

Academic Program - UG

Syllabus 2023-24

V & VI Semester B.E.

Computer Science and Engineering

ACADEMIC AUTONOMY



**SHRI DHARMASTHALA MANJUNATHESHWARA COLLEGE OF
ENGINEERING & TECHNOLOGY,
DHARWAD – 580 002**

(An Autonomous Institution approved by AICTE & Affiliated to VTU, Belagavi)

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SDM College of Engineering & Technology, Dharwad

It is certified that the scheme and syllabus for V & VI Semesters of UG program in Computer Science and Engineering is recommended by Board of Studies of Computer Science and Engineering Department and approved by the Academic Council, SDM College of Engineering & Technology, Dharwad. This scheme and syllabus will be in force from the academic year 2023-24 till further revision.

Principal

Chairman BoS & HoD

Department of Computer Science and Engineering

College Vision and Mission

Vision

To develop competent professions with human values

Mission

- To have contextually relevant Curricula.
- To promote effective Teaching Learning Practices supported by Modern Educational Tools and Techniques.
- To enhance Research Culture.
- To involve the Industrial Expertise for connecting Classroom contents to real-life situations.
- To inculcate Ethics and soft-skills leading to overall personality development.

QUALITY POLICY:

In its quest to be a role model institution, committed to meet or exceed the utmost interest of all the stake holders.

Core Values:

- Competency
- Commitment
- Equity
- Team work and Trust

DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING

VISION

To develop competent professionals in the field of Computer Science and Engineering with human values.

MISSION

1. To have contextually relevant curricula in line with industry trends and body of knowledge stated by IEEE/ACM.
2. To promote OBE based effective Teaching Learning Practices supported by modern educational tools and techniques.
3. To enhance research.
4. To involve the industrial expertise for connecting classroom contents to real-life situations.
5. To inculcate ethics and soft-skills leading to overall personality development.

Program educational Objectives (PEO)

- I. To prepare students for successful careers in Industry, Research and Institutions of higher learning
- II. To encourage students to work in teams to address industrial and socially relevant problems / projects.
- III. To provide students with a sound mathematical, scientific and engineering fundamentals necessary to formulate, analyse and solve engineering problems.
- IV. To promote student awareness and commitment to lifelong learning and professional ethics during the course of professional practice.

PROGRAMME OUTCOMES (POs) and Programme Specific Outcomes (PSOs)

Program Outcomes (POs):

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):

13. **System Inception and Elaboration:** Conceptualize the software and/or hardware systems, system components and process/procedures through requirement analysis, modeling /design of the system using various architectural / design patterns, standard notations, procedures and algorithms.
14. **System Construction:** Implement the systems, procedures and processes using the state of the art technologies, standards, tools and programming paradigms.
15. **System Testing and Deployment:** Verify and validate the systems, procedures and processes using various testing and verification techniques and tools.
16. **System Quality and Maintenance:** Manage the quality through various product development strategies under revision, transition and operation through maintainability, flexibility, testability, portability, reusability, interoperability, correctness, reliability, efficiency, integrity and usability to adapt the system to the changing structure and behavior of the systems /environments

**Scheme of Teaching and Examination
V Semester**

Course Code	Course Category	Course Title	Teaching		Examination				
			L-T-P (Hrs/Week)	Credits	CIE	Theory (SEE)		Practical (SEE)	
					Max. Marks	Max. Marks	Duration in Hrs.	Max. Marks	Duration In Hrs.
21UHUC520	HU	Management, Entrepreneurship and IPR	3-0-0	3	50	100	3	-	-
21UCSC500	PC	Database Management Systems	3-0-0	3	50	100	3	-	-
21UCSC501	PC	Object Oriented Modeling and Design Patterns	3-0-0	3	50	100	3	-	-
21UCSL502	PC	Database Management Systems Lab	0-0-2	1	50	-	-	50	2
21UCSL503	PC	Web Technology Lab	0-0-2	1	50	-	-	50	2
21UCSL504	PC	Minor Project – I	0-0-2	1	50	-	-	-	-
21UCSE5X X	PE	Program Elective – 1	3-0-0	3	50	100	3	-	-
21UAEE520	PC	Data Analysis and Visualization Tools	2-0-0	2	50	50	2	-	-
21UCSC512	PC	Web Technology	3-0-0	3	50	100	3	-	-
21UCSL513	PC	Internship – 1	Minimum 2 Weeks	1	50	-	-	-	-
Total			17-0-6	21	500	550		100	

Program Elective – 1:

Course Code	Course Category	Course Title	Teaching		Examination				
			L-T-P (Hrs/Week)	Credits	CIE	Theory (SEE)		Practical (SEE)	
					Max. Marks	Max. Marks	Duration in Hrs.	Max. Marks	Duration In Hrs.
21UCSE505	PE	Internet of Things	3-0-0	3	50	100	3	-	-
21UCSE506	PE	Unix Systems Programming	3-0-0	3	50	100	3	-	-
21UCSE507	PE	Mobile Applications Development	3-0-0	3	50	100	3	-	-
21UCSE508	PE	Operations Research	3-0-0	3	50	100	3	-	-
21UCSE509	PE	Computer Graphics	3-0-0	3	50	100	3	-	-
21UCSE510	PE	Advanced Graph Theory	3-0-0	3	50	100	3	-	-
21UCSE511	PE	System Modeling and Simulation	3-0-0	3	50	100	3	-	-

VI Semester

Course Code	Course Category	Course Title	Teaching		Examination				
			L-T-P (Hrs/Week)	Credits	CIE	Theory (SEE)		Practical (SEE)	
					Max. Marks	Max. Marks	Duration in Hrs.	Max. Marks	Duration In Hrs.
21UCSC600	PC	Computer Networks	3-0-0	3	50	100	3	-	-
21UCSC601	PC	Advanced Computer Architecture	3-0-0	3	50	100	3	-	-
21UCSC602	PC	Automata Theory and Compiler Design	3-0-0	3	50	100	3	-	-
21UCSE6XX	PE	Program Elective – 2	3-0-0	3	50	100	3	-	-
21UCSE6XX	PE	Program Elective – 3	3-0-0	3	50	100	3	-	-
21UCSO6XX	OE	Open Elective – 1	3-0-0	3	50	100	3	-	-
21UCSL603	PC	Computer Networks Lab	0-0-2	1	50	-	-	50	2
21UCSL604	PC	Automata Theory and Compiler Design Lab	0-0-2	1	50	-	-	50	2
21UCSL605	PC	Minor Project – 2	0-0-3	1	50	-	-	50	2
21UHUL606	HU	Soft Skills / Aptitude	0-0-2	1	50	-	-	-	-
Total			18-0-9	22	500	600		150	

Program Elective – 2:

Course Code	Course Category	Course Title	Teaching		Examination				
			L-T-P (Hrs/Week)	Credits	CIE	Theory (SEE)		Practical (SEE)	
					Max. Marks	Max. Marks	Duration in Hrs.	Max. Marks	Duration In Hrs.
21UCSE607	PE	Advanced Data Structures and Algorithms	3-0-0	3	50	100	3	-	-
21UCSE608	PE	Data Science	3-0-0	3	50	100	3	-	-
21UCSE609	PE	Natural Language Processing	3-0-0	3	50	100	3	-	-

Program Elective – 3:

Course Code	Course Category	Course Title	Teaching		Examination				
			L-T-P (Hrs/Week)	Credits	CIE	Theory (SEE)		Practical (SEE)	
					Max. Marks	Max. Marks	Duration in Hrs.	Max. Marks	Duration In Hrs.
21UCSE610	PE	Soft and Evolutionary Computing	3-0-0	3	50	100	3	-	-
21UCSE611	PE	Software Testing	3-0-0	3	50	100	3	-	-
21UCSE612	PE	Pattern Recognition	3-0-0	3	50	100	3	-	-

Open Elective – 1:

Course Code	Course Category	Course Title	Teaching		Examination				
			L-T-P (Hrs/Week)	Credits	CIE Max. Marks	Theory (SEE) Max. Marks Duration in Hrs.		Practical (SEE) Max. Marks Duration In Hrs.	
21UCSO613	OE	Cloud Computing	3-0-0	3	50	100	3	-	-
21UCSO614	OE	Ontology and Semantic Web	3-0-0	3	50	100	3	-	-

V Semester

21UHUC520 Management, Entrepreneurship, and IPR (3-0-0) 3

Contact Hours: 39

Course Learning Objectives (CLOs): This course focuses on the following learning perspectives:

- The evolution of managerial aspects like planning, organizing, decision making, and staffing.
- The scope of entrepreneurship in small, medium, and large scale industries.
- The issues related to intellectual property rights.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		Mapping to POs(1-12)/ PSOs (13-16)		
		Substantial Level (3)	Moderate Level (2)	Slight Level (1)
CO-1	Explain the characteristics of management in an organization.	11	-	9
CO-2	Describe the role of staffing and motivation in management.	-	1	-
CO-3	Explain the role of entrepreneur in building firms.	-	6	-
CO-4	Describe the importance of institutional support for an enterprise.	1	-	9
CO-5	Explain the contemporary issues related to intellectual property rights.	-	8	-

POs/PSOs	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Mapping Level	2.0	-	-	-	-	2.0	-	2.0	1.0	-	2.0	-	-	-	-	-

Pre-requisites: Knowledge of humanities course.

Contents:

Unit-I

Engineering and Management: Historical Development of Engineering and Management, Management as synthesis.

Planning, Forecasting and Decision Making: Nature of Planning, foundation of planning, some planning concepts, forecasting, nature of decision making, management science, tools for decision making. **7 Hrs**

Unit-II

Organizing and staffing: Nature of organizing, traditional organizational theory, technology and modern organization structures, staffing technical organization, authority and power; delegation, meeting and committees.

Motivation: Motivation, leadership, motivating and leading technical professionals.

Controlling: Process of control, financial and non-financial controls. **8 Hrs**

Unit-III

Foundations of Entrepreneurship: Meaning of entrepreneur, functions of entrepreneur, types of entrepreneur, concept of entrepreneurship, role of entrepreneurs in economic development & barriers of entrepreneurship.

Small Scale Industry: Definition, characteristics of SSI, role of SSI in economic development, advantages of SSI, steps to start an SSI, impact of liberalization, privatization, and globalization on SSI, definition of ancillary and tiny industry. **8 Hrs**

Unit-IV

Government and Institutional Support: Nature of support from government, objectives and functions of SSI, SIDBI, DIC, single window agency, KIADB, KSSIDC, KSFC.

Preparation of Project: Meaning of project identification, project report, contents and formulation, identification of business opportunities, feasibility studies, types and purpose. **8 Hrs**

Unit-V

Intellectual Property Rights: Meaning and forms of intellectual property rights, competing rationale for protection, international conventions and security.

Copyright: Meaning of copyright, content of copy right, ownership and rights, period of copyright, assignment and relinquishment of copyright, license, infringement of copy right, fair use, offenses and penalties.

Patents: Concept of patent, patentable inventions, procedure for obtaining patent, rights and obligations of patent holders, infringements and remedies, offenses and penalties.

Industrial Designs: Definition of design, procedure for registration, rights conferred by registration, infringements, Trademark and related issues. **8 Hrs**

Reference Books:

- 1) N.V.R. Naidu and T. Krishna Rao, "Management and Entrepreneurship", International Publishing House Pvt Ltd, 2008
- 2) Morse and Bobcock, "Managing Engineering and Technology", 5/E, PHI. India 2013.
- 3) Thomas.W.Zimmerer, "Essentials of Entrepreneurship", 2/E, PHI. India 2012.
- 4) N.K.Acharya, "Intellectual Property Rights", 4/E, Asia Law House, 2012.

21UCSC500	Database Management Systems	(3-0-0) 3
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Contact Hours: 39

Course Learning Objectives (CLOs): This course focuses on the following learning perspectives:

- Data models and relational theories
- Database design, programming using SQL/PL-SQL, database architecture and transaction concepts.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		Mapping to POs(1-12)/ PSOs (13-16)		
		Substantial Level (3)	Moderate Level (2)	Slight Level (1)
CO-1	Compare the traditional file system and Data Base approach	-	2,13	-
CO-2	Identify entities, attributes, their relationships and prepare ER model for the given application scenario.	2,3,13	-	15
CO-3	Write the queries using relational algebra for the given data manipulation requirement of an RDBMS.	2,3,13,14	-	15
CO-4	Write SQL queries using all the standard clauses, correlated queries, aggregate and date related functions for the given application scenario.	2,3,13,14	-	15

CO-5	Write triggers, stored procedures and functions for the given application scenario.	2,3,13,14	-	15
CO-6	Design database in appropriate normal form for a given application scenario.	2,3,13,14	-	15
CO-7	Explain the strategies to deal with the issues related to transaction management and to ensure ACID properties.		1,13	

POs/PSOs	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Mapping Level	2.0	2.8	3.0	-	-	-	-	-	-	-	-	-	2.7	3.0	1.0	-

Pre-requisites: Knowledge of

- Programming languages
- Set Theory
- File Systems
- Abstract application development process.

