	No. of Hours	Cos
	Backtracking: Principle, Control Abstraction, Time Complexity Analysis, 8-Queen Problem. **Case Study**: Sum of Subsets Problem.	6	CO4

	Application of BT: Sudoku Solver App **Branch-and-Bound:** Principle, Control Abstraction, Time Complexity Analysis, Knapsack Problem. **Case Study** :- Traveling Salesperson Problem, **Application:** Airline Crew Scheduling problem.		
Unit V	**Complexity Theory**	**No. of Hours**	**Cos**
	Polynomial and Non-Polynomial Class Problems, Deterministic and Non-Deterministic Algorithms, P class problems, NP class problems. **NP complete class problems**- Vertex cover problem, 3-SAT problem **NP-Hard Problems:** Clique problem. **Case Study**:- Reduction problem (3SAT to Clique Problem). **Application of Complexity**: Visiting All the Cities in State, Country and Globe	6	CO5
Unit VI	**Parallel Algorithms**	**No. of Hours**	**Cos**
	Sequential and Parallel Computing, RAM & PRAM Models for Parallel Processing, Parallel Algorithm with Analysis. Optimal Parallel Algorithms. **Quantum Algorithms:** Grover's Algorithm for Efficient Search. **Case study:-** Analysis of Parallel Quick Sort. **Application**: Database and Data Mining for Banking Data.	6	CO6

Books:

Text Books(T):

T1. Horowitz and Sahani, "Fundamentals of Computer Algorithms", University Press.

T2.Gills Brassard and Paul Bartly, "Fundamentals of Algorithmic", PHI, New Delhi.

T3. . A.V.Aho., "The Design and Analysis of Algorithms" Pearson Education, NewDelhi.

T4. K, Louden, " Mastering Algorithms", O" Reily Media Inc

Reference Books(R):

R1. Fayez Gebali, "Algorithms and Parallel Computing", Willy Publication.

R2. Thomas H. Coreman and Charles R. L. Leiserson, "Introduction to Algorithm", PHI Publications.

R3. M.R.Kabat, "Design and Analysis of Algorithms", PHI Learning (p) Ltd.

R4. S. Sridhar ,""Design and Analysis of Algorithms", Oxford University Press.

e-Resources(E):

E1:Robert Sedgewick and Kevin Wayne, "algorithms" Princeton University. https://bank.engzenon.com/tmp/5e7f6ee5-d4dc-4aa8-9b0a-42d3c0feb99b/6062caf3-c600-4fc2-b413-4ab8c0feb99b/Algorithms-4th-Edition.pdf.

E2: Jeff Erickson, "algorithms", a Creative Commons Attribution 4.0 International License https://jeffe.cs.illinois.edu/teaching/algorithms/book/Algorithms-JeffE.pdf.

E3: Junhui deng, "Data structures and algorithms specialization", tsinghua University, Beijing. https://www.coursera.org/specializations/data-structures-algorithms-tsinghua

E4:Prof.Madhavan, "Design and Analysis of Algorithms https://nptel.ac.in/courses/106106131

CO302: Computer Network		
Teaching Scheme	**Examination Scheme**	
Lectures: 3 Hrs. / Week	**Continuous Internal Assessment (CIA):**	**40 Marks**
Credits: 3	**End-Sem Exam (ESE):**	**60 Marks**
	Total:	**100 Marks**

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Prerequisite Course: Computer Organization and Architecture, Digital Electronics and Data Communication

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Course Objectives:

1. To learn and understand the fundamental concepts of computer network.
2. To learn and understand different techniques for framing, error control and flow control.
3. To learn and understand different techniques for channel allocation and IEEE standards.
4. To learn and understand switching and routing techniques used in internet layer.
5. To learn and understand TCP and UDP protocols used in transport layer.
6. To learn and understand application layer protocol.

Course Outcomes (COs):

On successful completion of the course, student will be able to–

Course Outcomes	Bloom's Taxonomy	
	Level	**Descriptor**
1. **Design** and implement different computer networks using network technologies.	3	Apply
2. **Design** and implement different error and flow control algorithms.	2	Understand
3. **Demonstrate** basic concepts of channel allocation.	2	Understand
4. **Demonstrate** different switching and routing techniques.	2	Understand
5. **Design** and implement client server architecture using transport layer protocol.	3	Apply
6. **Develop** different network applications.	3	Apply

Mapping of Course Outcomes to Program Outcomes (POs) & Program Specific Outcomes (PSOs):

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	2	3	1	2	1	1	-	1		1	1	2	1	-
CO2	1	2	2	-	-	-	-	-	-	-	-	1	2	1	-
CO3	1	1	1	1	-	-	-	-	-	-	-	1	2	-	-
CO4	1	3	1	-	1	-	-	-	-	-	-	1	3	1	-
CO5	1	2	2	1	1	-	-	-	-	-	-	1	3	1	-
CO6	2	3	3	1	2	2	-	-	2	-	1	2	3	2	1

Course Contents

Unit-I	Introduction to Computer Network	No. of Hours	COs
	Communication System: Introduction of LAN, MAN, WAN, WAN Acceleration, PAN, Ad-hoc Network. **Network Architectures:** Client-Server, Peer To Peer. **Topologies:** Star and Hierarchical, OSI Model, TCP/IP Model. **Network Devices:** Bridge, Switch, Router and Access Point, Smart NIC. **Case Study:** Switch & Access point configuration	7 Hrs.	1
Unit-II	**Logical Link Control Layer**	No. of Hours	COs
	Design Issues: Services to Network Layer, Framing, Error Control and Flow Control, **Error Control:** Parity Bits, Hamming Codes (7/8-bits) and CRC. **Flow Control Protocols:** Unrestricted Simplex, Stop and Wait, Sliding Window Protocol.	7 Hrs.	2
Unit-III	**Medium Access Control Layer**	No.of Hours	COs
	Channel Allocation: Static and Dynamic. **Multiple Access Protocols:**	7 Hrs.	3

		No.of Hours	COs
	Pure and Slotted ALOHA, CSMA, WDMA. **IEEE Standards and Frame Formats**: IEEE 802.3, CSMA/CD, Binary Exponential Back off algorithm, Fast Ethernet, Gigabit Ethernet, IEEE 802.11a/b/g/n and IEEE 802.15 and IEEE 802.16 Standards, CSMA/CA. **Case Study:** Simulation of protocols using NS2		
Unit-IV	**Internet Layer**	**No.of Hours**	**COs**
	Switching Techniques and IP Protocol: IPv4 and IPv6 addressing schemes, Subnetting, NAT, CIDR, ICMP, **Routing Protocols:** Distance Vector, Link State, and Path Vector. **Routing in Internet:** RIP, OSPF, BGP, Congestion control and QoS, MPLS. **Routing in MANET:** AODV, DSR. **Case Study:** Simulation of routing protocols using NS2 and Cisco Packet Tracer	7 Hrs.	4
Unit-V	**Transport Layer**	**No.of Hours**	**COs**
	Services and Berkley Sockets: Addressing, Connection establishment, Connection release. **Protocols:** TCP and UDP, Flow control and buffering, Multiplexing, TCP Congestion Control, Quality of Service (QoS), Differentiated services.	7 Hrs.	5
Unit-VI	**Application Layer**	**No.of Hours**	**COs**
	Protocols: Domain Name System (DNS), Hyper Text Transfer Protocol (HTTP), FTP, TELNET, Dynamic Host Control Protocol (DHCP), Simple Network Management Protocol (SNMP). **Email:** SMTP, MIME, POP3, Webmail. **Network Performance:** Throughput, Latency, Packet Loss, And Retransmission. **Case study:** Software Defined Network (SDN) and 5G Network	7 Hrs.	6

Books:
Textbooks:
1. Andrew S. Tenenbaum, "Computer Networks", PHI, ISBN 81-203-2175-8. 2. Fourauzan B., "Data Communications and Networking", 5t^h Edition, Tata McGraw- Hill, Publications, ISBN: 0 – 07 – 058408 – 7.
Reference Books:
1. Kurose, Ross "Computer Networking a Top Down Approach Featuring the Internet",Pearson, ISBN-10: 0132856204. 2. Matthew S. G, "802.11 Wireless Networks", O'Reilly publications, ISBN: 81-7656-992-5 3. C. Siva Ram Murthy and B. S. Manoj, "Ad Hoc Wireless Networks: Architectures and Protocols" Prentice Hall, ISBN-10: 8131706885; ISBN-13: 978-8131706886. 4. Holger Karl and Andreas Willing, "Protocols and Architectures for Wireless Sensor Networks", Wiley India , ISBN: 9788126533695. 5. Eldad Perahia, Robert Stacey, "Next Generation Wireless LANs", Cambridge, ISBN-10:1107016762; ISBN-13: 978-1107016767. 6. Efraim Turban, Linda Volonino, Gregory R. Wood "Computer Networking a Top Down Approach Featuring the Internet", 10th Edition, Wiley; ISBN13: 978-1-118-96126-1.
E-Resources:
1. https://nptel.ac.in/courses/106/105/106105183/
2. https://nptel.ac.in/courses/106/101/106101209/
3. https://nptel.ac.in/courses/106/105/106105080/

CO303: Web Technology

Teaching Scheme		Examination Scheme	
Lectures:	3 Hrs. / Week	CIA:	40 Marks
Credits:	3	ESE:	60 Marks
		Total:	100 Marks

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Prerequisite Course: Basic knowledge of Programming and Computer Systems

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Course Objectives:

1. To learn the concepts of HTML 5 for developing client side user interface

2. To learn the client side technologies for web development.

3. To reduce the amount of code for building user interface applications using AngularJS.

4. To build single-page web applications with ReactJS.

5. To learn the server side technologies for web development.

6. To build web applications quickly with less code using Spring Boot framework.

Course Outcome (COs): On completion of the course, students will be able to-

Course Outcomes	Bloom's Taxonomy	
	Level	Descriptor
1. **Apply** HTML 5 elements for developing client side user interface	3	Apply
2. **Apply** the Client side technologies for web development.	3	Apply
3**. Understand architecture** of AngularJS and **develop** single page application(SPA) using fundamentals of AngularJS	3	Apply
4. **Apply** the fundamentals of ReactJS to develop rich web applications.	3	Apply
5. **Apply** the server side technologies for developing dynamic web application	3	Apply
6. **Apply** Spring Boot framework to build web applications in less code	3	Apply

Mapping of Course Outcomes to Program Outcomes (POs) & Program Specific Outcomes (PSOs):

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	3	-	2	-	1	-	2	2	1	2	3	3	3

CO2	3	1	3	-	2	-	1	-	2	2	1	2	3	3	3
CO3	3	1	3	-	3	-	2	-	2	2	1	2	3	3	3
CO4	3	1	3	-	3	-	2	-	2	2	1	2	3	3	3
CO5	3	1	3	-	3	-	2	-	2	2	1	2	3	3	3
CO6	3	1	3	-	3	-	2	-	2	2	1	2	3	3	3

COURSE CONTENTS

Unit I	Introduction to Web Technologies	No. of Hours	Cos
	HTML 5: HTML5 Introduction,Structure of Web Page, Text Formatting tags, Image, tables, links, frames, forms,: Semantic Elements, Form Elements, Form Attributes, Form Input Types, Media Elements, SVG, Media Elements, Canvas, Drag and Drop	6	CO1 CO2
Unit II	**Client Side Technologies**	No. of Hours	Cos
	CSS: Need of CSS, Types of CSS, CSS Selectors, CSS for basic HTML tags, responsive CSS framework: Bulma	7	CO2 CO3 CO6
	XML: Introduction to XML, XML key component, Transforming XML into XSLT, DTD: Schema, elements, attributes, Introduction to JSON.		
	Java Script: JS in an HTML (Embedded, External), Data types, Control Structures, Arrays, Functions and Scopes, Objects in JS.		
	Bootstrap:IntroductionBootstrap ,Syntax of Bootstrap,Container and Container-fluid ,Connectivity of Bootstrap in page		
Unit III	**AngularJS**	No. of Hours	Cos
	Introduction ,MVC Architecture, Conceptual Overview, Setting up the Environment First Application, Understanding ng attributes, Expressions and Data Biding, Working with Directives, Conditional Directives, Styles Directives, Mouse and Keyboard Events	7	CO3 CO4

Unit IV	**ReactJs**	No. of Hours	Cos
	DirectivesControllers, Filters, Forms, Modules, Ajax in AngularJS, Routing, Introduction to SPA, Creating HTML Templates, Configuring Route Provider.		
	What is React Js, Advantages of React Js, Limitation of React Js, Installation. Overview of JSX, Rendering an Element into the DOM, Naming Conventions. Overview of Components, Props, State.Life Cycle of component and reusing of Component.Props Validation, API Calls Using WebApi. Overview of Flux,,Flux Elements, Limitations of Flux, Advantages of Flux	8	CO3 CO4
Unit V	**Server side Technologies**	No. of Hours	Cos
	Servlet: Introduction, life cycle of servlet, servlet directory structure, servlet example, form handling, cookies and session tracking. **JSP :** life cycle, JSP tags, built in objects, Directives, File uploading and page redirecting. Database connectivity using servlet and JSP	8	CO3 CO4 CO6
Unit VI	**Spring boot**	No.of Hours	Cos
	Introduction to spring boot, Building Spring Boot Application, Rest Annotation with In Memory Database & CRUD Operations, Rest Annotation with Relation DB, JPA Repository Concepts, Actuator Concepts, Spring Boot Custom Logging, Spring Boot Profile Components, Auto Configuration,Thymleaf Concepts, Integration with Spring Web, Spring Boot Security, Database Concepts	6	CO4 CO5
Books:			
Text Books(T):			

T1. Robin Nixon," Learning PHP, Mysql and Javascript with JQuery, CSS & HTML5", O'REILLY
T2.Juha Hinkula,"Full Stack Development with Spring Boot and React",3rd Edition Paperback
T3. Ken Williamson,"Learning AngularJS: A Guide to AngularJS Development (Greyscale Indian Edition)",O'REILLY

Reference Books(R):
R1. Adam Bretz &Colin J Ihri,"Full Stack Javascript Development with MEAN",SPD
R2. McGraw Hill Education publications," Developing Web Applications".
R3. AllanCole," Build Your Own Wicked Wordpress Themes",SPD

E-Resources:
E1: https://www.mygreatlearning.com/full-stack-web-development/free-courses   E2: https://www.coursera.org/learn/introduction-to-web-development-with-html-css-javacript

CO304: Theory of Computation

Teaching Scheme		Examination Scheme	
Lectures: 3 Hrs. / Week		Continuous Internal Assessment:	40 Marks
Tutorial : 1 Hr / Week		End-Sem Exam:	60 Marks
Credits: 4		Total:	100 Marks