Contents:

Unit-I

Introduction: Introduction; An example; Characteristics of Database approach; Actors on the screen; Workers behind the scene; Advantages of using DBMS approach; A brief history of database applications; when not to use a DBMS. Data models, schemas and instances; Three-schema architecture and data independence; Database languages and interfaces; The database system environment; Centralized and client-server architectures;

Entity-Relationship Model: Using High-Level Conceptual Data Models for Database Design; An Example Database Application; Entity Types, Entity Sets, Attributes and Keys; Relationship types, Relationship Sets, Roles and Structural Constraints; Weak Entity Types; Refining the ER Design; ER Diagrams, Naming Conventions and Design Issues; Relationship types of degree higher than two. **8 Hrs**

Unit-II

Relational Model and Relational Algebra: Relational Model Concepts; Relational Model Constraints and Relational Database Schemas; Update Operations,

Transactions and dealing with constraint violations; Unary Relational Operations: SELECT and PROJECT; Relational Algebra Operations from Set Theory; Binary Relational Operations: JOIN and DIVISION; Examples of Queries in Relational Algebra; Relational Database Design ER-to-Relational Mapping. **8 Hrs**

Unit-III

SQL: Data Definition and Data Types; DDL statements like creation and specification of table, DCL statements for Schema change, alter, delete etc; DML statements like Insert, Delete and Update statements in SQL etc and more complex statements for Basic queries Nested sub queries, Correlated sub queries. PL/SQL; Specifying constraints as Assertion and Trigger; Views (Virtual Tables) in SQL; Additional features of SQL; Database programming issues and techniques; Embedded SQL, Dynamic SQL; Database stored procedures and SQL. **8 Hrs**

Unit-IV

Database Design – 1: Informal Design Guidelines for Relation Schemas; Functional Dependencies; Inference rule, Equivalence of sets, Minimal set cover. Normal Forms Based on Primary Keys; General Definitions of Second and Third Normal Forms; Boyce-Codd Normal Form. **8 Hrs**

Unit-V

Database Design – 2: Properties of Relational Decompositions; Dependency preservation, Lossless (non additive) join properties, Problem with null values and dangling tuples.

Transaction Management: The ACID Properties; Transactions and Schedules; Concurrent Execution of Transactions; Lock- Based Concurrency Control; Performance of locking; Transaction support in SQL; Introduction to crash recovery; 2PL, Serializability and Recoverability; Lock Management; Introduction to ARIES; The log; Other recovery-related structures; The write-ahead log protocol; Check pointing.

7 Hrs

Reference Books:

- 1) Elmasri & Navathe, “Fundamentals of Database Systems”, 6/E, Addison-Wesley, 2012.
- 2) Raghu Ramakrishnan & Johannes Gehrke, “Database Management Systems”, 3/E, McGraw-Hill, 2003.
- 3) Silberschatz, Korth and Sudharshan, “Data base System Concepts”, 6/E, Mc-Graw Hill, 2010.
- 4) C.J. Date, A. Kannan & S. Swamynatham, “An Introduction to Database Systems”, 8/E, Pearson Education, 2006.

21UCSC501 Object Oriented Modeling and Design Patterns (3-0-0) 3

Contact Hours: 39

Course Learning Objectives (CLOs): This is a 3 credit, 39 contact hours course at undergraduate level focusing on the process of object oriented system modeling, design, patterns and tools used in the industry to enable them to construct software system using various standards and techniques.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		Mapping to POs(1-12)/ PSOs (13-16)		
		Substantial Level (3)	Moderate Level (2)	Slight Level (1)
CO-1	Apply fundamental Object Oriented concepts	13, 14	1,2,3, 15	-

	ts in sol vin g pro ble ms.			
CO-2	An aly ze pro ble m sce nar io an d ide ntif y cla sse s/ Obj ect s, thei r pro per ties an d ass oci atio ns.	13	1,2 ,3, 5,1 5	-
CO-3	An aly ze pro ble m	13	1,2 ,3, 5,1 5	-

	sce nar io an d mo del the sys te m usi ng UM L dia gra ms.			
CO-4	Ev alu ate the qu alit y of Obj ect Ori ent ed sys te m in-t er ms of Co hes ion, cou plin g, suff icie	-	16	1 5

	ncy , co mpl ete nes s an d pri miti ven ess .			
CO-5	Im ple me nt Obj ect Ori ent ed mo del in any Obj ect Ori ent ed lan gu ag e.	13, 14	1,2 ,3	1 5
CO-6	Ide ntif y an d ap ply the ap	-	13, 16	1

	pro pri ate pat tern s in sol vin g pro ble ms.			
CO-7	Pr op os e the ap pro pri ate str ate gie s to inc orp ora te sta nd ard qu alit y par am ete rs in the des ign of	-	13, 16	1

	a sys te m.															
POs/PSOs	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Mapping Level	1.7	2.0	2.0	-	2.0	-	-	-	-	-	-	-	2.7	3.0	1.6	2.0

Pre-requisites: Knowledge of

- Object Oriented Programming Language (any)
- Software Engineering

Contents:

Unit-I

Review: Object Oriented Concepts and principles.

Introduction, modeling concepts, class modeling: Object Orientation, developments themes; Evidence for usefulness of developments; modeling history. Modeling as Design Technique: Modeling; abstraction; The three models. Class Modeling: Object and class concepts; Link and associations concepts; Generalization and inheritance; A sample class model; Navigation of class models; Practical tips.

7 Hrs

Unit-II

Advanced class modeling, state modeling: Advanced object and class concepts; Association ends; N-ary associations; Aggregation; Abstract classes; Multiple inheritance; Metadata; Reification; Constraints; Derived data; Packages; Practical tips. State Modeling: Events, States, Transitions and Conditions; State diagrams; State diagram behavior; Practical tips.

Advanced state modeling, interaction modeling: Advance state modeling: nested state diagrams; nested states; signal generalization; concurrency; a sample state model; relation of class and state models; practical tips. Interaction modeling: use case models; sequence models; activity models. Use case relationships; procedural sequence models; special constructs for activity models.

Evaluation: OO system quality in terms of Cohesion, coupling, sufficiency, completeness and primitiveness.

Implementation : OO design in appropriate language

8 Hrs

Unit-III

Patterns-Part 1: Introduction; layers, pipes and filters, blackboard. Distributed systems: broker; interactive systems: mvc, presentation-abstraction-control. **8 Hrs**

Unit-IV

Patterns–Part2: Adaptable systems: microkernel; reflection. Structural decomposition: whole - part; organization of work: master - slave; access control: proxy. Others: Command Processor, View Handler, Forward Receiver, Client-Dispatcher-Server and publish Subscriber. **8 Hrs**

Unit-V

Quality: Functionality and architecture; architecture and quality attributes; system quality attributes; Quality attribute scenarios in practice; Other system quality attributes; Business qualities; Architecture qualities. Achieving Quality: Introducing tactics; Availability tactics; Modifiability tactics; Performance tactics; Security tactics; Testability tactics; Usability tactics; Relationship of tactics to architectural patterns; Styles. **8 Hrs**

Reference Books:

- 1) Michael Blaha & James Rumbaugh, “Object-Oriented Modeling and Design with UML”, 2/E, Pearson Education, 2007.
- 2) Frank Buschmann, RegineMeunier, Hans Rohnert, Peter Sommerlad & Michael Stal, “Pattern-Oriented Software Architecture, A System of Patterns”, Volume 1, John Wiley and Sons, 2006.
- 3) Len Bass, Paul Clements & Rick Kazman, “Software Architecture in Practice”, 2/E, Pearson Education, 2003.
- 4) Grady Booch et al, “Object-Oriented Analysis and Design with Applications”, 3/E, Pearson Education, 2007.
- 5) Ali Bahrami, “Object oriented systems development”, McGrawHill, 1999.
- 6) Mary Shaw and David Garlan, “Software Architecture Perspectives on an Emerging Discipline”, Prentice-Hall of India, 2007.

21UCSL502	Database Management Systems Lab	(0-0-2)1
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Contact Hours: 24

Course Learning Objectives (CLOs): This laboratory course focuses on hands on experience on creation of data models, database design, programming using SQL/PL-SQL and development of an application using any high level language.

Course outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		Mapping to POs(1-12)/ PSOs (13-16)		
		Substantial Level (3)	Moderate Level (2)	Slight Level (1)
CO-1	Identify entities, attributes, their relationships and prepare ER model for the given problem.	2, 3, 13	-	15
CO-2	Design database in appropriate normal form for the given problem.	2,3,13	-	15
CO-3	Write SQL queries using all the standard clauses, correlated queries, aggregate and date related functions for the given application scenario.	2,3,13,14	-	15
CO-4	Write the programs using advanced features of data base programming that includes PL/SQL, Cursors, Triggers, Stored procedures and Functions for given application scenario.	2,3,13,14	-	15

POs/PSOs	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Mapping Level	-	3.0	3.0	-	-	-	-	-	-	-	-	-	3.0	3.0	1.0	-

Prerequisites: Registration for / Completion of: DBMS theory course

Contents:

Part A: Multiple standalone preparatory exercises to meet the course outcomes.

Part B: Project work (Standalone application or web enabled application) based on knowledge gained from theory course and part-A hands on experience.

21UCSL503	Web Technology Laboratory	(0-0-2) 1
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Contact Hours: 26

Course Learning Objectives (CLOs): This course emphasizes on practice-based learning. It enables the students to understand the web application architecture and use the state-of-the-art technologies to provide web-based solutions.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		Mapping to POs (1 to 12)/ PSOs (13 to 16)		
		Substantial Level (3)	Moderate Level (2)	Slight Level (1)
CO-1	Explain the fundamentals of web technology and develop static web pages using XHTML	13	14	1,5,9
CO-2	Explain the significance of CSS and its associated frameworks in designing web pages and develop web pages using CSS and its associated frameworks	13	14	1,5,9
CO-3	Design and develop an interactive web application using jQuery, XHTML and CSS	13	14	1,5,9
CO-4	Design and develop dynamic web applications using server-side programming and demonstrate database connectivity	13	14	1,5,9
CO-5	Explain the use of AJAX technology to interact with the server asynchronously and demonstrate the use of AJAX in web applications	13	14	1,5
CO-6	Explain the role of web services in representing the data in the standard formats as per the requirements	-	5	1
CO-7	Explain the future of World Wide Web and its associated technologies	-	5	1,12

PO's	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Mapping Level	1.0	-	-	-	1.5	-	-	-	1.0	-	-	1.0	3.0	2.0	-	-

Prerequisites: Registration/ completion of Web Technologies and Applications course

Suggested Platforms:

- Any text editor (like notepad, HTML editors, IDEs like Visual Studio code) etc
- Any simple framework for web development (like WAMP, XAMPP, etc)

Contents:

Minimum one exercise to cover each course outcome specified above. Minimum 5 experiments to be completed by each student independently covering all course outcomes defined for this course. Course teacher has to publish list of experiments along with individual outcome for every experiment, during the beginning of the semester. Examiner may set any problem based on the published term work during examinations.

Reference Books:

- 1) Robert W. Sebesta, Programming the World Wide Web, 7/E Pearson Education, 2014
- 2) Noel Rappin, Modern CSS with Tailwind: flexible styling without the fuss, 1st edition, The Pragmatic Bookshelf, 2021
- 3) Jonathan Chaffer, Karl Swedberg, Learning jQuery, Third Edition, Pack Publishing, 2011
- 4) Karin K. Breitman, Marco Antonio Casanova and Walter Truszkowski, Semantic Web: Concepts, Technologies and Applications, Springer International Edition, 2007
- 5) Nicholas C Zakas et al, Professional AJAX, Wrox Publication, 2007

21UCSL504

Minor Project - 1

(0-0-2)1

Contact Hours: 24

Course Learning Objectives (CLOs): This course enables the student to identify the community expectations in terms of possible engineering solutions and prepare project proposal.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		Mapping to POs(1-12) / PSOs (13-16)		
		Substantial Level (3)	Moderate Level (2)	Slight Level (1)
CO-1	Identify the societal problems.	-	2,6,7,9,12,13	-
CO-2	Analyze real environment and Formulate the problem statement.	-	2,9,12,13	-
CO-3	Conduct exhaustive literature survey	-	2, 9,12,13	-
CO-4	Propose sustainable engineering solutions / prototypes.	-	3,5,7,12,13	-
CO-5	Prepare the report and communicate effectively through presentation.	-	8,9,10,12	-
CO-6	Manage the project in terms of various resources in a particular discipline or in a multi-disciplinary domain.	-	11	-

POs	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Mapping Level	-	2.0	2.0	-	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	-	-	-

Guidelines for conduction:

1. Team consists of 4-5 students.
2. In consultation with guide, the team should carry out their project work.
3. Final evaluation is based on following evidence will be looked into and accordingly rubrics will be developed, such as problem statement, design, prototype/part of implementation, use of standard tools and techniques for testing and validation procedure.
4. This requires designated committee to monitor the process of conduction

21UAEE524 Data Analysis and Visualization Tools (2-0-0) 2

Contact Hours: 26

Course Learning Objectives (CLOs):This course focuses on to interpret data plots and understand visualization concepts, to explore the relationship between two

continuous variables using scatter plots and line plots, to translate and present data correlations in a simple way.

Course Outcomes (COs):

CO	Description of the Course Outcome: At the end of the course the student will be able to:	Mapping to POs(1-6)		
		Substantial level(3)	Moderate level(2)	Slight level(1)
CO-1	Appreciate of key concepts of data visualization	4	3	6
CO-2	Design effective data visualization for visual mapping	4	3	6
CO-3	Demonstrate skills on creating visual representation of data	4	3	6
CO-4	Understand visualization classification and its techniques	4	3	6
CO-5	Demonstrate skills in creating different types of representation	4	3	6

Mapping Level:

POs	1	2	3	4	5	6
Mapping Level	-	-	2	3	-	1

Pre-requisites: Knowledge of programming

Contents:

1. Introduction of visual perception, visual representation of data, Gestalt principles, information overloads **6Hrs**

2. Creating visual representations, visualization reference model, visual mapping, visual analytics, Design of visualization applications. **5Hrs**
3. Classification of visualization systems, Interaction and visualization techniques misleading, Visualization of one, two and multi-dimensional data, text and text documents **5Hrs**
4. Visualization of groups, trees, graphs, clusters, networks, software, Metaphorical visualization **5Hrs**
5. Visualization of volumetric data, vector fields, processes and simulations, Visualization of maps, geographic information, GIS systems, collaborative visualizations, evaluating visualizations **5Hrs**

Reference Books:

1. Ward, Grinstein Keim, Interactive Data Visualization: Foundations, Techniques, and Applications. Natick: A K Peters, Ltd, 1st Edition, 2010
2. Kieran Healy, Data Visualization: A Practical Introduction, 1st Edition, 2018
3. Andy Krik, Data Visualisation : A Handbook for Data Driven Design, 1st Edition, 2016

21UCSE505

Internet of Things

(2-0-2) 3

Contact Hours: 39 (26T + 13L)

Course Learning Objectives (CLOs): This course provides the basic understanding of IoT technology, communication protocols, sensor networks and its applications. It focuses on setting up IoT ecosystem to implement use cases by applying the key concepts of IoT.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		Mapping to POs(1-12)/ PSOs (13-16)		
		Substantial Level (3)	Moderate Level (2)	Slight Level (1)
CO-1	Explain the working of IoT and its enabling technologies.	-	5	1, 12
CO-2	Explain the use cases of IoT and the use of sensors & actuators in IoT ecosystem.	-	5	1, 12
CO-3	Compare and contrast IoT & M2M and explain the generic design methodology for IoT system.	-	5, 13	1, 12

CO-4	Develop IoT applications using Arduino by making use of sensors and modules.	13	14	1, 5, 9, 15
CO-5	Develop IoT applications using Raspberry Pi microcontroller by making use of sensors and modules.	13	14	1, 5, 9, 15

POs/PSOs	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Mapping Level	1.0	-	-	-	1.6	-	-	-	1.0	-	-	1.0	2.7	2.0	1.0	-

Pre-requisites: Knowledge of Programming and Basics of Computer Networking

Contents:

Unit-I

Introduction to Internet of Things (IoT): Introduction, Physical and Logical Design of IoT, IoT Enabling Technologies, IoT levels and Deployment templates **7 Hrs**

Unit-II

Domain Specific IoTs: Introduction, Home Automation, Cities, Environment, Energy, Retail, Logistics, Agriculture, Industry, Health & Lifestyle

IoT Sensors and Actuators: Introduction, IoT sensors, RFID, Video Tracking, IoT Actuators **8 Hrs**

Unit-III

IoT and M2M: Introduction, M2M, Difference between IoT and M2M, SDN and NFV for IoT

IoT Platforms Design Methodology: Introduction, IoT Design Methodology, Case Study on IoT System for Weather Monitoring **7 Hrs**

Unit-IV

Arduino Programming: Features of Arduino, Arduino UNO, Arduino IDE, Arduino sketch structure, Arduino function libraries, Blinking LED example; Operators, control statements, loops, arrays, string, interrupts, Traffic Control System example

Integration of Sensors, Actuators and modules with Arduino: Sensor Types, Sensor Interface with Arduino, Interfacing DHT, LM35, LDR, Accelerometer and HC-SR04 sensors with Arduino; Actuators, Types of Motor Actuators, Servo motor, Servo library on Arduino; HC05 Bluetooth module, Features, Interfacing HC05 with Arduino, Controlling LED using Bluetooth; ESP8266 wifi module, Features, Send

LM35 sensor data to cloud using wifi module
2L + 7P Hrs

Unit-V

Raspberry Pi: Introduction, Specifications, Basic Architecture, Pin configuration, Blinking LED example; Capture image using Raspberry Pi

Implementation of IoT with Raspberry Pi: Temperature dependent auto cooling system; interfacing DHT, LM35, LDR, Accelerometer and HC-SR04 sensors with Raspberry Pi; Send LM35 sensor data to cloud using wifi module. **2L + 6P Hrs**

Conduction of Practical Sessions:

Practical sessions shall include experiments on the following:

- 1) Use of Arduino board and coding to blink built-in as well as external LEDs
- 2) Interfacing temperature, humidity, soil moisture, light intensity, accelerometer, ultrasonic and obstacle detection sensors with Arduino and displaying the results
- 3) Connecting modules like Bluetooth and Wi-Fi to Arduino and sending the sensed data to cloud for storage and analytics.
- 4) Use of Raspberry Pi as a surveillance system

Reference Books:

- 1) Arshdeep Bahga, Vijay Madiseti ,“Internet of Things – A Hands-on Approach”, Universities Press, 2015
- 2) Ammar Rayes, Samer Salam, “Internet of Things From Hype to Reality – The Road to Digitalization”, Second Edition, , Springer Nature Switzerland AG 2017, 2019

Additional References:

- 3) NPTEL course on “Introduction to internet of things” by Prof. Sudip Misra

21UCSE506**UNIX Systems Programming****(3-0-0) 3****Contact Hours: 39**

Course Learning Objectives (CLOs): This course facilitates the students to get familiarity with system calls, UNIX kernel structure and use of standards like ANSI and POSIX in programming.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		Mapping to POs(1-12)/ PSOs (13-16)		
		Substantial Level (3)	Moderate Level (2)	Slight Level (1)
CO-1	Describe the AN SI and PO SIX standards used in UN IX operating	-	1	1 3

	sys tem and pro gra mm ing			
CO-2	Ex pla in the UN IX file typ es and de mo nst rat e the use of UN IX file API s in pro gra mm ing.	13, 14	1,2, 3	1 5
CO-3	Ide ntif y the pro ces s ma nag em ent	13, 14	1,2, 3	1 5

	activities of UNIX and write programs that make use of processes and their environment.			
CO-4	Describe the use of signals in UNIX and illustrate the use of	13, 14	1,2, 3	1 5

	sig nal s in pro gra ms.			
CO-5	Ex pla in the nee d of dae mo ns in UN IX and ide ntif y the use of dae mo ns in UN IX OS .	13, 14	1,2, 3	1 5
CO-6	Ex pla in inte r pro ces s co mm uni cati	13, 14	1,2, 3	1 5

	on mechanisms of UNIX and wri te programs to demonstrate IPCs for client-server interactions.			
CO-7	De scribe the ANSI and POSIX standards used in UN	-	1	13

	IX ope rati ng sys tem and pro gra mm ing.															
POs/PSOs	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Mapping Level	2.0	2.0	2.0	-	-	-	-	-	-	-	-	-	2.4	3.0	1.0	-

Pre-requisites: Knowledge of

- UNIX operating system and its commands
- Operating Systems Fundamentals
- Basics of Networking

Contents:

Unit-I

ANSI and POSIX Standards: UNIX and ANSI Standards – ANSI C standard, POSIX standards, POSIX environment, POSIX feature test macros, limits checking at compile time and run time; UNIX and POSIX APIs – POSIX APIs, UNIX and POSIX development environment, API common characteristics

UNIX Files: file types, UNIX and POSIX file systems, UNIX and POSIX file attributes, inodes in UNIX system V, UNIX kernel support for files, directory files, hard and symbolic links. **7 Hrs**

Unit-II

UNIX File APIs: General file APIs, open, read, write, close, fcntl, lseek, link, unlink, stat, fstat, lstat, access, chmod, fchmod, chown, fchown, lchown, utime, file and record locking, directory file APIs, device file APIs, FIFO file APIs, symbolic link file APIs. **7 Hrs**

Unit-III

Environment of a UNIX Process: Introduction, main function, process termination, command line arguments, environment list, memory layout of a C program, alloca

function, environment variables, setjmp and longjmp functions, getrlimit and setrlimit functions

Process Control: Introduction, process identifiers, fork function, vfork function, exit functions, wait and waitpid functions, race conditions, exec functions, changing user IDs and group IDs, system function. **9 Hrs**

Unit-IV

Process Relationships: Introduction, terminal logins, network logins, process groups, sessions, controlling terminal, job control

Signals and Daemon Processes: Signals – UNIX kernel support for signals, signal, signal mask, sigaction, sigsetjmp and siglongjmp APIs, kill, alarm, interval timers; Daemon Processes – introduction, daemon characteristics, coding rules, error logging, client-server model. **9 Hrs**

Unit-V

Interprocess Communication: Introduction, pipes, message queues, UNIX APIs for message queues, client-server example for message queue, sockets, socket APIs, client-server example for socket. **7 Hrs**

Reference Books:

- 1) Terrence Chan, "UNIX System programming using C++", Prentice Hall India, 2015
- 2) W. Richard Stevens, "Advanced Programming in the UNIX environment", Pearson Education/ PHI, 2005
- 3) Kay A Robbins & Steven Robbins, "Unix Systems Programming: Communication, Concurrency, and Threads", Prentice Hall Publications, 2003.

21UCSE507

Mobile Applications Development

(3-0-0) 3

Contact Hours: 39

Course Learning Objectives (CLOs): This course focuses on the following learning perspectives:

- Familiarize with mobile apps development aspects.
- Design and develop mobile apps, using Android as development platform, with key focus on user experience design, native data handling and background tasks and modifications.
- Appreciation of nuances such as native hardware play, location awareness, graphics, and multimedia.
- Perform testing, signing, packaging and distribution of mobile apps.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:	Mapping to POs(1-12)/ PSOs (13-16)
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		Substantial Level (3)	Moderate Level (2)	Slight Level (1)
CO-1	Explain the android platform architecture.	5,13	7	3
CO-2	Acquire the knowledge of UI components and life cycle of activity with respect to android platform.	5	4	13
CO-3	Design and develop apps using native data handling on-devices like file I/O, SQLite, and enterprise data access.	14	3,13	7
CO-4	Design and develop spruce apps to demonstrate the use of various components involved in android platform.	13,14	3,13	7
CO-5	Explain and apply use of testing tools to test mobile apps.	15	16	5
CO-6	Explain the concept of versioning and distributing apps to mobile market place.	14	5	16

POs/PSOs	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Mapping Level	-	-	1.6	2.0	2.3	-	1.3	-	-	-	-	-	2.2	3.0	3.0	1.5

Pre-requisites: Knowledge of Java (J2SE) and basic RDBMS.

Contents:

Unit-I

Getting started with Mobility: Mobility landscape, Mobile platforms, Mobile apps development, Overview of Android platform, setting up the mobile app development environment along with an emulator, a case study on Mobile app development. **7 Hrs**

Unit-II

Building blocks of mobile apps: App user interface designing – mobile UI resources (Layout, UI elements, Draw-able, Menu), Activity – states and life cycle, interaction amongst activities, App functionality beyond user interface – Threads, Async task, Services – states and life cycle, Notifications, Broadcast recievers, Telephony and SMS APIs, Native data handling – on device file I/O, shared preferences, mobile databases such as SQLite, and enterprise data access (via Internet/Intranet). **9 Hrs**

Unit-III

Sprucing up mobile apps: Graphics and animation – custom views, canvas, animation APIs, multimedia – audio/video playback and record, location awareness, and native hardware access (sensors such as accelorometer and gyroscope) **9 Hrs**

Unit-IV

Testing mobile apps: Debugging mobile apps, White box testing, Black box testing, and test automation of mobile apps, Junit for Android, Robotium, MonkeyTalk **7 Hrs**

Unit-V

Taking mobile apps to Market: Versioning, signing and packaging mobile apps, distributing apps on mobile market place. **7 Hrs**

Practical / Project work: Students should implement (and learn to use the tools to accomplish this task) the following during Practical hours:

1. Understand the app idea and design user interface/wireframes of mobile app.
2. Set up the mobile app development environment.
3. Develop and debug mobile app components – User Interface, Services, Notifications, Broadcast recievers, data components.
4. Usingemulator to deploy and run mobile apps.
5. Testing mobile app – unit testing, black box testing and test automation.

Reference Books:

- 1) Donn Felker, Joshua Dobbs, and Barry Burd, “Android Application Development for Dummies”, Wiley Publishing Inc, 2011
- 2) Reto Meier, “Professional Android 2 Application Development”, Wrox Publisher, 3rd Edition, 2012.