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Prerequisite Course: Discrete Mathematics, Data Structures

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Course Objectives:

1. To study Finite State Machine, Finite Automata and its language

2. To learn Regular Expressions and Regular Languages

3. To understand Context Free Grammars and Context Free Languages

4. To study Pushdown Automata and its language

5. To learn and understand Turing Machine and its language

6. To be familiar with the theory of computability and complexity

.**Course Outcome (COs):** On completion of the course, students will be able to-

Course Outcomes	Bloom's Taxonomy	
	Level	Descriptor
1. **Construct** Finite Automata and its variants for regular languages.	3	Apply
2. **Build** regular expressions for a regular language and to prove theorems and properties of regular languages	3	Apply
3. **Write** context free grammar for context free languages and to prove properties of CFL	3	Apply
4. **Construct** Pushdown Automata for context free language	3	Apply
5. **Construct** Turing Machines for unrestricted kind of languages	3	Apply
6. **Understand** the key terms, such as computability, decidability, and complexity through problem solving.	2	Understand

Mapping of Course Outcomes to Program Outcomes (POs) & Program Specific Outcomes (PSOs):

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	2	-	-	-	-	2	1	-	1	3	1	-
CO2	2	2	2	1	-	-	-	-	2	1	-	1	2	-	-

CO3	2	2	2	1	-	-	-	-	2	1	-	1	2	-	-
CO4	3	2	2	2	-	-	-	-	2	1	-	1	3	1	-
CO5	3	2	2	2	-	-	-	-	2	1	-	1	3	1	-
CO6	2	1	-	1	-	-	-	-	2	1	-	2	2	1	-

COURSE CONTENTS

Unit I	FORMAL LANGUAGE THEORY AND FINITE AUTOMATA	No. of Hours	COs
	Introduction to Formal language, Alphabets, Strings and languages, Finite representation of language, **Finite Automata (FA)**: An Informal Picture of FA, Finite State Machine (FSM), Language accepted by FA, Definition of Regular Language, Deterministic and Nondeterministic FA (DFA and NFA), epsilon- NFA, Minimization of DFA's **FA with output:** Moore and Mealy machines -Definition, models, inter-conversion. **Case Study:** FSM for Traffic Signal Controller, Vending Machine	6	1
Unit II	**REGULAR EXPRESSIONS**	No. of Hours	COs
	Operators of RE, Building RE, Precedence of operators, Algebraic laws for RE, Equivalence of two RE's **Conversions:** RE to NFA, NFA to DFA, DFA to RE using Arden's theorem. **Pumping Lemma** for Regular languages, Closure and Decision properties. **Case Study :** RE in Text Search and Replace, Lexical analysis	6	2
Unit III	**CONTEXT FREE GRAMMAR**	No. of Hours	COs
	Context Free Grammar- Definition, sentential forms, Derivations, Parse trees, Context Free Language. Ambiguous Grammar, writing a grammar for language. **Simplification of CFG**, Eliminating Є-productions, unit	6	3

	productions, useless production, useless symbols **Normal Forms**- Chomsky normal form, Greibach normal form, Closure properties of CFL, Decision properties of CFL's, Chomsky Hierarchy **Case Study**: CFG for Parenthesis Match, Palindrome Strings, Parsers		
Unit IV	**PUSHDOWN AUTOMATA & LINEAR BOUNDED AUTOMATA**	**No. of Hours**	**COs**
	Formal Definition of the PDA, Equivalence of Acceptance by Final State & Empty stack, Non-Deterministic PDA, PDA and Context Free Language, Equivalence of PDA's and CFG's, Definition of **Linear Bounded Automata-** LBA and Context Sensitive Language. **Case Study:** Use of PDA in Top-Down and Bottom-up Parser Design	6	4
Unit V	**TURING MACHINES**	**No. of Hours**	**COs**
	Turing Machine Model, Formal Definition of TM, Instantaneous description for TM, Transition diagrams for TM, The Language of Turing Machine, Design of TM, Description of TM, Programming techniques for TM's, Extensions to the basic TM, Universal TM's, Halting Problem of TM,	6	5
Unit VI	**UNDECIDABILITY & INTRACTABLE PROBLEMS**	**No. of Hours**	**COs**
	Decidable Problems and Un-decidable Problems, Church-Turing Thesis, an un-decidable problem that is RE, Post's Correspondence Problem, The Classes P and NP, An NP-Complete Problem, A Restricted Satisfiability Problem, The Problem of Independent Sets, The Node-Cover Problem	6	6
Books:			
Text Books(T):			
T1. John E. Hopcroft, Rajeev Motwani, Jeffrey D.Ullman, "Introduction to Automata Theory Languages and Computation", Addison-Wesley, ISBN 0-201-44124-1.			

T2. John Martin, "Introduction to Languages of The Theory of Computation", 2nd Edition, Mc Graw Hill Education, ISBN-13: 978-1-25-900558-9, ISBN-10: 1-25-900558-5

Reference Books(R):

R1. H.L. Lewis, Christos H. Papadimitriou, "Elements of the Theory of Computation", Prentice Hall, ISBN-10: 0132624788; ISBN-13: 978-0132624787

R2. Sanjeev Arora and Boaz Barak, "Computational Complexity: A Modern Approach", Cambridge University Pre ss, ISBN:0521424267 97805214242643.

R3. Daniel Cohen, "Introduction to Computer Theory", Wiley & Sons, ISBN 97881265133454.

R4. J. Carroll & D Long, "Theory of Finite Automata", Prentice Hall, ISBN 0-13-913708-45

R5. Kavi Mahesh, "Theory of Computation: A Problem-Solving Approach", Wiley India, ISBN10 81265331106

R6. Michael Sipser, "Introduction to the Theory of Computation", Cengage Learning, ISBN-13: 97811331878137

R7. Vivek Kulkarni, "Theory of Computation", Oxford University Press, ISBN 0-19-808458

E-Books :

1. https://cglab.ca/~michiel/TheoryOfComputation/TheoryOfComputation.pdf
2. https://www.u-cursos.cl/ingenieria/2010/2/CC3102/1/material_docente/bajar?id=322214
3. https://e.famnit.upr.si/pluginfile.php/636821/mod_page/content/8/Automata.pdf
4. http://staff.ustc.edu.cn/~huangwc/book/Sipser_Introduction.to.the.Theory.of.Computation.3E.pdf

MOOCs Courses Links:

1. https://nptel.ac.in/courses/106/104/106104148/
2. https://nptel.ac.in/courses/106/104/106104028/

CO305A: Advanced Databases

Teaching Scheme	Examination Scheme	
Lectures: 3 Hrs. / Week	CIA:	40 Marks
Credits: 3	End-Sem Exam :	60 Marks
	Total:	100 Marks

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Prerequisite Course: (if any) Database Management System Concepts

Course Objectives:

1. To understand the types of digital data and big data.

2. To understand the Hadoop architecture.

3. To use map reduce Programming model for NoSQL Data.

4. To learn and use CQL on Column oriented data.

5. To learn and use the Redis Query Language on Key-Value Pair Data.

6. To learn and use the Neo4j Concepts on Graph Data.

Course Outcomes (COs): On completion of the course, student will be able to–

Course Outcome	Bloom's Taxonomy	
	Level	Descriptor
CO1: Understand the Types of Digital Data and Characteristics of Big Data	2	Understand
CO2: Understand the Hadoop Architecture	2	Understand
CO3: Apply the Mapreduce Programming model for NoSQL Data	3	Apply
CO4: Apply the CQL on Column Oriented Data	3	Apply
CO5: Apply the Redis Query Language on Key-Value Pair Data	3	Apply
CO6: Apply the Neo4j Concepts on Graph Data	3	Apply

Mapping of Course Outcomes to Program Outcomes (POs) & Program Specific Outcomes (PSOs):

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
CO1	1	--	2	2	2	--	--	--	--		3	2	3	2	1
CO2	2	--	2	2	2	--	--	--	--		2	2	2	2	--

CO3	1	--	2		2	--	--	--	--		2	2	2	3	--
CO4	2	--	--	2	--	--	--	--	--		2	2	1	2	--
CO5	2	--	2	2	--	--	--	--	--		2	2	2	3	--
CO6	2	--	3	2	2	--	--	--	--		2	3	2	2	1

COURSE CONTENTS

Unit I	Types of Digital Data	No. of Hours	COs
	Classification of Digital Data. Introduction to Big Data: Characteristics of Data, Evolution of Big Data, Definition of Big Data, Challenges with Big Data, Big Data Analytics: Where do we Begin?, What is Big Data Analytics?, What Big Data Analytics isn't?, Classification of Analytics, Terminologies Used in Big Data Environments.	7	1
Unit II	**Hadoop**	**No. of Hours**	**COs**
	Hadoop Overview, why not RDBMS?, RDBMS versus Hadoop, HDFS (Hadoop Distributed File System), Processing Data with Hadoop, Managing Resources and Applications with Hadoop YARN (Yet another Resource Negotiator).	7	2
Unit III	**MAPREDUCE**	**No. of Hours**	**COs**
	MAPREDUCE Programming: Introduction, Mapper, Reducer, Combiner, Partitioner, Searching, Sorting, Compression. Word Count example using MAPREDUCE	7	3
Unit IV	**Cassandra**	**No. of Hours**	**COs**
	Apache Cassandra – An Introduction, Features of Cassandra, CQL Data Types, CQLSH, Keyspaces, CRUD, Collections, Using a Counter, Time to Live, Alter Commands, Import and Export.	7	4
Unit V	**Redis**	**No. of Hours**	**COs**
	Compared to Other Databases and Software ,Features ,Why Redis, Strings, Lists, Sets, Hashes , Sorted sets , Strings Publish/Subscribe , Transactions , Expiring Keys, Elastic search.	7	5
Unit VI	**GraphDB**	**No. of Hours**	**COs**

	What is GraphDB, GraphDB vs RDBMS, GraphDB vs NoSQL, Data Modelling, Neo4j QL, Neo4j General Clauses, Neo4j Read Clauses, Neo4j Write Clauses, Neo4j Functions.	7	6

Books:

Text Books:

T1: Rathinaraja Jeyaraj , Ganeshkumar Pugalendhi, Anand Paul , Big Data with Hadoop MapReduce A Classroom Approach , First Edition , Apple Academic Press, 2020

T2: Seema Acharya, Subjashini Chellappan, Big Data and Analytics,First Editon, Wiley, 2015

Reference Books:

R1**.** S.K.Singh, "Database Systems : Concepts, Design and Application", Pearson, Education, ISBN 978-81-317-6092-5

R2. Pramod J. Sadalage and Martin Fowler, "NoSQL Distilled", Addison Wesley, ISBN-10: 0321826620, ISBN-13: 978-0321826626.

E-Resources(E):

1. https://in.coursera.org/learn/Advanceddatabase

CO305B: Software Testing and Quality Assurance

Teaching Scheme	Examination Scheme	
Teaching Scheme	**Examination Scheme**	
Lectures: 3 Hrs. / Week	Continuous Internal Assessment (CIA):	40 Marks
Credits: 3	End Sem Exam (ESE):	60 Marks
	Total:	100 Marks

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Prerequisite Course: Software Engineering.

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Course Objectives:

1. To study & understand fundamentals concepts of software testing.

2. To understand Black box testing with boundary value analysis.

3. To understand White box testing with its challenges.

4. To understand Testing Strategies, software quality management systems.

5. To learn Test planning and Management.

6. To learn various automated testing tools.

Course Outcomes (COs): After successful completion of the course, student will be able to:-

Course Outcomes	Bloom's Taxonomy	
	Level	Descriptor
1. **Understand** fundamentals concepts of software testing.	2	Understand
2. **Understand** black box testing with subtypes of black box testing	2	Understand
3. **Understand** white box testing with subtypes of white box testing	2	Understand
4. **Apply** different approaches of Testing Strategies with quality Management aspects.	3	Apply
5. **Apply** and analyze Test planning and Management with case study.	3	Apply
6. **Apply** automated tools for different types of application	3	Apply

Mapping of Course Outcomes to Program Outcomes (POs) & Program Specific Outcomes(PSOs):

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2								1		3	
CO2	3	3	2										3	
CO3		2	3	1					1					3
CO4	3	3	2		1								3	2
CO5	2	3	2								2	2	2	2

CO6	3	3	3			3	2			2			3	

Course Contents

Unit-I	**Introduction to Software Testing**	No. of hours	COs
	Need of testing, Basics of Software Testing, Testing Principles, Goals, Software Testing Life Cycle, Defects, Defect management, Verification and validation, Introduction Testing Strategies.	Hrs.6	CO1

Unit-II	**Black Box Testing**	No. of hours	
	Need of black box testing, Requirements Analysis, Testing Methods - Requirements based testing, Positive and negative testing, Boundary value analysis, Equivalence Partitioning class, Domain testing, Design of test cases. **Case studies-** ATM Machine & Internet Banking	Hrs.6	CO2

Unit-III	**White Box Testing**	No. of hours	
	Introduction, Need of white box testing, Testing types, Static testing by humans, Structural Testing – Control flow testing, LoopTesting, Design of test cases, Challenges in White box testing, **Case studies-** ATM Machine & Internet Banking	Hrs.6	CO3

Unit-IV	**Testing Strategies and Quality Management**	No. of hours	
	Types of Testing Strategies with Types: Unit, Integration, System, Acceptance testing, Usability testing, Regression testing, Scenario testing, Adhoc testing, Functional, Performance testing, Stress testing, Security testing, Alpha-Beta testing, **Software Quality Management**: Elements of SQA, SQA Tasks, Goals, and Metrics, Six Sigma for Software Engineering, ISO9000 Quality Standards. **Case Study**-Online shopping portal management	Hrs.6	CO4

Unit-V	Test Planning and Management	No. of hours	
	Requirement Traceability matrix, Work bench & writing test cases, Important Features of Testing Process, Test Strategy, Test Planning, Testing Process, establishing testing policy, categories of defect, Defect/ error/ mistake in software, Developing TestStrategy and Plan, Testing process. **Case Study**: Online Banking System	Hrs.6	CO5

Unit-VI	Automation Testing	No. of hours	
	Introduction to Agile Testing, Model based testing, Data driven automation, Manual testing versus Automated testing, Automated Testing Tools **Case Studies** 1.Introducing Selenium, Selenium-IDE, Selenium RC, 2.Junit or JMeter 3. Basic Mobile Testing Too: opium	Hrs.8	CO6

Books:

Text Books:

T1. Ron Patton," Software Testing", Pearson Educations, ISBN-978-0-672-32798-8.