21UCSE508

Operations Research

(3-0-0) 3

Contact Hours: 39

Course Learning Objectives (CLOs): This course focuses on following learning perspectives:

- Apply the fundamental techniques (graphical method, simplex method, dual simplex method) of operations research to solve real world problems.
- Estimate the transportation and assignment costs.
- Design, code, test, and debug programs to solve problems in the domain of

operations research.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		Mapping to POs(1-12)/ PSOs (13-16)		
		Substantial Level (3)	Moderate Level (2)	Slight Level (1)
CO-1	Formulate real-world problems in the form of mathematical model and solve using graphical method.	-	2	1
CO-2	Formulate real-world problems in the form of mathematical model and solve using simplex and artificial variables techniques.	-	1,2,3	-
CO-3	Solve LP problems using dual simplex method and perform sensitivity analysis.	-	1,2,3	16
CO-4	Build Models to Solve Transportation and Assignment problems.	-	1,2	5,16
CO-5	Solve a given problem using game theory techniques.	-	1,2	5

POs/PSOs	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Mapping Level	1.8	2.0	2.0	-	1.0	-	-	-	-	-	-	-	-	-	-	1.0

Pre-requisites: Knowledge of

- Algebra
- Probability

Contents:

Unit-I

Introduction: Definitions and various phases of operations research, Role of computers in operations research, Formulating a problem as a mathematical model in the form of linear programming (LP) problem – Minimization and Maximization Types, Solving LP problems using Graphical method. **7 Hrs**

Unit-II

Simplex Method: Canonical and Standard forms of LP problem, The simplex method – examples, Artificial variables Techniques (Big M and Two Phase method) - examples. **7 Hrs**

Unit-III

Advanced Topics in Linear Programming: Duality, Dual Simplex Method, Economic interpretation of duality, Sensitivity analysis, Dynamic Programming. **9 Hrs**

Unit-IV

Transportation Model: Introduction, Formulation, Methods for Initial Basic Feasible solution, Improving the basic feasible solution using Stepping Stone and MODI methods.

Assignment Model: Introduction, Formulation, Comparison with transportation model, Hungarian method. **9 Hrs**

Unit-V

Game Theory: Introduction, Formulation, Strategies – Pure and Mixed, Methods for solving Game theory problems – Saddle point, Rule of Dominance, Arithmetic method, Graphical method. **7 Hrs**

Reference Books:

- 1) Er. Premakumar Gupta and Dr. D.S.Hira, “Operations Research”, S Chand Publications, 2014.
- 2) Frederick S. Hillier and Gerald J. Lieberman, “Introduction to Operations Research”, 8th Edition, Tata McGraw Hill, 2005.
- 3) Wayne L. Winston, “Operations Research Applications and Algorithms”, 4th Edition, Thomson Course Technology, 2003.
- 4) Hamdy A T, “Operations Research: An Introduction”, 9th Edition, Pearson Publishers, 2014

21UCSE509

Computer Graphics

(3-0-0) 3

Contact Hours: 39

Course Learning Objectives (CLOs): This course introduces fundamental principles of computer graphics, its architecture and how transformations of objects are carried out. It facilitates students to identify good design principles to solve challenges involved in simulating real world objects/conditions. It also provides the students to learn and apply the aspects of interaction with computer and exposes them to open-source tools like OpenGL.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		Mapping to POs(1-12) / PSOs(13-16)		
		Substantial Level (3)	Moderate Level (2)	Slight Level (1)
CO-1	Explain the principles of Computer Graphics Architecture used in industry relevant tool like OpenGL.	-	13,14	1,2,12
CO-2	Explain the design objectives of APIs used in OpenGL.	-	14,12	1,5
CO-3	Apply input interaction techniques used in graphics environment.	14	2	-
CO-4	Apply affine transformations to solve problems relating to object transformations.	13	14	1
CO-5	Discriminate the views of objects in parallel and perspective projections under various lighting conditions.	-	13	14
CO-6	Formulate mathematical strategies for scan conversion algorithms to realize basic primitives, and represent curve and surfaces.	13,14	-	1,12

POs/PSOs	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Mapping Level	1.0	1.5	-	-	1.0	-	-	-	-	-	-	1.3	2.5	2.1	-	-

Pre-requisites: Knowledge of

- Basic Engineering Graphics
- Linear Algebra (Scalars, Vectors, Matrices)
- Algorithms and C programming.

Contents:

Unit-I

Introduction : Applications of computer graphics; A graphics system; Images: Physical and synthetic; Imaging systems; The synthetic camera model; The programmer's interface; Graphics architectures; Programmable pipelines; Performance characteristics. Graphics Programming: The Sierpinski gasket; Programming two dimensional applications

Input and Interaction: Interaction; Input devices; Clients and servers; Display lists; Display lists and modeling; Programming event-driven input; Menus; Picking; A simple CAD program; Building interactive models; Animating interactive programs; Design of interactive programs; Logic operations. **9 Hrs**

Unit-II

Geometric Objects and Transformations: Scalars, points, and vectors; Coordinate systems and frames; Modeling a colored cube; Affine transformations; Rotation, translation and scaling; Transformations in homogeneous coordinates; Concatenation of transformations; Interfaces to three-dimensional applications. **9 Hrs**

Unit-III

Viewing and Lighting : Classical and computer viewing; Viewing with a computer; Positioning of the camera; Simple projections; Projections in OpenGL, Hidden surface removal; Parallel-projection matrices; Perspective-projection matrices.

OpenGL: Introduction to OpenGL; Programming two-dimensional Application; The OpenGL API; Primitives and Attributes; Color; Control Functions. **7 Hrs**

Unit-IV

Basic Raster Graphics Algorithms for drawing 2D primitives : Scan converting lines, circles, Filling Rectangles, Polygons; Clipping in a raster world; Clipping lines, polygons; Anti-aliasing **7 Hrs**

Unit-V

Lighting and Shading: Light and matter; Light sources; The Phong lighting model.

Representing Curves and Surfaces: Parametric Cubic Curves – Hermite Curves, Bézier Curves. **7 Hrs**

Conduction of Practical Sessions: Practical Sessions to be held with the focus of learning Open Source Tools like OpenGL and its API features. For the successful completion of the course, students are expected to undertake project to explore advanced features of Open Source Tools like OpenGL.

Reference Books:

- 1) Edward Angel, “Interactive Computer Graphics A Top-Down Approach with OpenGL”, 5th Edition, Addison-Wesley, 2008
- 2) James D Foley, Andries Van Dam, Steven K Feiner & John F Hughes, “Computer Graphics Principles and Practice”, 2nd Edition, Addison-Wesley, 1997.
- 3) Edward Angel & Dave Shreiner, “Interactive Computer Graphics A Top-Down Approach with Shader-Based OpenGL”, 6th Edition, Addison-Wesley, 2012
- 4) F.S. Hill, Jr., “Computer Graphics Using OpenGL”, 2nd Edition, Pearson Education, 2005
- 5) Donald Hearn and Pauline Baker, “Computer Graphics- OpenGL Version”, 2nd Edition, Pearson Education, 2003

21UCSE510

Advanced Graph Theory

(3-0-0) 3

Contact Hours: 39

Course Learning Objectives (CLOs): This course focuses on following learning perspectives:

- Isomorphism, Connected and Disconnected Graphs.
- Spanning trees and Cutsets.
- Planarity of Graphs.
- Chromatic Number and Polynomial.
- Directed Graphs.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		Mapping to POs(1-12)/ PSOs (13-16)		
		Substantial Level (3)	Moderate Level (2)	Slight Level (1)
CO-1	Determine whether the two graphs are isomorphic or not.	-	1,2	-
CO-2	Prove the properties of trees, cutsets and determine the spanning trees of a graph.	-	2,13	1
CO-3	Determine the planarity and dual of a graph.	-	2,13	1
CO-4	Determine the chromatic polynomial and chromatic number of a graph.	-	2,13	1
CO-5	Explain the principles of directed graphs and represent the digraphs in different forms.	-	2,13	1

POs/PSOs	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Mapping Level	1.0	2.0	-	-	-	-	-	-	-	-	-	-	2.0	-	-	-

Pre-requisites: Knowledge of Discrete Mathematical Structures.

Contents:

Unit-I

Introduction to Graphs: Definition, Finite and Infinite Graphs, Incidence and Degree, Isolated vertex, Pendant Vertex, and Null graph.

Paths and Circuits: Isomorphism, Subgraphs, Walks, Paths, and Circuits, Connected and Disconnected Graphs, Operations on Graphs, Euler graphs, Hamiltonian Paths and Circuits **8 Hrs**

Unit-II

Trees and Fundamental Circuits: Trees, Fundamental properties of trees, Pendant vertices in a tree, Distance and Centres in a tree, Rooted and Binary trees, Spanning Trees, Finding all spanning trees in a graph, Spanning trees in a weighted graph, The matrix – tree theorem.

Cutsets: Introduction, Properties, All cutsets in a graph, Fundamental circuits and cutsets, The Chinese Postman problem. **8 Hrs**

Unit-III

Planar and Dual Graphs: Introduction to Planar graphs, Kuratowski's two graphs, Different representations of a Planar graph, Detection of Planarity, Geometric Dual.

8 Hrs

Unit-IV

Coloring: Chromatic number, Chromatic Partitioning, Chromatic Polynomial, Matchings, Coverings, The Four Color Problem, Brooks Theorem. **7 Hrs**

Unit-V

Directed Graphs: Definition, Types of Digraphs, Binary Relations, Directed Paths and Connectedness, Euler Digraphs, Trees with Directed Edges, Fundamental Circuits in Digraphs, Matrices A,B, and C of Digraphs, Adjacency matrix of Digraph, Random graphs. **8 Hrs**

Reference Books:

1. Narasingh Deo, "Graph Theory with Applications to Engineering and Computer Science", Dover Publications Inc 2016.
2. R. Balakrishnan & K. Ranganathan, "A Text Book of Graph Theory", 1st Edition, Springer Publications, 2000
3. Ralph P. Grimaldi "Discrete and Combinatorial Mathematics", 5th Edition, Pearson Education. 2006.
4. Kenneth H. Rosen "Discrete Mathematics and its Applications", 7th Edition, McGraw Hill, 2012.

Course Learning Objectives (CLOs): This course focuses on following learning perspectives:

- To introduce students to basic simulation methods and tools for modelling and simulation of continuous, discrete and combined systems.
- The ability to analyze a system and to make use of the information to simulate various systems to improve the performance.
- Analytical methods (Markov Models and Queuing Networks) and simulation techniques (Monte Carlo Techniques and Event Driven Simulation) applied in performance modelling of communication systems and networks.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		Mapping to POs(1-12) / PSOs (13-16)		
		Substantial Level (3)	Moderate Level (2)	Slight Level (1)
CO-1	Conceptualize the discrete system simulation with the aid of real time examples.	-	5,13	1,2,3,15
CO-2	Write a program to simulate a given scenario.	-	5,13,14	1,2,3,15
CO-3	Apply different statistical models available in simulation and their usage in specific applications.	-	5,13,14	1,2,3,15
CO-4	Design the queuing systems and evaluate the performance.	-	5,13	1,2,3,15
CO-5	Identify the distribution of data to adhere to fitness test and also analyze the corresponding simulation.	-	5,13	1,2,3,15

POs/PSOs	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Mapping Level	1. 0	1. 0	1. 0	-	2. 0	-	-	-	-	-	-	-	2. 0	2. 0	1. 0	-

Pre-requisites: Knowledge of Probability and Statistics

Contents:

Unit-I

Introduction: When simulation is the appropriate tool and when it is not appropriate; Advantages and disadvantages of Simulation; Areas of application; Systems and

system environment; Components of a system; Discrete and continuous systems; Model of a system; Types of Models; Discrete-Event System Simulation; Steps in a Simulation Study. Simulation examples: Simulation of queuing systems; Simulation of inventory systems; other examples of simulation. General Principles. **7 Hrs**

Unit-II

Concepts in Discrete-Event Simulation: The Event-Scheduling, Time-Advance Algorithm, World Views, Manual simulation Using Event scheduling; List processing.

7 Hrs

Unit-III

Statistical Models In Simulation: Review of technology and concepts; Useful statistical models; discrete distributions; Continuous distributions; Poisson process; Empirical distributions.

8 Hrs

Unit-IV

Queuing Models: Characteristics of queuing systems; Queuing notation; Long-run measures of performance of queuing systems; Steady state behavior of M/G/1 queue; Networks of queues.

8 Hrs

Unit-V

Input Modeling: Data Collection; Identifying the distribution with data; Parameter estimation; Goodness of Fit Tests; Fitting a non-stationary Poisson process; selecting input models without data; Multivariate and Time-Series input models.

Estimation of absolute performance: Types of simulations with respect to output analysis; stochastic nature of output data; Measures of performance and their estimation; Output analysis for terminating simulations; Output analysis for steady-state simulations.

9 Hrs

Reference Books:

- 1) Banks, John S. Carson II, Barry L. Nelson- David M. Nicol, "Discrete-Event System Simulation", 5th Edition, Pearson Education, 2013.
- 2) J. A. Sokolowski, C.M. Banks, "Principles of Modeling and Simulation: A multidisciplinary Approach", John Wiley & Sons Publications, 2011.
- 3) Sheldon M. Ross, "Simulation", 4th Edition, Elsevier, 2006.
- 4) D.S.Hira, "System Simulation", 2nd Edition, S.Chand Publications, 2008.