T2. M. G. Limaye," Software Testing Principles, Techniques and Tools", Tata McGraw Hill. ISBN-978-0070-139909 00-7013990-3

T3. A.B. Mathur, "Fundamental of software Testing", Pearson. ISBN: 9788131794760

Reference Books:

R1. Srinivasan Desikan, Gopalswamy Ramesh, "Software Testing principles and Practices", Pearson. ISBN- 97881-7758-1218

R2. Naresh Chauhan, "Software Testing Principles and Practices ", OXFORD, ISBN-10: 0198061846. ISBN-13: 9780198061847.

R3. Stephen Kan, "Metrics and Models in Software Quality Engineering", Pearson, ISBN-10: 0133988082; ISBN-13: 978-0133988086

CO305C: Cloud Computing

Teaching Scheme	Examination Scheme	
Lectures: 3 Hrs. / Week	End-Sem Exam:	60 Marks
Credits: 3	Continuous Assessment:	40 Marks
	Total:	100 Marks

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Prerequisite Course: Computer Network, Operating System and Administration
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Course Objectives:

1. To study cloud computing fundamentals.

2. To understand the virtualization environment in cloud computing.

3. To study various cloud computing platforms.

4. To study the applications that use cloud computing.

5. To study cloud security aspects.

Course Outcome (COs): On completion of the course, students will be able to-

Course Outcomes	Bloom's Taxonomy	
	Level	Descriptor
1. **Understand** the different cloud computing environment.	2	Understand
2. **Understand** virtualization concept and its types.	2	Understand
3. **Apply** security to cloud applications and data.	3	Apply
4. **Use** appropriate data storage techniques for cloud application.	3	Apply
5. **Use** cloud platforms like AWS and Microsoft Azure for application development and deployment.	3	Apply
6. **Understand** the future of cloud computing .	2	Understand

Mapping of Course Outcomes to Program Outcomes (POs) & Program Specific Outcomes (PSOs):

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO2	PSO3
CO1	1	2	2	-	-	-	-	-	-	-	2	-	-	-	-
CO2	1	3	3	-	-	-	-	-	-	-	-	-	-	2	1
CO3	1	2	-	-	-	-	-	-	-	2	-	-	2	-	-
CO4	-	3	3	-	-	-	-	-	-	-	3	-	-	3	2

CO5	1	-	-	-	-	-	3	-	-	-	-	-	-	-	1
CO6	-	2	-	-	-	-	1	-	-	2	3	-	-	3	3

COURSE CONTENTS

Unit I	INTRODUCTION	No. of Hours	COs
	Recent trends in Computing: Grid Computing, Cluster Computing, Distributed Computing, Utility Computing. **Introduction to Cloud Computing:** Characteristics of Cloud Computing, Pros and Cons of Cloud Computing, Migrating into the Cloud, Seven-step model of migration into a Cloud, **Cloud Architecture:** Cloud Computing Logical Architecture, Developing Holistic Cloud Computing Reference Model, Cloud System Architecture, Cloud Deployment Model. **Cloud Service Models:** SaaS, PaaS, IaaS. **Case Study :** Cloud Computing Model of IBM.	6	CO1
Unit II	VIRTUALIZATION	No. of Hours	COs
	Introduction: Definition of Virtualization, Adopting Virtualization, types of virtualization, types of hypervisors, virtualization tools and mechanisms- Xen,VMware. **Types of Virtualization:** Server Virtualization, OS Virtualization, Storage Virtualization, Network Virtualization, Virtualization Architecture and Software, The Virtualization Architecture, Virtual Clustering. **Web services:** AJAX and Mashups, SOAP and REST **Case Studies:** Microsoft Hyper-V.	6	CO2
Unit III	SECURITY IN CLOUD COMPUTING	No. of Hours	COs
	Risks in Cloud Computing: Risk Management, Enterprise-Wide Risk Management, Types of Risks in Cloud Computing. **Data Security in Cloud:** Security Issues, Challenges, advantages,	6	CO3

Disadvantages, Cloud Digital persona and Data security, Content Level Security.

Cloud Security Services: Confidentiality, Integrity and Availability, Security Authorization Challenges in the Cloud, Secure Cloud Software Requirements, Secure Cloud Software Testing.

Case Study : Cloud Security Tool: Acunetix.

Unit IV	DATA STORAGE AND CLOUD COMPUTING	No. of Hours	COs
	Introduction to Enterprise Data Storage: Data Storage Management, Cloud Data Stores, Using Grids for Data Storage,Direct Attached Storage, Storage Area Network, Network Attached Storage, Data Storage Management, File System, Cloud Data Stores, Using Grids for Data Storage. **Cloud Storage:** Data Management, Provisioning Cloud storage, Data Intensive Technologies for Cloud Computing. **Cloud Storage from LANs to WANs:** Introduction, Cloud Characteristic, Distributed Data Storage, Applications Utilizing Cloud Storage. **Cloud file systems:** GFS and HDFS, BigTable, HBase and Dynamo, Cloud data stores: Datastore and SimpleDB.	6	CO4
Unit V	CLOUD PLATFORMS	No. of Hours	Cos
	Amazon Web Services(AWS): Understanding Amazon Web Services, Amazon Web Service Components and Services, Working with the Elastic Compute Cloud (EC2), Amazon Machine Images, Pricing models, System images and software. Creating an account and instance on EC2, Working with Amazon Storage Systems, Amazon Simple Storage System (S3) , Amazon Elastic Block Store (EBS) , **Using Microsoft Cloud Services:**	6	CO4

Unit VI	RECENT TRENDS OF CLOUD COMPUTING	No. of Hours	COs
	Recent Trends: Mobile Cloud, Autonomic Cloud Engine, Comet Cloud, Multimedia Cloud, Energy Aware Cloud Computing, Jungle Computing, IOT and Cloud Convergence: The Cloud and IoT in your Home, The IOT and cloud in your Automobile. Kubernets: Introduction, Architecture, Monitoring and Management, Orchestration. **Docker at a Glance:** Process Simplification, Broad Support and Adoption, Architecture, Getting the Most from Docker, The Docker Workflow. **Case studies on DevOps:** DocuSign, Forter, Gengo.	6	CO6

Books:

Text Books(T):

T1. A. Srinivasan, J. Suresh, "Cloud Computing: A Practical Approach for Learning and Implementation", Pearson, 2014, ISBN: 9788131776513.

T2. Gautam Shroff, "Enterprise Cloud Computing: Technology, Architecture, Applications" Cambridge University Press , ISBN 978-0-521-13735-5.

Reference Books(R):

R1. Dr. Kumar Saurabh,"Cloud Computing", Wiley Publication, ISBN10: 8126536039.

R2. Buyya, "Mastering Cloud Computing", Tata McGraw Hill, ISBN-13: 978-1-25-902995-0.

R3. Kailash Jayaswal, "Cloud computing", Black Book, Dreamtech Press.

E-Books:

- https://sjceodisha.in/wp-content/uploads/2019/09/cloud-computing-Principles-and-Paradigms.pdf.
- https://studytm.files.wordpress.com/2014/03/hand-book-of-cloud-computing.pdf.
- https://arpitapatel.files.wordpress.com/2014/10/cloud-computing-bible1.pdf.

- https://nvlpubs.nist.gov/nistpubs/SpecialPublications/NIST.SP.500-291r2.pdf.

NPTEL /MOOCS Courses:

- https://onlinecourses.nptel.ac.in/noc21_cs14/preview?
- https://onlinecourses.nptel.ac.in/noc21_cs15/preview?
- https://www.digimat.in/nptel/courses/video/106105167/L01.html.
- https://www.digimat.in/nptel/courses/video/106105167/L03.html

CO306: Design and Analysis of Algorithms Lab

Teaching Scheme		Examination Scheme	
Practical:	2 Hrs. / Week	Oral:	50 Marks
Credits:	1	Total:	50 Marks

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Prerequisite Course: Fundamentals of Data Structures, Advanced Data Structures, Discrete Mathematics

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Course Objectives:

1. To study and implement application of divide and conquer algorithmic strategy

2. To study and implement application of greedy approach

3. To study and implement application of dynamic programming strategy

4. To study and implement application of backtracking approach

5. To identify and apply the suitable algorithmic strategy for the given problem.

Course Outcomes:

After successful completion of the course, students will able to:-

Course Outcome(s)		Bloom's Taxonomy	
		Level	Descriptor
CO1	Apply knowledge of divide and conquer technique to implement solution of problem statement.	3	Apply
CO2	Apply knowledge of greedy strategy implement solution of problem statement.	3	Apply
CO3	Apply the concept of dynamic programming to implement solution of problem statement.	3	Apply
CO4	Apply backtracking technique programming to implement solution of problem statement.	3	Apply
CO5	Apply the suitable algorithmic strategy to solve real world problem.	3	Apply

Mapping of Course Outcomes to Program Outcomes (POs) & Program Specific Outcomes (PSOs):

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	3	2	3	-	1	2	1	-	-	-	1	3		-
CO2	2	-	1	3	-	1	1	1	-	-	-	1	3	2	-
CO3	2	-	1	3	-	1	1	1	-	-	-	1	3	2	2

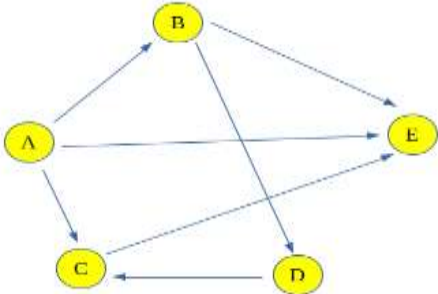|															
CO4	2	-	1	3	-	1	1	1	-	-	-	1	3	2	2
CO5	-	2	2	3	-	1	1	1	-	-	-	1	3		2

GENERAL INSTRUCTIONS:
1. Each student has to implement 5 assignment individually from set A to set E assigned by faculty members
2. Each student has to complete mini project in group of max 4 members based in CA.

LIST OF EXPERIMENTS:

	Sr. No.	Assignment	CO
A	1.	**Implement a problem of number of zeroes.** **Statement**: Given an array of 1s and 0s which has all 1s first followed by all 0s? Find the number of 0s. Count the number of zeroes in the given array. **Input**: arr[] = {1, 1, 1, 1, 0, 0} **Output**: 2 **Input**: arr[] = {1, 0, 0, 0, 0} **Output**: 4	CO1
	2.	**Implement a problem of move all zeroes to end of array.** **Statement:** Given an array of random numbers, Push all the zero's of a given array to the end of the array. For example, if the given arrays is {1, 9, 8, 4, 0, 0, 2, 7, 0, 6, 0}, it should be changed to {1, 9, 8, 4, 2, 7, 6, 0, 0, 0, 0}. The order of all other elements should be same. **Input** : arr[] = {1, 2, 0, 4, 3, 0, 5, 0}; **Output** : arr[] = {1, 2, 4, 3, 5, 0, 0, 0};	CO1
	3.	**Implement a problem of smallest number with at least n trailing zeroes in factorial.** **Statement:** Given a number n. The task is to find the smallest number whose factorial contains at least n trailing zeroes. **Input** : n = 1 **Output** : 5 **Input** : n = 6 **Output** : 25	CO1
B	1.	**Implement a problem of activity selection problem with K persons.** **Statement**: Given two arrays S[] and E[] of size N denoting starting and closing time of the shops and an integer value K denoting the number of people, the task is to find out the maximum number of shops they can visit in total if they visit each shop optimally based on the following conditions: • A shop can be visited by only one person • A person cannot visit another shop if its timing collide with it **Input**: S[] = {1, 8, 3, 2, 6}, E[] = {5, 10, 6, 5, 9}, K = 2 **Output**: 4 **Input**: S[] = {1, 2, 3}, E[] = {3, 4, 5}, K = 2 **Output**: 3	CO2
	2.	**Implement a problem of maximize Profit by trading stocks based on given rate per day.**	CO2

		Statement: Given an array arr[] of N positive integers which denotes the cost of selling and buying a stock on each of the N days. The task is to find the maximum profit that can be earned by buying a stock on or selling all previously bought stocks on a particular day. **Input**: arr[] = {2, 3, 5} **Output**: 5 **Input**: arr[] = {8, 5, 1} **Output**: 0	
	3.	**Implement a problem of minimum work to be done per day to finish given tasks within D days problem.** **Statement:** Given an array task[] of size N denoting amount of work to be done for each task, the problem is to find the minimum amount of work to be done on each day so that all the tasks can be completed in at most D days. Note: On one day work can be done for only one task. **Input**: task[] = [3, 4, 7, 15], D = 10 **Output**: 4 **Input**: task[] = [30, 20, 22, 4, 21], D = 6 **Output**: 22	CO2
C	1.	**Implement Coin Change problem.** **Statement** Given an integer array of coins[ ] of size N representing different types of currency and an integer sum, The task is to find the number of ways to make sum by using different combinations from coins[]. Note: Assume that you have an infinite supply of each type of coin. *Input: sum = 4, coins[] = {1,2,3}, Output: 4* *Input: sum = 10, coins[] = {2, 5, 3, 6} Output: 5*	CO3
	2.	**Implement Subset Sum Problem.** **Statement** Given a set of non-negative integers and a value sum, the task is to check if there is a subset of the given set whose sum is equal to the given sum. *Input: set[] = {3, 34, 4, 12, 5, 2}, sum = 9* *Output: True* *Input: set[] = {3, 34, 4, 12, 5, 2}, sum = 30* *Output: False*	CO3
	3.	**Implement Check if it is possible to transform one string to another.** **Statement** Given two strings s1 and s2 (all letters in uppercase). Check if it is possible to convert s1 to s2 by performing following operations. 1. Make some lowercase letters uppercase. 2. Delete all the lowercase letters. *Input: s1 = daBcd s2 = ABC Output: yes* *Input: s1 = argaju s2 = RAJ Output: yes*	CO3
D	1.	**Implement program to find all distinct subsets of a given set using Bit Masking Approach.** **Statement** Given an array of integers arr[], The task is to find all its subsets. The subset cannot contain	CO4

		duplicate elements, so any repeated subset should be considered only once in the output. *Input: S = {1, 2, 2} Output: {}, {1}, {2}, {1, 2}, {2, 2}, {1, 2,2}* *Input: S = {1, 2} Output: {}, {1}, {2}, {1, 2}*	
	2.	**Implement program Count all possible Paths between two Vertices.** **Statement** Count the total number of ways or paths that exist between two vertices in a directed graph. These paths don't contain a cycle, the simple enough reason is that a cycle contains an infinite number of paths and hence they create a problem. *Input: Count paths between A and E* *Output: Total paths between A and E are 4* *Input: Count paths between A and C* *Output: Total paths between A and C are 2*	CO4
	3.	**Implement program to print all subsets of a given Set or Array** **Statement** Given a set of positive integers, find all its subsets. *Input: array = {1, 2, 3}* *Output: // this space denotes null element.* * 1 1 2 1 2 3 1 3 2* *2 3 3* *Input: 1 2* *Output: 1 2 1 2*	CO4
E		**Mini Project:-**Implement CA assignment assigned in group as a CO301 (DAA theory subject) and store in source code in git repository.	CO5

Books:

Text Books(T):

T1. Horowitz and Sahani, "Fundamentals of Computer Algorithms", University Press.

T2.Gills Brassard and Paul Bartly, "Fundamentals of Algorithmic", PHI, New Delhi.

Reference Books(R):

R1. Fayez Gebali, "Algorithms and Parallel Computing", Willy Publication.

R2. Thomas H. Coreman and Charles R. L. Leiserson, "Introduction to Algorithm", PHI Publications.
e-Resources(E):
E1:Robert Sedgewick and Kevin Wayne, "algorithms" Princeton University. https://bank.engzenon.com/tmp/5e7f6ee5-d4dc-4aa8-9b0a-42d3c0feb99b/6062caf3-c600-4fc2-b413-4ab8c0feb99b/Algorithms-4th-Edition.pdf. E2: Jeff Erickson, "algorithms", a Creative Commons Attribution 4.0 International License https://jeffe.cs.illinois.edu/teaching/algorithms/book/Algorithms-JeffE.pdf. E3: https://www.geeksforgeeks.org/ E4: https://github.com/ E5: https://www.codechef.com/

CO308: Computer Network Laboratory

Teaching Scheme	Examination Scheme	
Practical : 2 Hrs. / Week	Term Work:	25 Marks
Credits: 1	Total:	25 Marks

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Prerequisite Course: Computer Organization and Architecture, Digital Electronics and Data Communication

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Course Objectives:

1. To learn and understand the fundamental LAN and WAN.
2. To learn and understand the error detection and correction.
3. To learn and understand Subnetting.
4. To learn and understand Client-Server architectures and prototypes by the means of network standards and technology.
5. To learn and understand DHCP protocol.
6. To learn and understand different network simulation tools.

Course Outcomes (COs):

On successful completion of the course, student will be able to–

Course Outcomes	Bloom's Taxonomy	
	Level	Descriptor
1. Design and develop Local Area Network.	3	Apply
2. Implementation of error detection and correction techniques.	3	Apply
3. Design and implementation of subnetting.	2	Understand
4. Implementation of Client-Server program using different protocols.	3	Apply
5. Installation and configuration of DHCP client and server.	3	Apply
6. Use the different network simulation tools.	4	Analyze

Mapping of Course Outcomes to Program Outcomes (POs) & Program Specific Outcomes (PSOs):

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	3		2	1	1		1		1	1	2	2	1
CO2	1	1	3		1								2	2	
CO3	1	2	1		1								3	1	
CO4	2	2	2		1							1	3	1	
CO5	1	1	1	1	1							1	2	1	1
CO6	1	2	3	1	3	1						2	2	1	2

List of Assignments (Any 9 Assignments should be performed)

Sr.No.	Title of Assignment
1	**Part A:** Setup a wired LAN using Switch. It includes preparation of cable, testing of cable using LAN tester, configure machines using IP addresses, testing using PING utility. **Part B:** Extend the same Assignment for Wireless using Access Point.
2	Write a program for error detection and correction for 7/8 bits ASCII codes using Hamming Codes using C/C++.
3	Write a program to demonstrate subnetting and find the subnet masks using C/C++/Java.
4	Write a program to simulate Go back N and Selective Repeat Modes of Sliding Window protocol using C/C++/Java.
5	Write a program using TCP socket for wired network for following using Java/Python: a. Say Hello to Each other b. File Transfer c. Calculator (Arithmetic)
6	Write a program using UDP socket for wired network for following Java/Python: a. Say Hello to Each other b. File Transfer c. Calculator (Arithmetic)
7	Study of Wireshark Packet Analyzer and test with assignment 5 & 6.
8	Study of any network simulation tools - To create a network with three nodes and establish a TCP connection between node 0 and node 1 such that node 0 will send TCP packet to node 2 via node 1.

9	Use network simulator NS2 to implement:
	     a. Analysis of CSMA and Ethernet protocols
	     b. Network Routing: Shortest path routing, AODV.

10	Configure RIP/OSPF/BGP routing algorithms using Cisco Packet Tracer.
11	Install and configure DHCP server.

CO308: Web Technology Laboratory			
Teaching Scheme		**Examination Scheme**	
Practical:	2 Hrs. / Week	**PR Examination**	50
Credits:	1	**Total**	50

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Prerequisite Course: Basic knowledge of Programming and Computer Systems

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Course Objectives:

1. To learn the concepts of HTML 5 for developing client side user interface

2. To learn the client side technologies for web development.

3. To reduce the amount of code for building rich user interface applications using AngularJS.

4. To build single-page web applications with ReactJS.

5. To learn the server side technologies for web development.

6. To build web applications quickly with less code using Spring Boot framework.

Course Outcome (COs): On completion of the course, students will be able to-

Course Outcomes	Bloom's Taxonomy	
	Level	**Descriptor**
1. **Develop** client side user interface using HTML5 elements.	2	**Apply**
2. **Apply** knowledge of the client side technologies for web development.	2	**Apply**
3. **Understand** architecture of AngularJS and to develop single page application(SPA) using fundamentals of AngularJS.	4	**Apply**
4. **Apply** the fundamentals of ReactJS to develop rich web applications.	3	**Apply**
5. **Apply** the server side technologies for developing dynamic web application	3	**Apply**
6. **Apply** Spring Boot framework to build web applications in less code	3	**Apply**

Mapping of Course Outcomes to Program Outcomes (POs) & Program Specific Outcomes (PSOs):

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	3	-	2	-	1	-	2	2	1	2	3	3	3

CO2	3	1	3	-	2	-	1	-	2	2	1	2	3	3	3
CO3	3	1	3	-	3	-	2	-	2	2	1	2	3	3	3
CO4	3	1	3	-	3	-	2	-	2	2	1	2	3	3	3
CO5	3	1	3	-	3	-	2	-	2	2	1	2	3	3	3
CO6	3	1	3	-	3	-	2	-	2	2	1	2	3	3	3

Suggested List of Assignments

[Students have to complete all the assignments towards the successful completion of Term Work, where all the implementation and design assignments are compulsory]

Group A

1. **Case study:** Before coding of the website, planning is important, students should visit different websites (Min. 5) for the different client projects and note down the evaluation results for these websites, either good website or bad website in following format:

Sr. No.	Website URL	Purpose of Website	Things liked in the website	Things disliked in the website	Overall evaluation of the website with Justification (Good/Bad)

From the evaluation, students should learn and conclude different website design issues, which should be considered while developing a website.

2. a. Installation and configuration of LAMP stack/Tomcat Server

   b. Design a static Web application using **HTML 5** with all possible elements.

3. Apply **CSS and Bootstrap** on Assignment 2

4. Implement Registration and Login Authentication using Java script.

5. Try making a to-do list app using **AngularJs.**

 The app should have the following features:

1. A form which allows you to add a to-do item

2. A delete button that will allow you to delete a particular todo item.

3. An edit portion which will allow you to edit a particular to-do item.

6.Implement a web page index.htm for any client website (e.g., a restaurant website project) using the following:

a. HTML syntax: heading tags, basic tags and attributes, frames, tables, images, lists, links for text and images, forms etc.

b. Use of Internal CSS, Inline CSS, External CSS and **ReactJS.**

7. Implement Database application using **JSP/Servlet**

8.Build a dynamic web application using **Spring boot** and perform basic database operations

9. **Mini Project:** Design and implement a dynamic web application for any business functionality using web development technologies that you have learnt in this course.

Books:
Text Books(T):
T1. Robin Nixon," Learning PHP, Mysql and Javascript with JQuery, CSS & HTML5", O'REILLY T2.Juha Hinkula,"Full Stack Development with Spring Boot and React",3rd Edition Paperback T3. Ken Williamson,"Learning AngularJS: A Guide to AngularJS Development (Greyscale Indian Edition)",O'REILLY
Reference Books(R):
R1. Adam Bretz &Colin J Ihri,"Full Stack Javascript Development with MEAN",SPD R2. McGraw Hill Education publications," Developing Web Applications". R3. AllanCole," Build Your Own Wicked Wordpress Themes",SPD
E-Resources:
E1: https://www.mygreatlearning.com/full-stack-web-development/free-courses E2: https://www.coursera.org/learn/introduction-to-web-development-with-html-css-javacript

CO309: Seminar and Communication skills

Teaching Scheme	Examination Scheme	
Lectures: 1 Hrs. / Week	**Term Work:**	**25 Marks**
Practical : 2 Hrs. / Week	**Oral:**	**25 Marks**
Credits: 2	**Total:**	**50 Marks**

==
Prerequisite:
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Course Objectives:

1. To develop ability of thinking and motivation for seminar.

2. To expose students to new technologies, researches, products, algorithms.

3. To explore basic principles of communication.

4. To explore empathetic listening, speaking techniques.

5. To study report writing techniques.

6. To develop Seminar presentation and Technical Communication Skills.

Course Outcomes (COs): On completion of the course, students will be able to-

Course Outcomes	Bloom's Taxonomy	
	Level	**Descriptor**
1. **Get** familiar with basic technical writing concepts and terms, such as audience analysis, jargon, format, visuals, and presentation.	2	Understand
2. **Perform** literature survey	3	Apply
3. **Understand** system and its components	2	Understand
4. **Write** the technical report	6	Create
5. **Prepare** presentation	6	Create
6. **Improve** communication skills	4	Analyse

Mapping of Course Outcomes to Program Outcomes (POs) & Program Specific Outcomes (PSOs):

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	-	2	1	2	-	-	-	-	-	2	-	2	-	-	2
CO2	-	3	-	-	-	-	-	-	-	3	-	-	-	-	1
CO3	1	-	-	-	-	-	-	-	-	-	-	-	2	-	1
CO4	-	1	-	-	-	-	-	-	-	3	-	1	1	-	2
CO5	-	-	-	-	2	-	-	-	-	3	-	2	-	-	2
CO6	-	-	-	-	-	-	-	-	-	3	-	2	-	-	1

Guidelines:

1. Each student will select a topic in the area of Computer Engineering andTechnology Preferably keeping track with recent technological trends and development beyond scope of syllabus avoiding repetition in consecutive years.

2. The topic must be selected in consultation with the instituteguide.

3. Each student will make a seminar presentation using audio/visual aids for duration of 20-25 minutes and submit the seminar report.

4. Active participation at classmate seminars isessential.

Recommended Format of the Seminar Report:

- Title Page with Title of the topic, Name of the candidate with Exam Seat Number / Roll Number, Name of the Guide, Name of the Department, Institution and Year& University

- Seminar Approval Sheet/Certificate

- Abstract and Keywords

- Acknowledgements

- Table of Contents, List of Figures, List of Tables and Nomenclature

- Chapters Covering topic of discussion- Introduction with section including organization ofthe report, Literature Survey/Details of design/technology/Analytical and/or experimental work, if any/ ,Discussions and Conclusions, Bibliography /References

List of Assignments

1. Identify application as social problem using algorithmic methodologies.

2. To determine scope and objectives of the defined problem.

3. To perform literature review of proposed system.

4. To represent system design and architecture.

5. To study implementation details of methodology selected.

6. To perform result analysis using data tables and comparison with other methods.

7. Seminar documentation and final presentation.

Reference Books:

1. Rebecca Stott, Cordelia Bryan, Tory Young, Speaking Your Mind: Oral Presentation and Seminar Skills (Speak-Write Series), Longman, ISBN-13:978-0582382435

2. BarunMitra, Effective Technical Communication a Guide for Scientist and Engineers, Oxford 9780195682915

3. Raman M. ,Shama, Technical Communication, Oxford,9780199457496

CO310:Corporate Readiness

Teaching Scheme	Examination Scheme	
Lectures: 2 Hrs./Week	Term Work:	50 Marks
Tutorial: --- Hr/Week	In-Sem Exam: --	
Class:-TY	End-Sem Exam: --	
Credits: 02	Total:	50 Marks

Prerequisite Course: (Quantitative aptitude, Verbal and Non-verbal communication)

Course Objectives:

1. To develop clarity in the exploration process of student career and to match his skills and interests with a chosen career path.
2. To develop required aptitude skills.
3. To design the functional and chronological resume.
4. To demonstrate the importance of critical thinking ability and expression in group discussions
5. To prepare students for the various professional interviews.
6. To develop different soft skills necessary to get success in their profession.

Course Outcomes (COs):

After successful completion of the course, student will be able to:

Course Outcome (s)		Bloom's Taxonomy	
		Level	Descriptor
CO1	Remember placement processes of various organizations and modern job search approach.	BTL 1	Remember
CO2	Understand Industry Specific skill set with a view to design an Ideal Resume.	BTL 2	Understand
CO3	Apply the knowledge of GD & Presentation Skill during Industry Assessments for Placement/Internship/Industry Training/Higher Studies/Competitive Exams etc.	BTL 3	Apply
CO4	Analyse and apply the critical thinking ability as required during Aptitude/Technical Tests.	BTL 4	Analyse
CO5	Evaluate Technical/General Dataset to interpret insights in it.	BTL 5	Evaluate
CO6	Create an ideal personality that fits Industry requirement.	BTL 6	Create

Mapping of Course Outcomes to Program Outcomes (POs) & Program Specific Outcomes (PSOs):

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	--	--	--	--	--	--	--	02	00	02	01	01	--	--	--	--
CO2	--	--	--	--	--	--	--	02	03	03	03	01	--	--	--	--
CO3	--	--	--	--	--	--	--	01	03	03	02	01	--	--	--	--
CO4	01	01	--	--	--	--	--	--	--	01	01	--	--	--	--	--
CO5	01	01	--	--	--	--	--	--	--	--	--	--	--	--	--	--

Mapping of Course Outcomes to Program Outcomes (POs) & Program Specific Outcomes (PSOs):															
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO6	--	--	--	--	--	--	--	02	03	03	02	03	--	--	--	--

Course Contents			
UNIT-I	**Placement Awareness**	**Hrs.**	**Cos**
	Discussion over Different Companies for recruitment, their eligibility criteria and placement procedures. Revision and Assessment of Quantitative Aptitude.	06 Hrs.	CO1
UNIT-II	**Resume Writing**	**Hrs.**	**CO**
	Keywords, resume examples for industry, professional font, active language, important achievements, Proofread and edit. Innovative resume building- video resume.	05 Hrs.	CO2
UNIT-III	**Group Discussion and Presentation skills**	**Hrs.**	**CO**
	Why GDs are implemented commonly, Aspects which make up a Group Discussion, Tips on group discussion, do's and don'ts of GD and Presentation skills.	05 Hrs.	CO3
UNIT-IV	**Logical Reasoning I**	**Hrs.**	**CO**
	Coding and Decoding (Visual Reasoning and series), Statement & Conclusions (Syllogisms), Relationships (Analogy), Data arrangements, Crypt arithmetic.	05 Hrs.	CO4
UNIT-V	**Logical Reasoning II**	**Hrs.**	**CO**
	Data Interpretation, Data Sufficiency	04 Hrs.	CO5
UNIT-VI	**Logical Reasoning III**	**Hrs.**	**CO**
	Blood relation and dices, Clocks and Calendar, Direction sense and cubes, Logical connectives, Puzzle.	05 Hrs.	CO6

Text Books:

[T1]. A Modern Approach to Verbal & Non-Verbal Reasoning by R.S. Agarwal.