Course Learning Objectives (CLOs): This course emphasizes on practice-based learning. It enables the students to understand the web application architecture and use the state-of-the-art technologies to provide web-based solutions.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		Mapping to POs(1 to 12)/ PSOs (13 to 16)		
		Substantial Level (3)	Moderate Level (2)	Slight Level (1)
CO-1	Explain the fundamentals of web technology and develop static web pages using XHTML	13	14	1,5,9
CO-2	Explain the significance of CSS and its associated frameworks in designing web pages and develop web pages using CSS and its associated frameworks	13	14	1,5,9
CO-3	Design and develop an interactive web application using jQuery, XHTML and CSS	13	14	1,5,9
CO-4	Design and develop dynamic web applications using server-side programming and demonstrate database connectivity	13	14	1,5,9
CO-5	Explain the use of AJAX technology to interact with the server asynchronously and demonstrate the use of AJAX in web applications	13	14	1,5
CO-6	Explain the role of web services in representing the data in the standard formats as per the requirements	-	5	1
CO-7	Explain the future of World Wide Web and its associated technologies	-	5	1,12

PO's	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Mapping Level	1.0	-	-	-	1.5	-	-	-	1.0	-	-	1.0	3.0	2.0	-	-

Prerequisites: Knowledge of:

- Any programming language
- Basics of database management systems

Contents:

Unit-I

Fundamentals of Web: Introduction to the Internet, The World Wide Web, Web Browsers, Web Servers, Uniform Resource Locators, Multipurpose Internet Mail Extensions, The Hypertext Transfer Protocol, The Web Programmer's Toolbox

3hrs

Introduction to XHTML:Origins and Evolution of HTML and XHTML, Basic Syntax, Standard XHTML Document Structure, Basic Text Markup, Images, Hypertext Links, Lists, Tables, Forms, Syntactic Differences between HTML and XHTML

5hrs

Unit-II

Cascading Style Sheets:Introduction, Levels of Style Sheets, Style Specification Formats, Selector Forms, Property Value Forms, Font Properties, List Properties, Color, Alignment of Text, The Box Model, Background Images, The and <div> Tags, Conflict Resolution**4hrs**

Tailwind CSS: Tailwind basics, typography, the Box, page layout, responsive design
3 hrs

Unit-III

jQuery: Getting Started- what jQuery does, why jQuery works, jQuery powered web-page, Plain JavaScript vs. jQuery; Selecting Elements- The Document Object Model, The \$() function, CSS selectors, custom selectors, DOM traversal methods, accessing DOM elements; Handling events- performing tasks on page load, simple events, compound events, journey of an event, the event object, removing an event handler; Manipulating the DOM- manipulating attributes, DOM tree manipulation, copying elements, content getter and setter methods, DOM manipulation methods

8hrs

Unit-IV

Introduction to PHP: Origins and uses of PHP, Overview of PHP, General Syntactic Characteristics, Primitives, Operations, and Expressions, Output, Control Statements, Arrays, Functions, Pattern Matching, Form Handling, Cookies, Session Tracking

Database access through the Web: Relational Databases, Architectures for Database Access, The MySQL Database System, Database Access with PHP and MySQL
9 hrs

Unit-V

Introduction to AJAX: Overview of Ajax, The Basics of Ajax, Return Document Forms
Introduction to Web 2.0: Overview of WWW 2.0, JSON, Web Services - SOAP & WSDL, RESTful
Future of Web: Overview of Semantic Web, Applications of Semantic Web, VirtualReality, Web OS
7 hrs

CTA activity:

As part of CTA activity, the student need to mandatorily work on simple use-case based project in a team (maximum 2 members per team) and demonstrate the working in front of evaluators.

Reference Books:

- 1) Robert W. Sebesta, Programming the World Wide Web, 7/E Pearson Education, 2014
- 2) Noel Rappin, Modern CSS with Tailwind: flexible styling without the fuss, 1st edition, The Pragmatic Bookshelf, 2021
- 3) Jonathan Chaffer, Karl Swedberg, Learning jQuery, Third Edition, Pack Publishing, 2011
- 4) Karin K. Breitman, Marco Antonio Casanova and Walter Truszkowski, Semantic Web: Concepts, Technologies and Applications, Springer International Edition, 2007
- 5) Nicholas C Zakas et al, Professional AJAX, Wrox Publication, 2007

21UCSL513	Internship - 1	(Minimum 2 Weeks) 1
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Contact Hours: 13

Course Learning Objectives (CLOs): Internship provides an opportunity to get industry exposure to real time scenarios that include professional skill development programs and adhere to the professional standards.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		Mapping to POs(1-12) / PSOs (13-16)		
		Substantial Level (3)	Moderate Level (2)	Slight Level (1)
CO-1	Apply the Technical knowledge in real industrial scenarios.	1, 8, 2,12	-	-
CO-2	Explain the social, economic and administrative considerations that influence the working environment of industrial organizations	3,5, 8, 13,12	11, 16	6, 7
CO-3	Inculcate Engineer's responsibilities and Professional ethics.	4,5, 8, 14,12	16	-
CO-4	Build technical reports and present the work carried out.	5, 8, 15,12	-	-

POs/PSOs	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Mapping Level	3.0	3.0	3.0	3.0	3.0	1.0	1.0	3.0	-	-	2.0	3.0	3.0	3.0	3.0	2.0

Internship Guidelines:

- Students are required to take up the internship in **offline** mode only.
- Students are **not permitted** to undergo internship in training institutes and non-technical organizations.
- Student need to obtain **NOC** (No Objection Certificate) from the head of the department and send it to the industry supervisor, who will approve and send the final acknowledgement letter to the students via Email/Post.

Evaluation Guidelines:

- **Evaluation by Industry:** Industry supervisor will evaluate overall performance of intern for 50 marks and will be considered as **CIE** marks.
- **SEE Evaluation through Seminar Presentation/VIVAVOCE at the institute**

The student will give a seminar based on his training report. The evaluation will be based on the following criteria:

- Quality of content presented.
- Proper planning for presentation.
- Effectiveness of presentation
- Depth of knowledge and skills.
- Attendance record,

Seminar presentation will enable sharing knowledge & experience amongst students & teachers and build communication skills and confidence in students.

21UCSL513

Soft Skills / Aptitude

(0-0-2) 1

Contact Hours: 24

Course Learning Objectives (CLOs):

This is included with the objectives of improving the communication skills, proficiency in English language and aptitude ability of the student to enhance the employability.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		Mapping to POs(1-12) / PSO(13-16)		
		Substantial Level (3)	Moderate Level (2)	Slight Level (1)
CO-1	Explain the significance of communication in the profession.	-	10	-
CO-2	Use the English language with proficiency	-	10	12
CO-3	Solve Aptitude related problems	-	9	12
CO-4	Demonstrate the competency in the placement activities.	-	9	-

POs	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Mapping Level	-	-	-	-	-	-	-	-	2.0	2.0	-	1.0	-	-	-	-

Contents:

Training on communication skills, proficiency in English language and aptitude ability involving the internal and external resource.

Evaluation:

Both the internal and external resource persons shall be engaged in imparting the related knowledge and shall have only CIE as the evaluation component. There shall be one test conducted at the end for 25 marks in Aptitude testing and there shall be one presentation by the student for 25 marks or any other suitable testing components. The arrangement for CIE evaluation is to be done by the department and maintain the relevant documents.

VI Semester

21UCSC600	Computer Networks	(3-0-0) 3
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Contact Hours: 39

Course Learning Objectives (CLOs): This course focuses on the following learning perspectives:

- Various network services and switching networks.
- Protocol design, implementation and performance issues.
- Various network management issues and possible remedies.
- Virtual networks for security issues in Internet Protocol (IP).

Course Outcomes (COs):

		Mapping to POs(1-12)/ PSOs (13-16)		
		Su bst ant ial Le vel (3)	M o d e r a t e L e v e l (2)	Sli ght Le vel (1)
Description of the Course Outcome: At the end of the course the student will be able to:				
CO-1	Ex pla in the co m	-	1 , 2 , 1 3	-

	mu nic ati on ser vic es, pro toc ols an d alg orit hm s of pa cke t-s wit chi ng net wo rks .			
CO-2	Ex pla in the wo rki ng of TC P/I P lay ere d mo del of co	4,5	1 , 2 , 1 3	14

	m mu nic ati on an d an aly ze the traf fic ma na ge me nt.			
CO-3	Ex pla in the iss ue s of int ern et rou tin g pro toc ols, VP N an d ov erl ay net wo	-	1 , 2 , 1 3	-

	rks .			
CO-4	Explain the working of ATM layered model of communication.	-	1, 2, 1, 3	-
CO-5	Explain the need of network management services, associate	4,5	1, 2, 1, 3	-

	d sec urit y iss ue s an d us e mo der n too ls to per for m net wo rk ma na ge me nt.																
POs/PSOs	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	
Mapping Level	2.0	2.0	-	3.0	3.0	-	-	-	-	-	-	-	2.0	1.0	-	-	

Pre-requisites: Knowledge of Operating Systems

Contents:

Unit-I

Communication Networks, Services, applications and layered architectures: Evolution of Network Architecture and Services: Telegraph Networks and Message Switching, Telephone Networks and Circuit Switching, and the Internet, Computer Networks and Packet Switching, examples of Protocols, Services, and Layering: HTTP, DNS, and SMTP, TCP and UDP Transport Layer Services; The OSI Reference Model: The seven layer OSI Reference Model, Unified View of Layers, Protocols, and Services

Overview of TCP/IP Architecture: TCP/IP Architecture, TCP/IP Protocol: How the layer work together, Protocol Overview; Application Layer Protocols and TCP/IP Utilities **8 Hrs**

Unit-II

Digital Transmission Fundamentals: Digital Representation of Information: Block-Oriented Information, Stream Information; Why Digital Communications ? : Comparison of Analog and Digital Transmission, Basic properties of Digital Transmission Systems; Digital Representation of Analog Signals: Bandwidth of Analog Signals, Sampling of an Analog Signal, Digital Transmission of Analog Signals; Characterization of Communication Channels: Frequency Domain Characterization, Time Domain Characterization; Fundamental Limits in Digital Transmission: The Nyquist Signaling Rate, The Shannon Channel Capacity; Line Coding ;Modems and Digital Modulation: Binary Phase Modulation, QAM and Signal Constellations, Twisted Pair, Coaxial Cable, Optical Fiber, Radio Transmission, Infrared Light; Error Detection and Correction: Error Detection, Two Dimensional Parity Checks, Internet Checksum, Polynomial Codes, Standardized Polynomial Codes, Error Detecting Capability of a Polynomial Code. **8 Hrs**

Unit-III

Circuit Switching Networks: Multiplexing: Frequency Division Multiplexing, Time Division Multiplexing, Wavelength-Division Multiplexing; SONET: SONET Multiplexing, SONET Frame Structure; Transport Networks: SONET Networks, Optical Transport networks; Circuit Switches: Space Division Switches, Time Division Switches; The Telephone Network: Transmission Facilities, End to End Digital Services. **8 Hrs**

Unit-IV

Packet-Switching Networks: Network services and internal network operations, Packet network topology, Datagrams and virtual circuits, Routing in packet networks, Shortest-path routing, ATM networks. **8 Hrs**

Unit-V

Traffic management at the packet level: Traffic management at the flow level, Traffic management at the flow-aggregate level.

TCP / IP: TCP / IP architecture, The Internet protocol, User datagram protocol, Transmission control protocol. **7 Hrs**

Reference Books:

1. Alberto Leon – Garcia & Indra Widjaja, “Communication networks – Fundamental Concepts and Key Architecture”, 2nd Edition, Tata McGraw Hill, 2005.
2. Nader F.Mir, “Computer and Communication Networks”, 2nd Edition, Pearson Education, 2009
3. Behrouz A Forouzon, “Data Communications and Networking”, 10th Edition, Tata McGraw Hill, 2006
4. William Stallings, “Data and Computer Communication”, 8th Edition, Pearson Education, 2013.

21UCSC601

Advanced Computer Architecture

(3-0-0) 3

Contact Hours: 39

Course Learning Objectives (CLOs): This course focuses on the different computer architecture designs in the present scenario by considering performance parameters. Further, the concept of parallel processing and the relationship between parallelism and performance of different parallel architectures and software tools are emphasized. The concepts in memory hierarchy design and storage systems are also discussed.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		Mapping to POs(1-12) / PSOs (13-16)		
		Substantial Level (3)	Moderate Level (2)	Slight Level (1)
CO-1	Analyze the various performance characteristics of computer architectures with respect to theory of parallelism.	4	1	-
CO-2	Explain the working principles of processors, Memory hierarchy, Memory Consistency models.	-	3	2
CO-3	Analyze various cache memory organizations, identify the characteristics of shared memory organization and illustrate sequential and weak consistency models.	5	1	13,16
CO-4	Identify the generations of multi-computer architectures and	3	2	13,16

	Analyze the concept of message passing mechanisms.			
CO-5	Detect the instruction level parallelism and explain the role of compiler in exploitation of ILP.	2	3	1

POs/PSOs	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Mapping Level	1.6	2.0	2.5	3.0	3.0	-	-	-	-	-	-	-	1.0	-	-	1.0

Pre-requisites: Knowledge of

- Computer Organization
- High level Programming
- Assembly Language Programming

Contents:

Unit-I

Theory of Parallelism: Parallel Computer Models, The State of Computing, Multiprocessors and Multicomputer, Multi-vector and SIMD Computers, Program and Network Properties, Conditions of Parallelism, Program Partitioning and Scheduling, Program Flow Mechanisms, System Interconnect Architectures, Principles of Scalable Performance, Performance Metrics and Measures, Parallel Processing Applications, Speedup Performance Laws, Scalability Analysis and Approaches. **8 Hrs**

Unit-II

Hardware Technologies: Processors and Memory Hierarchy: Advanced Processor Technology, Superscalar and Vector Processors, Memory Hierarchy Technology **8 Hrs**

Unit-III

Bus, Cache, and Shared Memory: Bus Systems, Cache Memory Organizations, Shared Memory Organizations, Sequential and Weak Consistency Models.