[T2]. Reasoning verbal and Non-Verbal by B. S. Sijwali.

[T3]. Master the Group Discussion & Personal Interview - Complete Discussion on the topics asked by reputed B-schools & IIMs by Sheetal Desarda.

References:

[R1]. Shortcuts in Reasoning (Verbal, Non-Verbal, Analytical).

[R2]. Analytical Reasoning by M. K. Panday.

[R3]. Logical and analytical reasoning by K. Gupta.

[R4]. Multi-dimensional reasoning by Mishra & Kumar Dr. Lal.

E- Books :

[1].https://httpss://themech.in/quantitative-aptitude-and-logical-reasoning-books/

[2].https://www.thelocalhub.in/2021/01/reasoning-competitive-exams-pdf.html

E-learning Resources/MOOCs/ NPTEL Course Links:

[1]. https://www.practiceaptitudetests.com/non-verbal-reasoning-tests/

[2]. https://www.educationquizzes.com/11-plus/non-verbal-reasoning/

[3]. https://www.livecareer.com/resume/examples/web-development/e-learning-developer

[4]. https://novoresume.com/career-blog/how-to-write-a-resume-guide

MC 311: Mandatory Course-V			
Teaching Scheme		**Examination Scheme**	
Theory	**1 Hrs. / Week**	**TW**	-
Credits:	No Credits	**Total:**	-

Important Note:

● The department has to finalize MLC from the given choices and will prepare suitable course contents atdepartmental level only.

● The departments are informed to finalize MLC for SEM I and SEM II immediately and will take itsapproval in the BoS Meeting.

● Department will keep record of its smooth conduction and activity details.

SEMESTER V

Learning an Art Form (Music: vocal or instrumental, dance, painting, clay modeling, etc.):

Cultivation of arts is an integral part of the development of human beings since the arts are what make us most human, most complete as people. They offer us the experience of wholeness because they touch us at the deepest levels of mind and personality. They come into being not when we move beyond necessity but when we move to a deeper necessity, to the deeper human need to create order, beauty and meaning out of chaos. They are the expressions of deepest human urges, imperatives and aspirations. While enriching the process of learning through enhanced perceptual and cognitive skills, learning of arts promotes self-esteem, motivation, aesthetic awareness, cultural exposure, creativity, improved emotional expression, as well as socialharmony and appreciation of diversity. They promote an understanding and sharing of culture, and equip the learners with social skills that enhance the awareness and respect of others.

Each institution will offer a range of introductory courses in different art forms: music, dance, theater, painting, and other art forms. Care should be taken to give adequate representation to local and regional art forms in which our culture abounds. This will, in turn, also ensure wider community involvement/interaction with the institution.

Students will be given an option to choose a particular art form, and learn and practice it under an artist-instructor. At the end of the course, a student should be able to demonstrate basic proficiency

in that particular art form. Contact hours per week should be 3-4 hours. Towards the end of the course, the institution can organize a function/program in which all the students publicly demonstrate their skills.

SEMESTER VI

CO312: Internet of Things		
Teaching Scheme	**Examination Scheme**	
Lectures: 4 Hrs. / Week	CIA	40 Marks
Credits: 4	End-Sem Exam:	60 Marks
	Total:	100 Marks

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Prerequisite Course: Computer Networking, Digital Electronics
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Course Objectives:

1. To understand fundamentals of IoT and embedded systems including essence, basic design strategy and process modeling.

2. To learn to implement secure infrastructure for IoT applications.

3. To introduce learners to a set of advanced topics in IoT and lead them to understand research in networks.

4. To develop a comprehensive approach towards building small low cost IoT applications.

5. To learn real world application scenarios of IoT along with its societal and economic impact using case studies and real time examples.

Course Outcome (COs): On completion of the course, students will be able to-

Course Outcomes	Bloom's Taxonomy	
	Level	**Descriptor**
1. **Understand** basic fundamentals of embedded systems and IoT Networking.	2	Understand
2. **Apply** knowledge of IoT programming to execute basic programs on IoT boards.	3	Apply
3. **Explain** Communication protocols in IoT, its enabling technologies for developing systems with its emergence.	2	Understand
4. **Apply** knowledge of IoT to build a sensor network for real time applications.	3	Apply
5. **Analyze** different computing models for building networks and cloud	4	Analyze

	for IoT.		
6. **Demonstrate** different case studies in the field of IoT.		3	Apply

Mapping of Course Outcomes to Program Outcomes (POs) & Program Specific Outcomes (PSOs):

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO2	PSO3
CO1	3	1	1	2	-	-	-	-	-	-	-	-	3	-	-
CO2	3	2	1	2	1	-	-	-	-	-	-	-	3	-	-
CO3	2	3	3	3	2	3	-	-	2	-	1	-	-	3	-
CO4	1	2	3	2	3	3	-	-	2	1	2	2	3	2	-
CO5	2	2	2	3	3	3	-	-	2	1	2	2	2	2	-
CO6	2	2	1	2	2	2	-	-	1	-	1	-	3	-	3

COURSE CONTENTS

Unit I	Introduction	No. of Hours	COs
	Embedded System, Definition, Characteristics, Modern IoT Applications, Sensors and Actuators. IoT Architecture and block diagram Networking for IoT: Connectivity Terminologies. IoT Network Configuration	6	1
Unit II	Programming for IoT	No. of Hours	COs
	Introduction to Arduino Programming: Features of Arduino, Board details, Setup and IDE. Introduction to Python programming: Python IDE, Basic programs on Raspberry Pi, Setup and Installation of OS, Pin Configuration, Implementation of IoT Applications with Raspberry Pi.	6	2
Unit III	Communication Networks and Protocols	No. of Hours	COs
	HART (Highway Addressable Remote Transducer) and Wireless HART:	6	3

Unit IV	Wireless Sensor Networks	No. of Hours	Cos
	Layers in HART, HART vs ZigBee, NFC (Near Field Comm.), Bluetooth: Features, Connections, Piconet, Modes, L2CAP, RFComm, SDP, Z wave, ISA 100.11A: Features, Security, Usage Target Tracking		
	WSN: Components, Applications, Challenges, Nanonetworks, Coverage, Stationary WSN, Mobile WSN, UAV network. M2M: Overview, Application, Features, Ecosystem, Platforms. Interoperability in IoT: Challenges, Importance, Modes,	6	4
Unit V	Cloud for IoT	No. of Hours	Cos
	Introduction to SDN: Overview, Architecture, attributes, challenges. SDN for IoT: Benefits, Different Approaches, SDN for Mobile Networking: ODIN, Ubi-Flow, Mobi-Flow, Data Handling and Analytics, Cloud for IoT.	6	5
Unit VI	Case Studies	No. of Hours	COs
	Smart Cities and Smart Homes, Connected Vehicles, Smart Grid, Industrial IoT, Agriculture, Healthcare, Activity Monitoring	6	6

Books:

Text Books(T):

T1. Arshdeep Bahga, Vijay Madisetti, ―Internet of Things – A hands-on approach‖, Universities Press, ISBN: 0: 0996025510, 13: 978-0996025515.

T2. Olivier Hersent, David Boswarthick, Omar Elloumi, The Internet of Things: Key

Applications and Protocols, 2nd Edition,Wiley Publication,ISBN: 978-1-119-99435-0

Reference Books(R):

1) S. Misra, A. Mukherjee, and A. Roy, 2020. Introduction to IoT. Cambridge University Press.

Availability:https://www.amazon.in/Introduction-IoT-Sudip-

Misra/dp/1108959741/ref=sr_1_1?dchild=1&keywords=sudip+misra&qid=1627359928&sr=8-1

2) S. Misra, C. Roy, and A. Mukherjee, 2020. Introduction to Industrial Internet of Things and Industry 4.0. CRC Press.

Availability:

https://www.amazon.in/dp/1032146753/ref=sr_1_3?dchild=1&keywords=sudip+misra&qid=1627359971&sr=8-3

3) Research Papers

eResources (ER):

1) NPTEL, Introduction To Internet Of Things, Prof. Sudip Misra, IIT Kharagpur

2) NPTEL, Introduction To Industry 4.0 And Industrial Internet Of Things, Prof. Sudip Misra, IIT Kharagpur

CO313: System Software

Teaching Scheme		Examination Scheme	
Lectures:	3Hrs. / Week	Continuous Internal Assessment:	40 Marks
Credits:	3	End-Sem Exam:	60 Marks
		Total:	100 Marks

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Prerequisite Course: Computer Organization and Architecture, Operating System and Administration, Data Structures

Course Objectives:

1. To learn and understand basics of system programming and language processing

2. To learn and understand Lexical and Syntax Analysis

3. To understand the Intermediate code forms and Intermediate Code Generation for different types of statements

4. To understand various ways for optimizing the intermediate code, and generation of target code

5. To obtain knowledge of data structures and algorithms used in design of assembler and macroprocessor.

6. To learn different variants of loaders and their functions such as allocation, linking, relocation, and loading

Course Outcome (COs): On completion of the course, students will be able to-

Course Outcomes	Bloom's Taxonomy	
	Level	Descriptor
1. Explain various Components of System Software and Understand the Fundamental of Language Processing	2	Understand
2. Demonstrate the Lexical and Syntax Analyzer for certain language.	3	Apply
3. Write the intermediate code in various forms for different types of input statements	3	Apply
4. Apply different code optimization techniques to generate the optimized code	3	Apply
5. Identify suitable data structures and design two pass assembler and macro processor	3	Apply

6. Use suitable data structures and design different types of loader schemes	3	Apply

Mapping of Course Outcomes to Program Outcomes (POs) & Program Specific Outcomes (PSOs):

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	2	1	-	-	-	-	2	1	-	1	2	1	-
CO2	2	2	3	2	2	-	-	-	2	1	-	1	2	1	-
CO3	2	2	3	2	-	-	-	-	2	1	-	1	2	1	-
CO4	2	2	3	2	-	-	-	-	2	1	-	1	2	1	-
CO5	2	2	3	2	-	-	-	-	2	1	-	1	2	1	-
CO6	2	2	3	2	-	-	-	-	2	1	-	1	2	1	-

COURSE CONTENTS

Unit I	Introduction to System Software	No. of Hours	COs
	Introduction: Introduction to Systems software, Goals of System Software, System Programs, Machine Structure. **Components of System Software:** Assembler, Macro processor, Compiler, Interpreter, Linker, Loader, Debugger, Operating System. **Language Processors:** Language Processing Activities, Fundamentals of Language Processing.	6	CO1
Unit II	Introduction to Compiler	No. of Hours	COs
	Structure of a Compiler, Compiler and Interpreter. **Lexical Analysis:** Role of the lexical analyzer, Specification of Tokens, Recognition of Tokens, Lexical Analyzer Generator LEX. **Syntax Analysis:** Role of Parser, Writing a Grammar, Top-Down Parsing, Bottom-Up Parsing, Parser Generators YACC. **Case Study : LEX and YAAC specification and features.**	6	CO2
Unit III	Intermediate Code Generation	No. of Hours	COs
	Syntax-Directed Definitions, Evaluation Orders for SDD's, Variants of Syntax Trees, Three-Address Code, Types and Declarations, Translation of	6	CO3

Unit IV	Code Optimization and Generation	No. of Hours	COs
	Principal sources of optimization, Basic Blocks and Flow Graphs Optimization of basic blocks, Code-improving transformations Issues in the Design of Code Generator, Target Language, Next-use information, Peephole optimization, Simple Code Generator.	6	CO4

Unit V	Assembler and Macro Processor	No. of Hours	COs
	Elements of Assembly Language Programming, A simple Assembly scheme, Pass Structure of Assembler. **Design of two pass assembler:** Processing of declaration statements, Assembler Directives and imperative statements, Advanced Assembler Directives, Intermediate code forms, Pass I and Pass II of two pass Assembler. **Macro Processor:** Macro instructions, Features of macro facility, Design of two-pass macro processor. **Case Study: GNU M4 Macro Processor**	6	CO5

Unit VI	Linkers and Loaders	No. of Hours	COs
	Loader schemes: Compile and go, General Loader Scheme, Absolute loaders, subroutine linkages, relocating loaders, direct linking loaders, overlay structure. Design of an absolute loader. **Linkers:** Relocation and linking concepts, self relocating programs, Static and dynamic link libraries.	6	CO6

Books:

Text Books(T):

1. Dhamdhere D., "Systems Programming and Operating Systems", McGraw Hill, ISBN 0 - 07 - 463579 – 4

2. John Donovan, "System Programming", McGraw Hill, ISBN 978-0--07-460482-3.

3. Alfred V.Aho,Monica S.Lam,Ravi Sethi, Jeffrey D. Ullman, "Compilers-Principles,Techniques

and Tools", Pearson,ISBN:978-81-317-2101-8

| **Reference Books(R):** |
| John R. Levine, Tony Mason, Doug Brown, "Lex and Yacc",O'Reilly & Associates,Inc,ISBN:1-56592-000-7 |
| Leland Beck, "System Software: An Introduction to Systems Programming", Pearson |
| K. Louden, "Compiler Construction: Principles and Practice", Cengage Learning, ISBN 978-81-315-0132-0 |

| **e-Books :** |
| 7. https://www.elsevier.com/books/systems-programming/anthony/978-0-12-800729-7 |
| 8. https://www.kobo.com/us/en/ebook/linux-system-programming-1 |
| 9. https://www.e-booksdirectory.com/details.php?ebook=9907 |

| **MOOCs Courses Links:** |
| T3. https://www.udemy.com/course/system-programming/ |
| T4. https://onlinecourses.nptel.ac.in/noc20_cs13/preview |
| T5. https://www.udemy.com/course/compiler-design-n/ |
| T6. https://www.mygreatlearning.com/academy/learn-for-free/courses/compiler-design |