Pipelining and Superscalar Techniques: Linear Pipeline Processors, Nonlinear Pipeline Processors, Instruction Pipeline Design, Arithmetic Pipeline Design **8 Hrs**

Unit-IV

Parallel and Scalable Architectures: Multiprocessors and Multi computers - Multiprocessor System Interconnects, Cache Coherence and Synchronization Mechanisms, Three Generations of Multi computers, Message-Passing Mechanisms. **8 Hrs**

Unit-V

Software for parallel programming: Parallel Program Development and Environments: Parallel Programming Environments, Synchronization and Multiprocessing Modes. Instruction and System Level Parallelism, Instruction Level Parallelism: Computer Architecture, Basic Design Issues, Problem Definition, Model of a Typical Processor, Compiler-detected Instruction Level Parallelism, Operand Forwarding, Reorder Buffer, Register Renaming, Tomasulo's Algorithm, Branch Prediction, Limitations in Exploiting Instruction Level Parallelism, Thread Level Parallelism. **7 Hrs**

Reference Books:

- 1) Kai Hwang and Naresh Jotwani, "Advanced Computer Architecture (SIE): Parallelism, Scalability, Programmability", 3rd Edition, McGraw Hill Education, 2015
- 2) John L. Hennessy and David A. Patterson "Computer Architecture: A quantitative approach" 5th Edition, Morgan Kaufmann, Elsevier 2013.
- 3) Richard Y.Kain, "Advanced Computer Architecture: A System's Design Approach", Pearson Publications, 2015
- 4) John D. Carpinelli, "Computer Systems Organization and Architecture", Pearson Publications, 2001

21UCSC602 Automata Theory and Compiler Design (3-0-0) 3

Contact Hours: 39

Course Learning Objectives (CLOs):

This is a 3 credit course at undergraduate level enabling the students to understand structure of a compiler, representation of patterns and syntax using lexical rules and grammars respectively, employ finite state machines to solve problems in computing. Understand working of parsers, translation schemes, code optimization and code generation.

Course Outcomes (COs):

CO	Description of the Course Outcome: At the end of the course, the student will be able to:	Mapping to POs/PSOs		
		Substantial	Moderate	Low
CO-1	Construct a finite automaton for a given pattern and explain its working principles.	-	1,2,3,13	-
CO-2	Write regular expressions for given patterns and explain different techniques and principles used.	-	1,2,3,13	-
CO-3	Explain the basic structure and working principles of phases of compiler.	-	13	1

CO-4	Write grammar for a given language specification and Design a parser based on the appropriate parsing technique and validate the design.	13	1,2,3,14	15
CO-5	Generate an optimized intermediate code.	-	1,2,3, 13	15
CO-6	Explain the working principles of various run time environments like stack allocation, heap management and garbage collection technique used in compiler.	-	1,2,3, 13	15
CO-7	Generate optimized code for the given intermediate code.	-	1,2,3, 13	15

POs	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Mapping Level																

Prerequisites: Knowledge of: Programming Language (any).

Contents:

Unit-I

Introduction to Finite Automata: The central concepts of Automata theory – Alphabet, Strings & Languages. Finite Automata: Deterministic Finite Automata (DFA), Non-Deterministic Finite Automata (NFA), Equivalence of NFA and DFA, FA with Epsilon (ϵ) transitions, Equivalence and Minimization of Automata

Regular Expressions and languages: Regular Expressions, Applications of Finite Automata and Regular Expressions.

8 Hrs

Unit-II

Context-Free Grammars (CFG) and Languages (CFL): Context-Free Grammars, Parse Trees, Applications of Context-Free Grammars, Ambiguity in Grammars and Languages.

Pushdown Automata (PDA): Definition of Pushdown Automata, The languages of a PDA,
Normal forms
for Context Free Grammar

Normal forms

8 Hrs

Unit-III

Introduction to Compilers: Different Phases of Compilers, Comparison of Compilers and Interpreters. Top-down Parsing: Predictive parser. Bottom-up Parsing: LALR parser

8 Hrs

Unit-IV

Intermediate Code Generation and Optimizations: Syntax-directed translation; Syntax-directed translation schemes, Variants of syntax trees; Three-address code; Types and declarations; Translation of expressions; Type checking; Control flow; Various techniques of machine independent optimization.

8 Hrs

Unit-V

Run-Time Environments: Storage Organization; Stack allocation of space; Access to non-local data on the stack; Heap management; Introduction to garbage collection.

Code Generation: Issues in the design of Code Generator; The Target language; Addresses in the target code; Basic blocks and Flow graphs; Optimization of basic blocks; A Simple Code Generator.

7 Hrs

Reference Books:

1. John E. Hopcroft, Rajeev Motwani, Jeffrey D. Ullman Introduction to Automata Theory, Languages and Computation, Pearson Education, 3/E, 2013.
2. Peter Linz, An Introduction to Formal Languages and Automata, Narosa Publishing House, 5/E, 2011.
3. Alfred V Aho, Monica S. Lam, Ravi Sethi, Jeffrey D Ullman, "Compilers- Principles, Techniques and Tools", 2/E, Addison-Wesley, 2007.
4. D.M.Dhamdhere, "System Programming and Operating Systems", 2nd revised edition, Tata McGraw - Hill, 2009 reprint.

21UCSL603	Computer Networks Lab	(0-0-2) 1
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Contact Hours: 12

Course Learning Objectives (CLOs): This course focuses on the following learning perspectives:

- Configuration of networking devices.
- Troubleshooting IPv4 and IPv6 Addressing
- DHCP and DNS Servers

Course Outcomes (COs):

<p>Description of the Course Outcome: At the end of the course the student will be able to:</p>	<p>Mapping to POs(1-12)/ PSOs (13-16)</p>
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		Su bst anti al Lev el (3)	Mo der ate Lev el (2)	S li gh t L e v e l (1)
CO-1	Co nfi gur e the Cis co net wor kin g dev ices like rout ers, swit che s, and hub s etc usi ng co mm and s.	13, 14	1,2, 3	5 , 1 5

CO-2	Si mul ate diff ere nt top olo gie s/n etw ork usi ng Cis co Pac ket Tra cer app licat ion.	13, 14	1,2, 3	5 , 1 5
CO-3	Ma nag e IP add res ses and trou ble sho otin g	13, 14	1,2, 3	5 , 1 5
CO-4	Ma nag e app licat ion s like We b,	13, 14	1,2, 3	5 , 1 5

	Em ail, DH CP, DN S and FT P.			
CO-5	Stu dy on Ind ustr y rele van t tool s to perf orm traff ic ma nag em ent.	13, 14	1,2, 3	5 , 1 5
CO-6	Wri te C pro gra m usi ng RF Cs to imp lem ent sta nda rd	13, 14	1,2, 3	5 , 1 5

	prot oco l usi ng TC P / IP.															
POs/PSOs	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Mapping Level	2.0	2.0	2.0	-	1.0	-	-	-	-	-	-	-	3.0	3.0	1.0	-

Pre-requisites: Knowledge of Data Communication and Computer Networks (registration).

Contents:

Sl. No.	Term Work
T1	<p>Building a Simple Network: Part 1: Set Up the Network Topology (Ethernet only) Part 2: Configure PC Hosts Part 3: Configure and Verify Basic Switch Settings</p> <p>Learning Outcomes: [CO-1,2]</p>
T2	<p>Connecting a Wired and Wireless Part 1: Connect to the Cloud Part 2: Connect Router0 Part 3: Connect Remaining Devices Part 4: Verify Connections Part 5: Examine the Physical Topology</p> <p>Learning Outcomes: [CO-1,2]</p>
T3	<p>Troubleshooting IPv4 and IPv6 Addressing Part 1: Troubleshoot First Issue Part 2: Troubleshoot Second Issue Part 3: Troubleshoot Third Issue</p> <p>Learning Outcomes:[CO-2,3]</p>
T4	<p>Configuring IPv6 Addresses on Network Devices Part 1: Set Up Topology and Configure Basic Router and Switch Settings</p>

	<p>Part 2: Configure IPv6 Addresses Manually Part 3: Verify End-to-End Connectivity</p> <p>Learning Outcomes:[CO-2,3]</p>
T5	<p>Designing and Implementing a Subnetted IPv4 Addressing Scheme Part 1: Design a Network Subnetting Scheme Part 2: Configure the Devices Part 3: Test and Troubleshoot the Network</p> <p>Learning Outcomes:[CO-1,2,3]</p>
T6	<p>Web and Email Part 1: Configure and Verify Web Services Part 2: Configure and Verify Email Services</p> <p>Learning Outcomes:[CO-3,4]</p>
T7	<p>DHCP and DNS Servers Part 1: Configure Static IPv4 Addressing Part 2: Configure and Verify DNS Records</p> <p>Learning Outcomes:[CO-3,4]</p>
T8	<p>FTP Servers Part 1: Configure FTP Services on Servers Part 2: Upload a File to the FTP Server Part 3: Download a File from the FTP Server</p> <p>Learning Outcomes:[CO-3,4]</p>
T9	<p>Troubleshooting Connectivity Issues The objective of this Packet Tracer activity is to troubleshoot and resolve connectivity issues, if possible. Otherwise, the issues should be clearly documented and so they can be escalated.</p> <p>Learning Outcomes:[CO-1,2,3,4]</p>
T10	<p>Study on Industry relevant tools to perform traffic management.</p> <p>Learning Outcomes:[CO-5]</p>
T11	<p>Write C program using RFCs to implement standard protocol using TCP / IP.</p> <p>Learning Outcomes:[CO-6]</p>

Course Learning Objectives (CLOs): This laboratory course focuses on representation of patterns and syntax using lexical rules and grammars respectively, Implementation of parser & translation schemes, Implementation of assemblers, loaders, linkers & macro processor, Knowledge of system level APIs for implementation of IPC and system commands.

Course outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		Mapping to POs(1-12)/ PSOs (13-16)		
		Substantial Level (3)	Moderate Level (2)	Slight Level (1)
CO-1	Prepare the grammar for the given constructs and Write a program using compiler writing tools to implement lexical analyzer and parser.	13,14	1,2,3	15
CO-2	Write a program to implement a parser.	13,14	1,2,3	15
CO-3	Write a program to implement assembler functions.	13,14	1,2,3	15
CO-4	Write a program to Implement various UNIX commands using system calls.	13,14	1,2,3	15
CO-5	Use IPC concepts in implementing communication protocol.	13,14	1,2,3	15

POs/PSOs	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Mapping Level	2.0	2.0	2.0	-	-	-	-	-	-	-	-	-	3.0	3.0	1.0	-

Prerequisites: Knowledge of: Unix Operating System, Any programming language, and Finite automata and formal Languages

Contents:

1. Programs on Lex and Yacc.
2. Implementation of parser.
3. Implementation of assembler.
4. Emulation of basic commands of UNIX using system calls.
5. Application development using Inter Process Communication.

21UCSL605

Minor Project - 2

(0-0-2) 1

Contact Hours: 24

Course Learning Objectives (CLOs): Though the specific objectives of this course depend on the Project chosen, below are the generic objectives of this course:

Understand the domain, Analyze through Modeling and Implementation through state of the art technology available. To know Software Engineering Principles: Modeling, Estimation, Design standards and architectural issues through use of Standards etc. Also, write modular programs and handle exceptions to provide reliable solutions, to test and verify the programs for different scenarios.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		Mapping to POs(1-12)/ PSOs (13-16)		
		Substantial Level (3)	Moderate Level (2)	Slight Level (1)
CO-1	Identify and formulate the problem	11, 12	1,2,	6,7

	e m .			
CO-2	A n a l y z e th e pr o bl e m sc e n ar io a n d D e s i g n th e so lut io ns to co m pl ex e n gi n e er	11,1 2, 1	2,3, ,8,1	6,7

	in g pr o bl e m us in g so ft w ar e e n gi n e er in g pr in ci pl es or a p pr o pr iat e re se ar ch m et h o d			
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	ol o gy			
CO-3	I d e n t i f y a n d I m p l e m e n t a f e a s i b l e s o l u t i o n u s i n g a p p r o p r i a t e t e c h n o l o g y	11,1 2,14	3,4, ,8,1	-

	to ol s, pr oc e d ur es a n d te ch ni q u es .			
CO-4	V er if y a n d V al id at e th e pr o p os e d sy st e m fo r	11,1 2,15	5,8, 6	-

	co rr ec tn es s a n d to d e m o n s t r a t e c o m p l i a n c e w i t h t e d e s i g n a n d h e n c e t h e s t a t e d			
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	re q u i r e m e n t s/ r e s e a r c h g a p.																		
CO-5	Pr e p a r e t h e r e p o r t a n d c o m m u n i c a t e e f f e c t i v e l y t h r o u g h p r e s e n t a t i o n.	10, 1	8,9	-															
POs/PSOs	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16			

Mapping Level	2.0	2.0	2.0	2.0	2.0	1.0	1.0	2.0	2.0	3.0	3.0	3.0	3.0	3.0	3.0	2.0
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- Prerequisites:** Knowledge of
- Software Engineering concepts
 - Any Programming Language

Guidelines for the Conduction of Project Work:

A project may belong to any of the following categories:

- 1. Learning Centric:** Here the output of the project activity is enhancement of the student's knowledge. Here the student chooses a work with the intension to gain the knowledge.
- 2. Application:** Traditional Software Engineering project, with appreciable complexity. Scenario of demonstration had to be made clear and Completeness is important.
- 3. Product Base:** The final output is a novel one which may be the assembly of several existing subsystems. Completeness is important till the user manual.
- 4. Research Oriented:** A research problem of student's interest. Achievement would be a publication in the IEEE/ACM international/national conferences.