CO314: DATA MINING AND WAREHOUSING		
Teaching Scheme		**Examination Scheme**	
Lectures: 3 hrs/week		Continuous Assessment:	40 Marks
Credits:3		End-Sem Exam:	60 Marks
		Total:	100 Marks

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Prerequisite Course: (if any) Database Management System

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Course Objectives:

1. To understand the fundamentals of Data Mining.

2. To identify the appropriateness and need of mining the data.

3. To learn the pre-processing, mining and post processing of the data.

4. To understand various Distant Measures techniques in data mining.

5. To understand clustering techniques and algorithms in data mining.

6. To understand classification techniques and algorithms in data mining.

Course Outcomes (COs):

On completion of the course, student will be able to–

Course Outcomes	Bloom's Taxonomy	
	Level	**Descriptor**
Apply basic, intermediate and advanced techniques to mine the data.	3	Apply
Analyze the output generated by the pre-processing of data.	2	Understand
Ability to explore the data warehouse and its design.	4	Analyze
Examine the hidden patterns in the data	4	Analyze
Apply the mining process by frequent pattern analysis techniques.	3	Apply
Demonstrate the Classification techniques for realistic data.	3	Apply

Mapping of Course Outcomes to Program Outcomes (POs) & Program Specific Outcomes (PSOs):

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3

CO1	3	2	2	3	2	--	--	--	--	2	--	--	3	2	2
CO2	3	2	2	3	2	--	--	--	--	--	--	--	3	2	2
CO3	1	2	3	1	2	--	--	--	--	--	--	--	1	3	2
CO4	2	2	2	3	2	--	--	--	--	--	--	--	3	2	2
CO5	3	2	2	3	2	3	2	--	--	2	--	--	2	2	2
CO6	2	2	2	3	2	3	2	--	--	2	--	--	2	2	3

Unit-I	Introduction to Data Mining	No.of Hours	COs
	Data Mining, Kinds of pattern and technologies, Data Mining Task Primitives, issues in mining, KDD vs data mining, OLAP, knowledge representation, data pre-processing - cleaning, integration, reduction, transformation and discretization, Data: Data, Information and Knowledge; Attribute Types: Nominal, Binary, Ordinal and Numeric attributes, Discrete versusContinuous Attributes.	7 Hrs.	CO1

Unit-II	Data Pre-processing	No.of Hours	COs
	Introduction to Data Pre-processing, Data Cleaning: Missing values, Noisy data; Data integration: Correlation analysis; transformation: Min-max normalization, z-score normalization anddecimal scaling; data reduction: Data Cube Aggregation, Attribute Subset Selection, sampling; and Data Discretization: Binning, Histogram Analysis.	6 Hrs.	CO2

Unit-III	Data Warehouse	No.of Hours	COs

	Data Warehouse, Operational Database Systems and Data Warehouses(OLTP Vs OLAP), A Multidimensional Data Model: Data Cubes, Stars, Snowflakes, and Fact Constellations Schemas; OLAP Operations in the Multidimensional Data Model, Concept Hierarchies, Data Warehouse Architecture, The Process of Data Warehouse Design, A three-tier data warehousing architecture, Types of OLAP Servers: ROLAP versus MOLAP versus HOLAP.	6 Hrs.	CO3
Unit-IV	**Cluster Analysis: Measuring Similarity & Dissimilarity**	No.of Hours	COs
	Measuring Data Similarity and Dissimilarity, Proximity Measures for Nominal Attributes and Binary Attributes, interval scaled; Dissimilarity of Numeric Data: Minskowski Distance Euclidean distance and Manhattan distance Proximity Measures for Categorical, Ordinal Attributes, Ratio scaled variables; Dissimilarity for Attributes of Mixed Types, Cosine Similarity, partitioning methods- k-means, k-medoids.	7 Hrs.	CO4
Unit-V	**Frequent Pattern Analysis**	No.of Hours	COs
	Market Basket Analysis, Frequent item set, closed item set & Association Rules, mining multilevel association rules, constraint based association rule mining, Generating Association Rules from Frequent Item sets, Apriori Algorithm, Improving the Efficiency of Apriori, FP Growth Algorithm. Mining Various Kinds of Association Rules: Mining multilevel association rules, constraint based association rule mining, Meta rule-Guided Mining of Association Rules.	6 Hrs.	CO5
Unit-VI	**Classification**	No.of Hours	COs

Introduction, classification requirements, methods of supervised learning, decision trees- attribute selection, tree pruning, ID3, scalable decision tree techniques, rule extraction from decisiontree, Regression, Bayesian Belief Networks, Training Bayesian Belief Networks, Classification Using Frequent Patterns, Associative Classification, Lazy Learners-k-Nearest-Neighbour Classifiers, Case-Based Reasoning, Multiclass Classification, Metrics for Evaluating Classifier Evaluating the Accuracy of a Classifier.	8 Hrs.	CO6

Books:

Text Books:

T1. Han, Jiawei Kamber, Micheline Pei and Jian, "Data Mining: Concepts and Techniques", Elsevier Publishers, ISBN:9780123814791, 9780123814807.

T2. Mohammed J. Zaki, Wagner Meira Jr., "Data Mining and Analysis", Cambridge University Press, ISBN:9781316614808.

Reference Books:

R1. Vipin Kumar, "Introduction to Data Mining", Pearson, ISBN-13: 978-0321321367 ISBN-10: 0321321367

R2. Ikhvinder Singh, "Data Mining & Warehousing", Khanna Publishing House, ISBN-10: 9381068704, ISBN-13: 978-9381068700

R3. Charu C. Aggarwal, "Data Mining: The Textbook", Springer, ISBN 978331914141-1, 978331914142-8

R4. Ian H. Witten, Eibe Frank, "Data Mining: Practical Machine Learning Tool and Techniques", Elsevier Publishers, ISBN: 0-12-088407-0

R5. Luís Torgo, "Data Mining with R, Learning with Case Studies", CRC Press, Talay and Francis Group, ISBN9781482234893

R6. Carlo Vercellis, "Business Intelligence - Data Mining and Optimization for Decision Making", Wiley Publications, ISBN: 9780470753866

CO315A: Digital Forensics			
Teaching Scheme		**Examination Scheme**	
Lectures:	4 Hrs. / Week	Continuous Internal Assessment:	40 Marks
Credits:	4	End-Sem Exam:	60 Marks
		Total:	100 Marks

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Prerequisite Course: (if any) Operating system, Computer organization

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Course Objectives:

1. To emphasize the fundamentals and importance of digital forensics.

2. To learn different techniques and procedures that enables them to perform a digital investigation

3. To conduct a digital investigation in an organized and systematic way

4. To learn open-source forensics tools to perform digital investigation and understand the underlying theory behind these tools.

5. To emphasize theoretical and practical knowledge, as well as current research on Digital Forensics

6. To learn programming for Computer Forensics.

Course Outcomes (COs): On completion of the course, student will be able to

Course Outcomes		Bloom's Taxonomy	
		Level	**Descriptor**
CO1	Understand basic software and hardware requirement for digital forensics.	2	Understand
CO2	Describe the representation and organization of data and metadata within modern computer systems.	2	Understand
CO3	Understand the trade off and differences between various forensic tools.	2	Understand
CO4	Analyze network based evidence and mobile network forensic.	4	Analyze
CO5	Investigate software reverse engineering.	4	Analyze
CO6	Demonstrate forensics of hand held devices.	3	Apply

Mapping of Course Outcomes to Program Outcomes (POs) & Program Specific Outcomes (PSOs):

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	--	--	2	--	--	--	--	--	2	3	2	1	2	--
CO2	2	--	--	2	--	--	--	--	--	2	2	2	1	2	--
CO3	1	--	--		--	--	--	--	--	3	2	2	2	2	--
CO4	2	--	--	2	--	--	--	--	--	3	2	2	2	3	1
CO5	2	--	--	2	--	--	--	--	--	3	2	2	2	3	2
CO6	2	--	--	2	--	--	--	--	--	3	2	3	1	3	--

(Specify values as : 3: High Level, 2: Medium Level, 1: Low Level for mapping of Cos to POs)

Course Contents

Unit-I	**Introduction to digital Forensics**	No.of Hours	COs
	Digital crimes, evidence, extraction, preservation, etc. Overview of hardware and operating systems: structure of storage media/devices; windows/Macintosh/ Linux -- registry, boot process, file systems, file metadata.	06 Hrs.	CO1

Unit-II	**Data recovery and Digital evidence controls**	No.of Hours	COs
	Data recovery: identifying hidden data, Encryption/Decryption, Steganography, recovering deleted files. Digital evidence controls: uncovering attacks that evade detection by Event Viewer, Task Manager, and other Windows GUI tools, data acquisition, disk imaging, recovering swap files, temporary &cache files.	06 Hrs.	CO2

Unit-III	**Computer Forensics analysis and validation**	No.of Hours	COs
	Computer Forensics analysis and validation: Determining what data to collect and analyze, validating forensic data, addressing data-hiding techniques, performing remote acquisitions Network Forensics: Network forensics overview, performing live acquisitions, developing standard procedures for network	06 Hrs.	CO3

	forensics, using network tools, examining the honeynet project. Computer Forensic tools: Encase, Helix, FTK, Autopsy, Sleuth kit Forensic Browser, FIRE, Found stone Forensic ToolKit, WinHex, Linux dd and other open source tools.		

Unit-IV	**Network Forensic**	No.of Hours	COs
	Network Forensic: Collecting and analysing network-based evidence, reconstructing web browsing, e-mail activity, and windows registry changes, intrusion detection, tracking offenders, etc. Mobile Network Forensic: Introduction, Mobile Network Technology, Investigations, Collecting Evidence, Where to seek Digital Data for further Investigations, Interpretation of Digital Evidence on Mobile Network.	06 Hrs.	CO4

Unit-V	**Software Reverse Engineering**	No.of Hours	COs
	Software Reverse Engineering: defend against software targets for viruses, worms and other malware, improving third-party software library, identifying hostile codes-buffer overflow, provision of unexpected inputs.	06 Hrs.	CO5

Unit-VI	**Computer crime and Legal issues**	No.of Hours	COs
	Computer crime and Legal issues: Intellectual property, privacy issues, Criminal Justice system for forensic, audit/investigative situations and digital crime scene, investigative procedure/standards for extraction, preservation, and deposition of legal evidence in a court of law.	06 Hrs.	CO6

Text Books:

1.	Digital Forensics with Open Source Tools. Cory Altheide and Harlan Carvey, ISBN: 978-1-59749-586-8, Elsevier publication, April 2011.

2.	Guide to Computer Forensics and Investigations (4th edition). By B. Nelson, A. Phillips, F. Enfinger, C. Steuart. ISBN 0-619-21706-5, Thomson, 2009.

3.	Computer Forensics and Cyber Crime: An Introduction (3rd Edition) by Marjie T. Britz, 2013.

Reference Books:

1.	Network Forensics: Tracking Hackers Through Cyberspace, Sherri Davidoff, Jonathan Ham Prentice Hall, 2012

2.	Computer Forensics: Hard Disk and Operating Systems, EC Council, September 17, 2009

3.	Computer Forensics Investigation Procedures and response, EC-Council Press, 2010

4.	EnCase Computer Forensics., 2014

5.	File System Forensic Analysis. By Brian Carrier. Addison-Wesley Professional, March 27, 2005.

6.	NIST Computer Forensic Tool Testing Program (www.cftt.nist.gov/)

7.	Computer Forensics: Investigating Data and Image Files (Ec-Council Press Series: Computer Forensics) by EC-Council (Paperback - Sep 16, 2009)

8.	Digital Evidence and Computer Crime, Third Edition: Forensic Science, Computers, and the Internet by Eoghan Casey, 2011

9.	The Art of Memory Forensics: Detecting Malware and Threats in Windows, Linux, and Mac Memory. Michael Hale Ligh, Andrew Case, Jamie Levy, AAron Walters, ISBN: 978-1-118-82509-9, July 2014

CO315B: DIGITAL IMAGE PROCESIING

Teaching Scheme		Examination Scheme	
Lectures:	3Hrs. / Week	Continuous Internal Assessment:	40 Marks
Credits:	3	End-Sem Exam:	60 Marks
		Total:	100 Marks

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Prerequisite Course: Engineering Mathematics

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Course Objectives:

1. To learn fundamentals of Image Processing.

2. To learn image enhancement and restoration techniques.

3. To learn image compression techniques.

4. To learn image segmentation techniques.

5. To study different edge and object detection techniques.

6. To study different applications in areas of Image Processing.

Course Outcomes:

After completion of the course, students are able to -

COs	Course Outcomes	BTL	Discriptor
CO1	Understand basics of Image Processing.	2	Understand
CO2	Learn and Understand Image Enhancement and Restoration techniques.	2	Understand
CO3	Describe and apply Image Compression techniques.	3	Apply
CO4	Describe and apply Image Segmentation techniques.	3	Apply
CO5	Understand and apply different Edge and Object Detection techniques.	3	Apply
CO6	Develop applications in the area of Image processing and Machine Learning	4	Evaluate

Course Contents

Unit-I	Introduction to Image Processing	No. of Hrs	COs
	Fundamental steps in Digital Image processing, Components of an Image Processing System, Image sampling and Quantization: Basic concept in Sampling and Quantization, Representing Digital Images, Spatial and Gray Level resolution. Basic relationships between pixels.	7 Hrs.	CO1

Unit-II	Image Enhancement and Restoration	No. of Hrs	COs
	Image Enhancement: Introduction, Contrast Intensification, Smoothing and Image Sharpening **Restoration:** Introduction, Minimum mean square error restoration, Least square error restoration, Restoration by: Singular value decomposition, Maximum a Posterior estimation, Homomorphic Filtering.	7 Hrs.	CO2

Unit-III	Image Compression	No. of Hrs	COs
	Image Compression: Introduction, Coding Redundancy, Huffman Coding, Arithmetic Coding, LZW coding, Transform Coding, Sub-image size selection, blocking, Run length coding. **Image Compression Models:** Lossy Compression methods, Lossless Compression methods.	7 Hrs.	CO3

Unit-IV	Image Segmentation	No. of Hrs	COs
	Segmentation: Introduction, Region extraction, Pixel based approach, Segmentation using Threshold - Multi level Thresholding Local Thresholding, Region based approach, Region based segmentation- Region growing, split and merge technique, local processing, regional	7 Hrs.	CO4

	processing, Hough transform		

Unit-V	Edge and Line Detection	No. of Hrs	COs
	Introduction, Edge detection, Derivative (difference) operators, Morphologic edge detection, Pattern fitting approach, Edge linking and Edge following, Edge element extraction by thresholding, Edge detector performance, Line detection, Corner detection..	7 Hrs.	CO5

Unit-VI	Image Processing Applications	No. of Hrs	COs
	Applications of image enhancement and analysis, Object Detection and Recognition (Preprocessing, Feature Extraction and Machine Learning)	7 Hrs.	CO6

Books:

Text Books:

1.Rafel Gonzallez and R. Woods," Digital Image Processing", Pearson Education, 3d Edition, ISBN 0-201-18075-8

2. Anil K. Jain, "Fundamentals of Digital Image Processing", Pearson Education, 3d Edition, ISBN-13: 978-0133361650

Reference Books:

1. B. Chanda and D. Dutta Majumder," Digital Image Processing And Analysis", PHI Edition, ISBN-13: 978-8120343252

2. William K. Pratt, "Digital Image Procesing", John Wiley Publication, 4th Edition, ISBN: 978-0-471-76777-0 1.

3. Milan Sonka, Vaclav Hlavac and Roger Boyle, "Image Processing, Analysis, and Machine Vision", Thomson Publication, Second Edition, ISBN-13: 978-0495082521

Web Resources:

https://www.coursera.org/learn/introduction-image-processing

https://www.coursera.org/specializations/image-processing

https://www.coursera.org/projects/image-processing-with-python

https://onlinecourses.nptel.ac.in/noc23_ee118/preview/digital image processing

CO315 C: Advanced Java Programming		
Teaching Scheme	**Examination Scheme**	
Lectures: 4 Hrs. / Week	Continuous Assessment:	40 Marks
Credits: 4	End-Sem Exam:	60 Marks
	Total:	100 Marks

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Prerequisite Course: Core Java, Web Technology.