General Instructions to Students:

- Students are expected to perform extensive literature survey, identify problem statements and prepare synopsis in consultation with project guide/supervisor. Students are expected to submit Synopsis- Initial (Registration Phase-1) approved by project guide, to the project coordinator as per the schedule notified. A copy is to be maintained with students and the guide. This registration/ Initial synopsis contains the description of the project concept created and acts as a base line for design and Implementation of the system.
- Notification/schedules and evaluation procedures will be sent to all students in the Google groups created in the department.
- Batch size is of maximum 4 students. Mixing of divisions is not permitted unless it is the sponsored/research project and request is initiated by project supervisor/guide.
- Students may approach the faculty members of CSE department for choosing them as project guide/supervisor.

- A teacher can guide/supervise maximum of 2 UG project groups. However in special case, a DUGC (Project Coordinating Team, **PCT**, working on the behalf of DUGC) may assign additional project groups to a given teacher.
- The department will financially support presentations of publication of paper only for reputed conference publications.
- DUGC/Project coordinating team (**PCT**) may be consulted for any other/ missing information.

Evaluation Procedures:

- a) CIE Marks for the project is to be awarded by project guide/supervisor and SEE marks are to be awarded by examiners (appointed by DUGC) and PCT based on the overall guidelines and project classifications/rubrics by looking into Software Engineering aspects & usefulness w.r.t research/innovation/technology/industry trends through formal interactions and presentations. However, each team is expected to give a formal complete presentation of their work at the end of each phase (1 to 4) to project coordinating team (PCT).
- b) PCT evaluates the work and suggest the corrections and observation. All project teams are expected to incorporate these changes in their work. These observations will be made available to Project guides and SEE examiners, which will help them to evaluate and award marks during assessment process.
- c) Project guides should keep track of all interactions they do with project team members on weekly basis.
- d) All Projects are evaluated and individual students are awarded a grade based on the grading criteria set.
- e) Individuals' grade/marks is decided based on both CIE and SEE marks/grade.
- f) A project is considered for possible award of S grade; if and only if its 'research outputs' / 'product innovation outputs' results in to a publication of a paper. In a special case, innovative or sponsored business applications with focus on recent technological trends/ Industry trends catering for societal needs may be considered. If contents of paper/research output are not at satisfactory level, then, the assessment results in to appropriate lower grades.
- g) A project is considered for possible award of A grade; if and only if it demonstrate product development skills in core system or systems level applications using all aspects of software engineering product development phases like: requirements, design, implementation, testing including standards like: use of design/architectural patterns, coding standards, use of tools for design/testing, programming practices, documentation and reporting etc... In a special case, innovative or sponsored business applications with focus on recent technological trends / Industry trends catering for societal needs may be considered.
- h) If project work contribution/ output is not at satisfactory level, then the assessment results @ appropriate lower grades. All grades/marks are awarded based on individual contributions evaluated from software engineering perspectives **specified in the rubrics.**
- i) Expected important features:

- Report preparation using Latex.
- Online plagiarism check report is to be enclosed in the report.
- Use of IEEE standard. Ex: reference listing and use of PPTs for presentation etc...
- Use of software tools. Ex: for Design, version control, UI design, Testing etc...
- Conduction of workshop/ training on technology/domain to students and Preparation of training material/manual (.doc & .pdf).
- Publication of paper based on outcome of the project.
- Submission of proposal to KSCST (Govt. of Karnataka) or other agencies for funding.
- Any other features suggested by guides/coordinators from time to time.

j) Marks Weightage and Various parameters for project evaluation for both CIE and SEE level @ 6th Semester.

k)

Sl.No.	Parameter for Assessment	Marks (%)
1	Requirements Analysis (SRS): Abstract and Detailed.	20
2	Design Specification; Use of: UML diagrams, architecture diagram, ER diagram, Patterns etc... Proper cohesiveness and coupling of various components in the system design.	35
4	Use of Tools and standards.	5
5	Implementation: Code documentation, style, robustness, maintainability, Testability, Usability (User Experience) etc...	10
6	Testing: for every scenario of all use cases identified.	10
7	Final Oral Presentation (viva-voce) (IEEE Standards for slides, oral presentation techniques etc...)	10
8	Project Reports- Final and Intermediate if any: preparation using LATEX and plagiarism check	10

Note:

1. Sufficient and completeness of each parameter is to be seen while awarding marks for individual students.
2. Marks for individual students in a given project team may vary based on individuals 'learning outcomes.

- All project teams are expected to participate in the project exhibition arranged at department level. Project teams are expected to share their project experience to all their juniors and motivate them to take-up challenging work as their project work. During project exhibition, Top 2 projects from the batch will be awarded with a certificate of appreciation at the end of academic year.

21UCSL606

Soft Skills / Aptitude

(0-0-2) 1

Contact Hours: 24

Course Learning Objectives (CLOs):

This is included with the objectives of improving the communication skills, proficiency in English language and aptitude ability of the student to enhance the employability.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		Mapping to POs(1-12) / PSO(13-16)		
		Substantial Level (3)	Moderate Level (2)	Slight Level (1)
CO-1	Explain the significance of communication in the profession.	-	10	-
CO-2	Use the English language with proficiency	-	10	12
CO-3	Solve Aptitude related problems	-	9	12
CO-4	Demonstrate the competency in the placement activities.	-	9	-

POs	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Mapping Level	-	-	-	-	-	-	-	-	2.0	2.0	-	1.0	-	-	-	-

Contents:

Training on communication skills, proficiency in English language and aptitude ability involving the internal and external resource.

Evaluation:

Both the internal and external resource persons shall be engaged in imparting the related knowledge and shall have only CIE as the evaluation component. There shall be one test conducted at the end for 25 marks in Aptitude testing and there shall be one

presentation by the student for 25 marks or any other suitable testing components. The arrangement for CIE evaluation is to be done by the department and maintain the relevant documents.

21UCSE607 Advanced Data Structures and Algorithms (3-0-0) 3

Contact Hours: 39

Course Learning Objectives (CLOs): This course focuses on following learning perspectives:

- Asymptotic and Amortized Analyses
- Linear sorting algorithms
- Advanced data structures such as Heaps, B-trees, Red-Black trees etc.
- String matching algorithms

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		Mapping to POs(1-12) / PSOs (13-16)		
		Substantial Level (3)	Moderate Level (2)	Slight Level (1)
CO-1	Analyze the performance of the given algorithm using asymptotic notations and amortized techniques.	-	1,2	-
CO-2	Explain the working and assumptions of linear sorting methods and apply them to solve a given problem.	-	2,13	1
CO-3	Compare the working of string matching algorithms and use them appropriately in developing applications.	-	2,13	1
CO-4	Build and perform the operations on heap structures.	-	2,13	1
CO-5	Build and perform the operations on search structures.	-	2,13	1
CO-6	Use the hash tables for the implementation of dictionary operations.	-	2,13	1
CO-7	Choose the appropriate data structure and use relevant algorithms to solve problems in	-	2,13	1,11

	different domains including project management.			
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POs/PSOs	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Mapping Level	1.1	2.0	-	-	-	-	-	-	-	-	1.0	-	2.0	-	-	-

Pre-requisites: Knowledge of

- Programming language (any)
- Data Structures
- Algorithms

Contents:

Unit-I

Introduction to Complexity Analysis: Review of Asymptotic notations and their properties, Amortized analysis – Aggregate, Accounting and Potential methods.

Linear Sorts: Counting Sort, Bucket Sort, and Radix Sorting with Analysis for all algorithms. **8 Hrs**

Unit-II

String Matching: Naive algorithm; Rabin-Karp algorithm; String matching with Finite automata, KMP algorithm, Boyer-Moore algorithm. **8 Hrs**

Unit-III

Heap Structures: Binomial heaps, Fibonacci heaps.

Search Structures: 2-3 trees, 2-3-4 trees, B-trees, B⁺ trees, Red-black trees. **8 Hrs**

Unit-IV

Hashing: Direct Address Tables, Hash Tables, Collision Resolution by Chaining – Analysis, Hash Functions – Properties, Division and Multiplication methods, Universal Hashing, Open Addressing – Linear and Quadratic Probing, Double hashing. **8 Hrs**

Unit-V

Applications: Huffman coding, Garbage collection and compaction, Min-Cut Max-Flow algorithm, Activity networks. **7 Hrs**

Reference Books:

1. Thomas H.Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein-"Introduction to Algorithms", 3rd Edition, Prentice Hall India, 2009.
2. E. Horowitz, S.Sahni and Dinesh Mehta- "Fundamentals of Data structures in C++", Galgotia, 2006.
3. Anany Levitin, "Introduction to the Design and analysis of algorithms", 3rd Edition, Pearson Education, 2011

21UCSE608

Data Science

(3-0-0) 3

Contact Hours: 39

Course Learning Objectives (CLOs): This course is a 3 credit undergraduate course focusing on the data and types, data preprocessing. The details of R language are discussed to enable the students to perform data analytics. It also discusses the supervised and unsupervised learning.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		Mapping to POs(1-12)/ PSOs (13-16)		
		Substantial Level (3)	Moderate Level (2)	Slight Level (1)
CO-1	Explain the flow process for processing data science problems and the data types.	-	1, 2	13
CO-2	Apply the preprocessing methods to the raw data to make it available for analysis.	1, 2	-	-
CO-3	Use the R language to perform the data visualization and the analysis using fundamental statistical techniques.	3	-	12
CO-4	Explain the machine learning techniques.	-	1, 2	13
CO-5	Explain the unsupervised learning techniques.	-	1, 2	13

POs/PSOs	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Mapping Level	2.3	2.3	3.0	-	-	-	-	-	-	-	-	1.0	1.0	-	-	-

Pre-requisites: Knowledge of Statistics

Contents:

Unit-I

Introduction: Evolution, Roles, Stages in Data Science Project, Applications, Data Security and Privacy Issues

Data: Data types - Structured and Unstructured, Challenges with Unstructured data, Social media data, Multi modal data, Data Storage and Presentation **7 Hrs**

Unit-II

Data Preprocessing: Cleaning, Integration, Transformation, Reduction, Discretization.

Techniques: Correlation, Regression. Exploratory Analysis. **7 Hrs**

Unit-III

R Language: Basics, Control structures, Functions, Impoting Data.

Graphics and Data Visualization: Installing ggplot2, Loading the data, Plotting the Data.

Statistics and Machine Learning: Basic Statistics, Regression, Clustering **9 Hrs**

Unit-IV

Machine Learning: Introduction, Regression, Classification, Gradient Descent. **8 Hrs**

Unit-V

Unsupervised Learning: Introduction, Agglomerative Clustering, Reinforcement Learning **8 Hrs**

Reference Books:

- 1) Chirag Shah, "A Hands on Introduction to Data Science", Cambridge University Press, 2020
- 2) Laura Igual and Santi Segui, "Introduction to Data Science", Springer International Publications, 2017
- 3) Richord Cotton "Learning R", O'Reilly Publications, 2013.

21UCSE609 Natural Language Processing (3-0-0) 3

Contact Hours: 39

Course Learning Objectives (CLOs):

This course focuses on the concepts, techniques and applications of natural language processing and text mining.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		Mapping to POs(1 to 4)		
		Substantial Level (3)	Moderate Level (2)	Slight Level (1)
CO-1	Explain the Concepts of mathematics and linguistic foundations of natural language processing	-	3	6
CO-2	Perform the various processing on the words.	-	1	6
CO-3	Apply the formal relationships between words.	-	1	6
CO-4	Represent the meaning of the sentence and perform various semantic analysis.	-	1	5,6
CO-5	Explain the architecture and Operations of text mining.	-	1	6
CO-6	Explain and apply the text categorization and clustering techniques	-	1	5,6

POs	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6
Mapping Level	2	-	2	-	2	2

Prerequisites:

1. Basic knowledge on Mathematical foundation, Linguistic essentials
2. Knowledge of Finite Automata, Regular Expression and Grammar
3. Knowledge of Machine Learning Techniques.

Contents:

Unit-I

Introduction: Basics of Natural Language Processing, Mathematical Foundations, Linguistic Essentials, Corpus Based Work

Words: Collocations, Empirical Laws, Basics of Text processing, Morphology and Finite State Transducers, Probabilistic Models of Pronunciation and Spelling, N-grams, Maximum Entropy models, Random Fields

8 Hrs

Unit-II

Syntax: Word Classes and Part-of-Speech Tagging, Context Free Grammar for Languages, Parsing with Context Free Grammar, Markov Models, , Lexicalized and Probabilistic Parsing

8Hrs

Unit-III

Semantics: Distributional Semantics, Lexical Semantics, Topic Models, Word Sense Disambiguation, Methodological Preliminaries, Supervised & Unsupervised Disambiguation, Dictionary-Based Disambiguation, Latent Dirichlet Allocation for text classification, Latent Semantic Indexing, Probabilistic Latent Semantic Indexing

8Hrs

Unit-IV

Introduction to Text Mining: Overview of text mining, General Architecture, Core Operations, Preprocessing techniques, Document classification, Information extraction, Evaluation of performance, sentiment analysis

8 Hrs

Unit-V

Text Categorization: Machine Learning Approach to Text Categorization. Classification of Linked and Web Data, Text Clustering: Supervised and Unsupervised Clustering. Text Summarization Techniques.