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Course Objectives:

1. To understand Strut Framework.

2. To understand Object Relational Mapping (ORM).

3. To study Hibernate.

4. To equip students with the knowledge and skills to effectively use the Spring Framework's core features.

5. To study Spring Model View Controller (MVC) Framework.

6. To understand Spring ORM.

Course Outcomes (COs): On completion of the course, students will be able to-

Course Outcomes	Blooms Taxonomy	
	Level	**Descriptor**
1. **Develop** web application using Struts Framework.	3	Apply
2. **Develop** Java applications that interact with relational database using Hibernate.	3	Apply
3. **Understand** relationships, caching mechanism and transaction management in Hibernate.	2	Understand
4. **Understand** Spring Core and its Feature.	2	Understand
5. **Develop** Web application using Spring MVC effectively employing MVC pattern.	3	Apply
6. **Develop** Java applications that interact with relational database using Spring ORM.	3	Apply

Mapping of Course Outcomes to Program Outcomes (POs) & Program Specific Outcomes (PSOs):

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	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	3	-	3	-	2	-	-	-	-	2	3	3	3
CO2	3	1	3	-	3	-	2	-	-	-	-	2	3	3	3
CO3	2	-	2	-	-	-	2	-	-	-	-	2	2	2	2
CO4	2	-	2	-	-	-	2	-	-	-	-	2	2	2	2
CO5	3	1	3	-	3	-	2	-	-	-	-	2	3	3	3
CO6	3	1	3	-	3	-	2	-	-	-	-	2	3	3	3

COURSE CONTENTS

Unit I	STRUTS	No. of Hours	COs
	MVC, Struts architecture, Setting up the environment, Registration application, ValueStack and Object-Graph Navigation Language (OGNL), Interceptors, Form Validation, Struts 2 Tag, Database application using Struts.	8	1

Unit II	HIBERNATE: FROM SETUP TO ADVANCED QUERIES	No. of Hours	COs
	ORM, Hibernate Architecture, Mapping and Configuration files, Installation, Hibernate Application Requirements, CRUD operations, State of Objects, Annotations, Session Interface, Hibernate Query Language, Criteria API, Native SQL Query, Named Queries.	7	2

Unit III	RELATIONSHIPS, CACHING IN HIBERNATE	No. of Hours	COs
	Relationships: One to One, One to Many, Many to One, Many to Many, Collection Mapping. **Hibernate Caching Mechanism:** First Level Cache, Second Level Cache. Transaction Management, Integration of Hibernate with Servlets and Struts.	7	3

Unit IV	SPRING CORE	No. of Hours	COs
	Spring Container, Inversion of Control, Dependency Injection, Environment Setup, Beans Definition, Scope, Life Cycle, Properties, Injecting Collections, Auto-Wiring, Component-Scan, Annotations, DevTools, Configuration, Repository.	8	4

Unit V	SPRING MVC	No. of Hours	COs
	DispatchServlet, Spring MVC Controller, View Resolver, Configurations, Annotations, Templating, JSP Views, Resource Mapping, Form Field Definitions and Validations.	8	5

Unit VI	SPRING ORM	No. of Hours	COs
	Comparison of Spring ORM with Hibernate, Integration of Hibernate with Spring, Spring Data JPA, Transaction Management, Data Access Objects, Mapping, Caching.	8	6

Books:

Text Books(T):

T1. Donald Brown, Chad Michael Davis, and Scott Stanlick, "Struts 2 in Action", Dreamtech Press, ISBN-13 **:** 978-8177228755.

T2. Ramin Rad, "Mastering Hibernate", Packt Publishing, ISBN: 9781782175339.

T3. Iuliana Cosmina, Rob Harrop, Chris Schaefer, and Clarence Ho, "Pro Spring 5: An In-Depth Guide to the Spring Framework and Its Tools", 5th ed. Apress, ISBN-13: 978-1-4842-2807-4.

Reference Books(R):

R1.Chuck Cavaness, "Programming Jakarta Struts ", O'Reilly Media, Inc, ISBN:9780596003289.

R2. Craig Walls, "Spring in Action ", 6th ed. Manning Publications Co., ISBN: 9781617297571.

R3. Christian Bauer, Gavin King, "Java Persistence with Hibernate", 2nd ed. Manning Publications Co., ISBN 9781617290459.

E-Resources(E):

1. https://www.coursera.org/specializations/spring-framework

2. https://www.ebooks.com/en-us/book/540793/hibernate-a-developer-s-notebook/james-elliott/

3. https://www.ebooks.com/en-ae/book/210726026/introducing-spring-framework-6/felipe-gutierrez/

PR316 : Intellectual Property Rights and Entrepreneurship Development

Teaching Scheme		Examination Scheme	
Theory	2 Hrs. / Week	Continuous Assessment:	20 Marks
Credits:	2	In-Sem Exam:	-
		End-Sem Exam:	30 Marks
		Total:	50 Marks

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Prerequisite Course: NIL

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Course Objectives:

1. To introduce student with IPR

2. To explain IPR procedure in India such as Patents, Designs and Trademarks

3. To make aware of the economic importance of IPRs.

4. To develop the ability to search and analyse the IPRs.

5. To Instill a spirit of entrepreneurship among the student participants.

6. To give insights into the Management of Small Family Business.

Course Outcomes (COs): After learning the course the learners will be able to,

Course Outcome(s)	Blooms Technology	
	Level	Descriptor
1. Understand patenting system	2	Create
2. Understand the procedure to file patent in India	2	Apply
3.Understanding of financial importance of IPR	2	Understand
4. Search and analyse the patents, designs and Trademarks	4	Analyse
5. Identify the Skill sets required to be an Entrepreneur.	4	Analyse
6. Understand the Role of supporting agencies and Governmental initiatives to promote Entrepreneurship.	4	Analyse

Mapping of Course Outcomes to Program Outcomes (POs) & Program Specific Outcomes (PSOs):

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1						2			2			3		
CO2						2			2			3		
CO3						2			2			3		
CO4						2			2			3		
CO5						2	2	2				3		
CO6						2	2	2				3		

Unit 1	Introduction to IPR	No.of Hours	COs
	· Concepts of IPR · The history behind development of IPR · Necessity of IPR and steps to create awareness of IPR · Concept of IP Management · Intellectual Property and Marketing · IP asset valuation ⦁ Introduction to the leading International Instruments concerning Intellectual Property Rights: the Berne Convention, Universal Copyright Convention, The Paris Convention, Patent Cooperation Treaty, TRIPS, The World Intellectual Property Organization (WIPO) and the UNESCO	4	1
Unit-2	**Patents**	No.of Hours	COs

	· Introduction to Patents
	
	· Procedure for obtaining a Patent
	
	· Licensing and Assignment of Patents
	
	      i. Software Licensing
	
	      ii. General public Licensing
	
	      iii. Compulsory Licensing
	
	· Infringement of Patents
	
	· Software patent and Indian scenario
		4	2

Unit-3	**Designs**	No. of Hours	COs
	● Registrable and non-Registrable Designs ● Novelty & Originality ● Procedure for Registration of Design ● Copyright under Design ● Assignment, Transmission, License ● Procedure for Cancellation of Design ● Infringement ● Remedies	4 Hrs.	3
Unit 4	**Trademarks and Copyrights**	No.of Hours	COs
	A) **Trademarks** · Concept of trademarks · Importance of brands and the generation of "goodwill" · Trademark registration procedure · Infringement of trademarks and Remedies available · Assignment and Licensing of Trademarks B) **Copyright Right** ● Concept of Copyright Right · Assignment of Copyrights	4 Hrs.	4

	· Registration procedure of Copyrights		
	· Infringement (piracy) of Copyrights and Remedies		
	· Copyrights over software and hardware		
Unit 5	**Entrepreneurship: Introduction**	**No.of Hours**	**COs**
	5.1 **Concept and Definitions**: Entrepreneur & Entrepreneurship, Entrepreneurship and Economic Development, A Typology of Entrepreneurs. **5.2 Entrepreneurial Competencies:** The Entrepreneur's Role, Entrepreneurial Skills: creativity, problem solving, decision making, communication, leadership quality; Self-Analysis, Culture & values, Risk-taking ability, Technology knowhow. **5.3 Factor Affecting Entrepreneurial Growth:** Economic & Non-Economic Factors, EDP Programmes. **5.4 Steps in Entrepreneurial Process:** Deciding Developing Moving Managing Recognizing.	4	5
Unit 6	**Resources for Entrepreneurship**	**No.of Hours**	**COs**
	6.1 Project Report Preparation: Specimen Format of Project Report; Project Planning and Scheduling using PERT / CPM; Methods of Project Appraisal – Feasibility Study both	4	6

	Economicand Market		
	Preparation projected financial statement.		
	6.2 Role of Support Institutions and Management of Small **Business:**		
	Director of		
	Industries,DIC,		
	SIDO,		
	SIDBI		
	,		
	Small Industries Development Corporation		
	(SIDC),SISI,		
	NSIC,		
	NISBUED		
	,		
	State Financial Corporation (SFC)		
	EPC,		
	ECGC.		
	6.3 Various Governmental Initiatives:		
	Make in India, Startup India, Stand Up India, Digital India, Skill India		
	6.4 Case Studies of Successful Entrepreneurs		
Text Books:			
	1. Neeraj Pandey and Khushdeep Dharni, Intellectual Property Rights, PHI, New Delhi		
	2. The Indian Patent act 1970.		
	3. The copyright act 1957		
	4. Manual of patent office practice and procedure of Govt. of India.		
	5. Manual of Designs Practice and Procedure of Govt. India		
	6. Manual of Trademarks Practice and Procedure of Govt.		

India	
7. Semiconductor Integrated Circuits Layout Design (SICLD) Act 2000 of Govt. India	
8. Intellectual Property Rights- A Primer, R. Anita Rao & Bhanoji, Rao, Eastern BookCo.	
9. The Dynamics of Entrepreneurial Development & Management by Desai, Vasant, HimalayaPublishing House, Delhi.	
10. Managing Small Business by Longenecker, Moore, Petty and Palich, Cengage Learning,India Edition.	
11. Cases in Entrepreneurship by Morse and Mitchell, Sage South Asia Edition.	
12. Entrepreneurship – Indian Cases on Change Agents by K Ramchandran, TMGH.	

Reference Books:

1. Handbook of Indian Patent Law and Practice,	
2. : New Venture Creation by David H. Holt	
3. Entrepreneurship Development New Venture Creation by Satish Taneja, S.L.Gupta	
4. Project management by K. Nagarajan.	

CO317: IOT Lab

Teaching Scheme		Examination Scheme	
Practical:	2 Hrs. / Week	Oral Examination	50
Credits:	1	Total	50

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Prerequisite Course: Digital Electronics, Computer Network

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Course Objectives:

1. To understand functionalities of various single board embedded platforms fundamentals

2. To explore a comprehensive approach towards building small low cost embedded IoT system.

3. To implement the assignments based on sensory inputs.

4. To explore the use of Cloud of Things in IoT applications.

5. To understand remote handling of IoT applications using Web Interface.

6. To recognize importance of IoT in real-time application implementation

Course Outcome (COs): On completion of the course, students will be able to-

Course Outcomes	Bloom's Taxonomy	
	Level	Descriptor
1. Understand embedded platform fundamentals, operating systems for IoT systems.	2	Understand
2. Use IoT embedded platforms for low cost IoT system implementations	3	Apply
3. Describe various IoT devices, embedded platforms, programming environments for IoT systems	2	Understand
4. Demonstrate the small system for sensor-based application.	3	Apply
5. Solve the problems related to the primitive needs using IoT.	3	Apply
6. Demonstrate IoT application for distributed environment.	3	Apply

Mapping of Course Outcomes to Program Outcomes (POs) & Program Specific Outcomes (PSOs):

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	-	-	-	-	-	-	-	3	-	3	-	-
CO2	3	3	3	-	-	-	-	-	-	-	3	-	-	3	-
CO3	3	3	3	-	-	-	-	-	-	2	-	-	-	3	-

CO4	3	3	3	-	-	-	-	-	-	3	-	-	-	3	-
CO5	3	2	2	-	-	-	-	-	-	3	-	-	-	3	-
CO6	3	3	3	-	-	-	-	-	-	3	-	3	-	3	3

Suggested List of Assignment

[Students have to complete at list 7 assignment towards the successful completion of project work, where all the implementation and design assignments are compulsory]

Group A [All assignments are compulsory**]**

1. **Identify different boards like Raspberry-Pi, Beagle board, Arduino and other microcontrollers.**
2. **Basic IoT setup with Arduino and ESP8266.**
   - Connection of Arduino board with ESP8266 Wi-Fi module, interfacing Arduino with ESP8266 using AT commands like UART, CWMODE, CWLAP, CWJAP, CIPMUX, CIPSERVER, CIFSR. Connecting Arduino to access-point with LAN/internet with static IP. Checking TCP connection with Arduino over LAN/internet.
3. **Writing first IoT based Program on Arduino**:
        To control an LED connected to an Arduino: Write a basic program (i.e., html code) in a PC for creating command buttons on a browser window. -Write and upload the Arduino code for ON/OFF control of the LED. -Run the program of Arduino and give the browser-based command to control the LED.

4. **Survey of different commercial and open-source clouds, create a report on it.**

Group B [All assignments are compulsory**]**

5. **Implementation of temperature control using Arduino Uno as master and ESP8266 sensor as slave and upload the data on think speak.**

6. **Cloud based data logging:**
    IoT based Temperature logger using ThingSpeak (Or any other cloud service) Arduino, LM35 and ESP8266.

- Connection of LM35 with Arduino board (which is already connected to internet/intranet with the help of ESP8266)

- Setting up a cloud-based account (Thingspeak etc.) or any other IoT cloud service / server.

- Write and upload an Arduino temperature data logger program using LM35, given IoT cloud service and ESP8266.

- View and verify the temperature logs on the IoT cloud service.

Group C [Any one project implementation and documentation**]**

7. **Home Automation:**

IoT-based home automation

- Connection of relays with Arduino board (which is already connected to internet/intranet with the help of ESP8266)

- Writing cloud based or local executable code (i.e., plain html code) to communicate with the above Arduino board.

- Execute the above code to send the ON/OFF control commands via internet/intranet to the relays connected to different pins of the Arduino board which ultimately will switch ON/OFF the electrical/electronic appliances.

8. **Street Light Control**

IoT Based Street Light Control

- Connection of LDR and relays (connected to street lights) with Arduino board (which is already connected to internet/intranet with the help of ESP8266)

- Writing cloud based or local executable code (i.e., plain html code) to communicate with the above Arduino board.

- Execute the above code to sense the ambient light near the street light and if it is less/greater than the predefined threshold level then sends the ON/OFF control commands via internet/intranet to the relays connected to different pins of the Arduino board which ultimately will switch ON/OFF the street lights

9. **Speed Control of DC Motor**

IoT based Speed Control of DC Motor with PWM signals

- Connection of L293D motor driver (connected to and DC motor) with Arduino board (which is already connected to the internet/intranet with the help of ESP8266)

- Writing cloud-based or local executable code (i.e., plain HTML code) to communicate with the above

Arduino board.

- Executing the above code to send the instructions to the above Arduino board which in turn generates PWM signals to be fed to the motor driver and hence control the speed of the DC motor.

10. **Selecting any project from the list and implementing it.**

  - **Documents list**

    - Planning and Research

    - Components Survey and selection.

    - Hardware Assembly

    - Software Development

    - Integration and testing of project.

    - Presentation of the project.

CO318: System Software Lab

Teaching Scheme		Examination Scheme	
Lectures:	2 Hrs. / Week	**OR Exam:**	25 Marks
Credits:	1	**TW:**	**Marks**
		Total:	25 Marks

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Prerequisite Course: System Software, Computer Organization and Architecture, Data Structures

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Course Objectives:

1. To learn and understand Lexical and Syntax Analysis

2. To get familiar with tools like LEX & YACC.

3. To understand the Intermediate code forms and generate Intermediate Code for given input statement

4. To understand design of two pass assembler.

5. To learn and understand design of two pass macroprocessor.

Course Outcome (COs): On completion of the course, students will be able to-

Course Outcomes	Bloom's Taxonomy	
	Level	**Descriptor**
1. Use LEX tool to generate lexical analyzer	3	Apply
2. Use YACC tool to generate syntax analyzer	3	Apply
3. Use YACC specifications to implement semantic analysis	3	Apply
4. Use LEX and YACC specifications to generate Intermediate code in various forms	3	Apply
5. Design and Understand Two Pass Assembler	3	Apply
6. Design and Understand Two Pass Macroprocessor	3	Apply

Mapping of Course Outcomes to Program Outcomes (POs) & Program Specific Outcomes (PSOs):

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	2	2	2	3	-	-	-	-	-	-	1	2	1	-

CO2	1	2	2	2	3	-	-	-	-	-	-	1	2	1	-
CO3	1	2	2	2	3	-	-	-	-	-	-	1	2	1	-
CO4	1	2	2	2	3	-	-	-	-	-	-	1	2	1	-
CO5	1	2	3	2	3	-	-	-	-	-	-	1	2	1	-
CO6	1	2	3	2	3	-	-	-	-	-	-	1	2	1	-

Guidelines for Student

The laboratory assignments are to be submitted by students in the form of journal. Journal consists of Certificate, Table of Contents, and **Handwritten write-up** of each assignment (Title, Objectives, Problem Statement, Inputs and Outputs, Theory -Concept in brief, algorithm, flowchart, test cases, mathematical model (if applicable), conclusion/analysis). **Program codes with sample output of all performed assignments are to be submitted as softcopy**

Suggested List of Laboratory Assignments

4. Write a program using LEX specifications to implement lexical analysis phase of compiler to generate tokens of subset of 'C' program.
5. Write a LEX program to display word, character and line counts for a sample input text file
6. Write a program using YACC specifications to implement syntax analysis phase of compiler to validate type and syntax of variable declaration in C program.
7. Write a program using YACC specifications to implement syntax analysis phase of compiler to recognize simple and compound sentences given in input file.
8. Write a program to implement recursive descent parser(RDP) for sample language.
9. Write a program using YACC specifications to implement calulator to perform various arithmetic operations
10. Write a program using LEX and YACC to generate a symbol table
11. Write a program using LEX and YACC to generate Intermediate code in the form of Three addresss and Quadruple form for assignment statement
12. Study of data structures and algorithms used for design and implementation of pass-I and pass-II of a two-pass assembler for a pseudo-machine using OOP features.
13. Study of data structures and algorithms used for design and implementation of pass-I and pass-II of a two-pass macroprocessor using OOP features.
Books:

Text Books(T):
John Donovan, "System Programming", McGraw Hill, ISBN 978-0--07-460482-3.
Dhamdhere D., "Systems Programming and Operating Systems", McGraw Hill, ISBN 0 - 07 - 463579 – 4
John R. Levine, Tony Mason, Doug Brown, "Lex and Yacc", O'Reilly & Associates, Inc, ISBN:1-56592-000-7
Reference Books(R):
10. Alfred V.Aho,Monica S.Lam,Ravi Sethi, Jeffrey D. Ullman, "Compilers-Principles,Techniques and Tools", Pearson,ISBN:978-81-317-2101-8
11. Leland Beck, "System Software: An Introduction to Systems Programming", Pearson
12. Dick Grune, Bal, Jacobs, Langendoen, "Modern Compiler Design", Wiley, ISBN 81-265-0418-8

CO319: DATA MINING AND WAREHOUSIG LAB		

Teaching Scheme	Examination Scheme	
Practical: 2 Hrs./ Week	OR Exam:	50 Marks
Credits: 1	Total:	50 Marks

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Prerequisite Course: (if any) Database Management System

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Course Objectives:

1. To understand the fundamentals of Data Mining.

2. To identify the appropriateness and need of mining the data.

3. To learn the pre-processing, mining and post processing of the data.

4. To understand various Distant Measures techniques in data mining.

5. To understand clustering techniques and algorithms in data mining.

6. To understand classification techniques and algorithms in data mining.

Course Outcomes (COs):

On completion of the course, student will be able to–

CO No.	Title	Bloom's Taxonomy	
		Level	Descriptor
CO1	Apply basic, intermediate and advanced techniques to mine the data.	3	Apply
CO2	Analyze the output generated by the pre-processing of data.	2	Understand
CO3	Ability to explore the data warehouse and its design.	4	Analyze
CO4	Examine the hidden patterns in the data	4	Analyze
CO5	Apply the mining process by frequent pattern analysis techniques.	3	Apply
CO6	Demonstrate the Classification techniques for realistic data.	3	Apply

Mapping of Course Outcomes to Program Outcomes (POs) & Program Specific Outcomes (PSOs):

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	3	2	--	--	--	--	2	--	--	3	2	2
CO2	3	2	2	3	2	--	--	--	--	--	--	--	3	2	2
CO3	1	2	3	1	2	--	--	--	--	--	--	--	1	3	2

CO4	2	2	2	3	2	--	--	--	--	--	--	--	3	2	2
CO5	3	2	2	3	2	3	2	--	--	2	--	--	2	2	2
CO6	2	2	2	3	2	3	2	--	--	2	--	--	2	2	3

List of Assignments
1. Implement Data pre-processing tasks.
2. Implement Frequent pattern analysis using Apriori algorithm.
3. Implement Frequent pattern analysis using FP-Growth algorithm.
4. Visualize the Clusters Using Suitable tool (Weka).
5. Visualize the Decision tree classification algorithm Using Suitable tool (Weka).
6. Consider a suitable text dataset. Remove stop words, apply stemming and feature selection techniques to represent documents as vectors. Classify documents and evaluate precision, recall. (For Ex: Movie Review Dataset)
Books:
Text Books: (Max. 2-3 Books with details as per given example)
1. Luís Torgo, "Data Mining with R, Learning with Case Studies", CRC Press, Talay and Francis Group, ISBN9781482234893
2. Han, Jiawei Kamber, Micheline Pei and Jian, "Data Mining: Concepts and Techniques", Elsevier Publishers, ISBN:9780123814791, 9780123814807.
3. Mohammed J. Zaki, Wagner Meira Jr., "Data Mining and Analysis", Cambridge University Press, ISBN:9781316614808.
Reference Books:(Min. 04 Books with details as per given example)
1. Vipin Kumar, "Introduction to Data Mining", Pearson, ISBN-13: 978-0321321367 ISBN-10: 0321321367
2. Ikhvinder Singh, "Data Mining & Warehousing", Khanna Publishing House, ISBN-10: 9381068704, ISBN-13: 978-9381068700
3. Charu C. Aggarwal, "Data Mining: The Textbook", Springer, ISBN 978331914141-1, 978331914142-8
4. Ian H. Witten, Eibe Frank, "Data Mining: Practical Machine Learning Tool and Techniques", Elsevier Publishers, ISBN: 0-12-088407-0
5. Luís Torgo, "Data Mining with R, Learning with Case Studies", CRC Press, Talay and

Francis Group, ISBN9781482234893

6. Carlo Vercellis, "Business Intelligence - Data Mining and Optimization for Decision Making", Wiley Publications, ISBN: 9780470753866

CO320 : Creational Activity				
Teaching Scheme			**Examination Scheme**	
Practical:	2 Hrs. / Week	Termwork	50	
Credits:	1	Total	50	

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Prerequisite Course: Basic knowledge of Programming and Computer Systems
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Course Objectives:

1. To encourage students to be member of professional bodies/clubs/chapters.

2. To enhance mini project developed by students in the view of product development.

3. To validate and test enhanced mini project.

4. To motivate students for participation and interaction in extra-curricular or co- curricular activities.

Course Outcome (COs): On completion of the course, students will be able to-

CO	Course Outcomes	Bloom's Taxonomy	
		Level	Descriptor
CO1	**Understand** working of professional bodies and participate in events organized by such bodies.	2	Understand
CO2	**Analyze** implemented code and create a working product.	4	Analyze
CO3	**Apply** different testing methods and tools.	3	Apply
CO4	**Apply** their knowledge to participate in extra-curricular or co-curricular activities.	3	Apply

Mapping of Course Outcomes to Program Outcomes (POs) & Program Specific Outcomes (PSOs):

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	2	-	-	-	3	-	2	2	-	-	1	-	-	2
CO2	3	2	2	-	-	-	-	-	-	-	-	-	2	2	-
CO3	3	2	2	-	-	-	-	-	-	-	-	-	2	2	-
CO4	1	2	-	-	-	3	-	2	2	-	-	1	-	-	2

Subject Description:

- The course will acquaint students with a variety of technical activities and skills which help to develop their employability skills required for placement. The course will focus on skill and personality development of students.
- Course is divided in two categories i.e compulsory activities and elective activities organized in different buckets. From elective activities students have to select one bucket.
- Groups of students will be same as Semester-V Mini Project groups.

Guidelines

I] Compulsory Activities

1. Membership of Professional body (ex. CSI,IEEE etc) or Member of Coding groups like geeks for geeks and participation in at least one event organized by respective body.
2. Completion of project in view of product development.
3. Testing of Mini Project performed in SEM-V (Test cases with sufficient data set).

II] Group of students have to select one Bucket from Following

Bucket 1: Certification

Standard certification like salesforce, NPTEL, Coursera, AWS, SAP, any other certification or international certification which help to develop their employability skills required for placement.

Bucket 2: Publication

Publication of paper in reputed journal in association with expert faculty.

OR

Presentation and Publication in National or International conference.

Bucket 3: Achievement

State /National level winner in extra-curricular or co- curricular activities, which includes Sports, Arts, Coding or Hackathon Competition, Idea or Innovation.

Bucket 4: Product Development and Projects

End product development and Patent

OR

Winner in State or National project competition.

OR

Project Presented at National Level competition.

Bucket 5: Any other domain chosen by student in consult with faculty member.

MC321: Mandatory Learning Course-VI			
Teaching Scheme		Examination Scheme	
Lectures:	1 Hrs. / Week	In-Sem Exam:	-
Credits:	Non Credit	End-Sem Exam:	-
		Continuous Assessment:	-
		Total:	-

Each individual has behavior patterns that are shaped by the context of his or her past. Most often, adapting the behavior to the changing context of the reality a person lives in becomes difficult which may lead to the reduction in personal effectiveness and natural self-expression.

The main focus of this course is to equip the students with useful approaches to help in the deeper understanding of self and help individuals empower themselves to be the source of their own growth and development. The course will help students to learn effective communication skills, Group and team building skills and will help them learn the goal setting process and thus become more effective in achieving their goals.

The broader objective of this course is to make the students aware about the different facets of self and to help them learn skills to strengthen their inner capacities. So that they are able to understand themselves, think and act effectively, to be able to communicate in an effective manner and to learn to lead and to form an effective team.

The specific objectives, however, are as follows.

1. To help the students to understand their real self by recognizing different aspects of their self-concept that will lead to an increased self-confidence.
2. To train the students for communicating effectively in both formal as well as in informal settings.
3. To help the students to understand the importance of non-verbal aspects of effective communication.
4. To help the students to understand Emotion and emotional intelligence, Managing one's' own emotional reservoirs, effective dealing with emotions at work
5. To facilitate the students in understanding the formation and function of group and team and to help them to learn the skills of a successful leader.
6. To help the students in understanding and practicing the goal setting process by recognizing the importance of each step involved in goal setting.

The activities involved are designed to facilitate their career goal decision making. The activities to achieve the above objectives can be suggested as follows.

- Motivational lectures
- Group Discussions/activities
- Case Study
- Games/Stimulation Exercises
- Role-Playing
- Mindfulness training.

Suitable Technical / Non-Technical Activities finalized by Department: Department has flexibility to decide suitable activities.