8 Hrs

Reference Books:

1. Dan Jurafsky, James H Martin, Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics and Speech Recognition, Pearson Education India, 2nd edition (2013).
2. Christopher Manning "Foundations of Statistical Natural Language Processing," MIT Press, July 1999.
3. Kao, Anne, and Steve R. Poteet, eds. Natural language processing and text mining. Springer Science & Business Media, 2007.
4. Ronen Feldman, James Sanger "The Text Mining Handbook: Advanced Approaches in Analyzing Unstructured Data." Cambridge University Press, 2007.
5. Sholom Weiss, Nitin Indurkha, Tong Zhang, Fred Damerau "Text Mining Predictive Methods for Analyzing Unstructured Information," Springer, paperback 2010.

21UCSE611

Software Testing

(3-0-0) 3

Contact Hours: 39

Course Learning Objectives (CLOs): This course discusses the notations and terminologies used in software testing with Principles of programming, Software Development Process from the perspective of quality, maintenance, testing, programming style. Further, it focuses on System quality through: requirements, design, coding, verification and validation procedures and applications, case studies, use of tools / programming techniques for design and implementation.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		Mapping to POs(1-12) / PSOs (13-16)		
		Substantial Level (3)	Moderate Level (2)	Slight Level (1)
CO-1	Map inputs to the expected outputs of the system by understanding the system behavior represented in the form of: requirements and design specifications / Models.	1, 13	-	-
CO-2	Design test cases based on requirement specifications.	2, 14	1	-
CO-3	Design test cases based on traditional design specifications.	-	3, 13	-
CO-4	Design test cases based on Object specifications/Models (UML).	13	3	-
CO-5	Write script in any programming Language/Tools to implement test cases designed.	14	15	-
CO-6	Design test cases based on various testing strategies to check the correctness of computer program.	-	15, 13	-

POs/PSOs	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Mapping Level	2.5	3.0	2.0	-	-	-	-	-	-	-	-	-	2.5	3.0	2.0	-

Pre-requisites: Knowledge of

- Programming language
- Software Engineering
- Object Oriented System Analysis and Design

Contents:

Unit-I

Programming Practice: A Testing Perspective: Programming Principles & Guidelines, Coding Processes, Refactoring, Verifications & Metrics, Style- Names, Expression and Statements, Consistency and Idioms, Function Macros, Debugging, Performance, Portability

Basics of Software Testing: Human Errors and Testing, Software Quality, Requirements, Behavior and Correctness, Correctness versus Reliability, Testing and Debugging, Test Metrics, Software and Hardware Testing, Testing and Verification, Defect Management, Execution History, Test generation Strategies, Static Testing. Model-Based Testing and Model Checking, Control-Flow Graph, Types of Testing, The Saturation Effect. **9 Hrs**

Unit-II

Test Generation from Requirements: Introduction; The Test-Selection Problem; Equivalence Partitioning; Boundary Value Analysis, Category-Partition Method, Cause-Effect Graphing, Test Generation from Predicates. **7 Hrs**

Unit-III

Dependence, Data Flow Models and Data Flow Testing: Definition-Use pairs; Data flow analysis; Classic analysis; From execution to conservative flow analysis; Data flow analysis with arrays and pointers; Inter-procedural analysis; Overview of data flow testing; Definition- Use associations; Data flow testing criteria; Data flow coverage with complex structures; The infeasibility problem. **7 Hrs**

Unit-IV

Structural Testing: Overview; Statement testing; Branch testing; Condition testing, Path testing; Procedure call testing; Comparing structural testing criteria; The infeasibility problem.

Test Case Selection and Adequacy Test Execution: Overview; Test specification and cases; Adequacy criteria; Comparing criteria; Overview of test execution; From test case specification to test cases; Scaffolding; Generic versus specific scaffolding; Test oracles; Self-checks as oracles; Capture and replay **9 Hrs**

Unit-V

Testing Object Oriented Software: Issues in Testing OO Software, Intra Class Testing, Testing with State Machine Models, Inter-Class Testing, Structural Testing of Class **7 Hrs**

Reference Books:

- 1) Brain W. Kernighan & Rob Pike, "The Practice of Programming", Pearson education, 2008.

- 2) Pankaj Jalote & Narosa, “An Integrated Approach to Software Engineering”, 3rd Edition Publishing House.
- 3) Edward Kit, “Software Testing in the Real World”, Pearson Education, 2006
- 4) Aditya P Mathur, “Foundations of Software Testing”, Pearson Education, 2008.
- 5) Mauro Pezze, Michal Young, John Wiley & Sons, “Software Testing and Analysis: Process Principles and Techniques”, 2008.

21UCSE612

Pattern Recognition

(3-0-0) 3

Contact Hours: 39

Course Learning Objectives (CLOs): This course focuses on the following learning objectives:

- Fundamentals of pattern recognition system
- Feature extraction and pattern classification algorithms.
- Unsupervised classification or clustering techniques
- Applications of pattern classification algorithm for a pattern recognition problem

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		Mapping to POs(1-12)/ PSOs (13-16)		
		Substantial Level (3)	Moderate Level (2)	Slight Level (1)
CO-1	Explain the basic structure and	-	1, 13	2, 3, 4

	inherent issues of the pattern recognition problems.			
CO-2	Apply feature types and classification techniques like Bayesian classifier and its der	-	1, 13	2, 3, 4

	ivative solutions in solving problems.			
CO-3	Compute the probability density using parametric, non-parametric and linear discriminant functions.	-	1, 13	2, 3, 4
CO-4	Distinguish	-	1, 13	2, 3, 4

	sh sup ervi sed lea rni ng me tho ds fro m the uns up ervi sed on es an d ap ply lea rni ng me tho ds to the cla ssif ier des ign.			
CO-5	Us e no n me tric me tho ds	-	1, 13	2, 3, 4

	to classify the models that can be described by logical rules.															
CO-6	Apply a suitable clustering method to solve a given problem.	-	1, 13	2,3, 4												
POs/PSOs	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Mapping Level	2.0	1.0	1.0	1.0	2.0	-	-	-	-	-	-	-	2.0	-	-	-

Pre-requisites: Knowledge of Statistics, Linear Algebra and Programming

Contents:

Unit-I

Introduction: What is pattern recognition? Pattern Recognition System; The Design Cycle; Learning and Adaptation. Clustering vs. Classification; Applications;

Features: Feature vectors - Feature spaces - Problem of feature identification Feature selection and feature extraction. **8 Hrs**

Unit-II

Bayesian Decision Theory: Introduction, Bayesian Decision Theory; Continuous Features, Minimum error rate classifiers, discriminant functions, and decision surfaces; The normal density; Discriminant functions for the normal density.

Maximum-Likelihood and Bayesian Parameter Estimation: Introduction; maximum-likelihood estimation; Bayesian Estimation; Bayesian parameter estimation: Gaussian Case, general theory; Hidden Markov Models.

8 Hrs

Unit-III

Non-Parametric Techniques: Introduction; Density Estimation; Parzen windows; K Nearest- Neighbor Estimation; The Nearest- Neighbor Rule; Metrics and Nearest-Neighbor Classification.

Linear Discriminant Functions: Introduction; Linear Discriminant Functions and Decision Surfaces; Generalized Linear Discriminant Functions; The Two-Category Linearly Separable case; Minimizing the Perception Criterion Functions; Relaxation Procedures; Non-separable Behavior; Minimum Squared-Error procedures; The Ho-Kashyap procedures. **8**

Hrs

Unit-IV

Support Vector Machines and Kernel based method: Introduction, obtaining the optimal hyperplane SVM formulation with slack variables; nonlinear SVM classifiers Kernel Functions for nonlinear SVMs; Mercer and positive definite Kernels. Support Vector Regression and ϵ -insensitive Loss function, examples of SVM learning. **8 Hrs**

Unit-V

Non-Metric Methods: Introduction; Decision Trees; CART; Recognition with Strings; Grammatical Methods.

Unsupervised Learning and Clustering: Introduction; Mixture Densities and Identifiability; Maximum-Likelihood Estimates; Application to Normal Mixtures; Unsupervised Bayesian Learning; Data Description and Clustering; Criterion Functions for Clustering. **7 Hrs**

Reference Books:

- 1) Richard O. Duda, Peter E. Hart, & David G. Stork, "Pattern Classification", 2nd Edition, Wiley-Interscience, 2012.
- 2) Earl Gose, Richard Johnsonbaugh, & Steve Jost, "Pattern Recognition and Image Analysis", Pearson Education, 2007.
- 3) V Susheela Devi & M NarsimhaMurthy, "Pattern Recognition - An Introduction", Universities Press, 2011.

21UCSO613

Cloud Computing

(3-0-0) 3

Contact Hours: 39

Course Learning Objectives (CLOs): This course focuses on the following learning objectives:

Understand the cloud computing paradigm. Recognize its various forms and implement some cloud computing features.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		Mapping to POs(1-12)/ PSOs (13-16)		
		Substantial Level (3)	Moderate Level (2)	Slight Level (1)
CO-1	Explain cloud computing philosophy & computing paradigms.	-	1,4	5
CO-2	Distinguish and demonstrate cloud service models and their risks.	-	2,4,5	-
CO-3	Explain and use SLA life cycle and agreement structure to build simple applications.	-	4,8	7

CO-4	Explain and build simple security models using cloud security principles.	-	1,2,4	5
CO-5	Develop and deploy cloud solution for the given application scenario.	1, 2, 3	4, 5	7

POs/PSOs	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Mapping Level	2.3	2.3	3.0	2.0	1.5	-	1.0	2.0	-	-	-	-	-	-	-	-

Pre-requisites: Knowledge of

- Operating Systems, Computer Architecture, Computer Networks & Web Technologies.
- Programming languages- Java, Web programming

Contents:

Unit-I

Introduction: Paradigms in Computing, Parallel Computing, Distributed Computing, Grid Computing, Service Computing; Service Oriented Architecture (SOA), Web Services. **7 Hrs**

Unit-II

Basics of Cloud Computing: Definition, Characteristics, Architecture, Components, Service Models, and Deployment Models.

Virtualization: Server, Storage, Network, Desktop Hypervisor, Virtual Machine, Multi-tenancy, Opportunities and Risks.

7 Hrs

Unit-III

Service Level Agreement (SLA): Definition, Types of SLA, SLA Life Cycle, Issues Related to Cloud SLA, SLA Frameworks: WS-Agreement, WSLA, WSOL, Slang, Bilateral Protocol; Translation of SLAs into Monitoring Specifications, Dynamic Creation of Monitoring Infrastructures, Penalty Management, Runtime Prediction.

7 Hrs

Unit-IV

Cloud Security: Cloud Security Fundamentals, Vulnerability Assessment, Security and Privacy in Cloud.

Cloud Computing Security Architecture: Identity Management and Access Control, Autonomic Security; VM Specific Security Techniques.

9 Hrs

Unit-V

Cloud Application Programming Models: Cloud File Systems: GFS and HDFS, BigTable, HBase and Dynamo; Map Reduce Programming Model, Hadoop: Hadoop Fundamentals, Hama and other Hadoop Related Services. Cloud Application Development Platforms: Xen Hypervisor, Amazon Web Service, Windows Azure, Google App Engine, Eucalyptus, Open Stack, Open Nebula.

9 Hrs

Experiments

1. Use of Cloud Web Services
2. Experiment on Cloud Storage using mobile
3. Explore Cloud platform like Amazon Web Service, Windows Azure, Google App Engine etc.

Reference Books:

1. A. T. Velte, "Cloud Computing - A Practical Approach", McGraw Hills 2010
2. Tanenbaum & V. Steen, "Distributed Systems: Principles and Paradigms", 2nd Edition, Pearson, 2015
3. David E.Y. Sarna, "Implementing and Developing Cloud Computing Applications", CRC Press, 2011
4. R. Krutz & R. D. Vines, "Cloud Security", Wiley-India, 2010
5. T. White, "Hadoop: The Definitive Guide", 4th Edition, O'Reilly Media, 2015
6. Judith Hurwitz, R.Bloor, M.Kanfman, F.Halper, "Cloud Computing for Dummies", Wiley India Edition
7. Rajkumar Buyya, James Broberg & Andrzej Goscinski, "Cloud Computing Principles and Paradigms", Willey 2014.
8. Dan C Marinescu, "Cloud Computing Theory and Practice", Elsevier (MK), 2013.

Course Learning Objectives (CLOs): This course focuses on following learning perspectives:

- Theoretical and practical aspects of ontology in semantic web.
- Concepts of RDF and web ontology language.
- Various patterns for developing and reusing ontologies.
- Models for knowledge management architecture in semantic web.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		Mapping to POs(1-12)/ PSOs (13-16)		
		Substantial Level (3)	Moderate Level (2)	Slight Level (1)
CO-1	Explain the working principles, architecture of semantic web and the importance of markup languages.	1	-	-
CO-2	Design and analyze ontologies using web ontology language.	-	3	-
CO-3	Apply the logic with web ontology language.	15	-	5
CO-4	Analyze scalable architectures and semantic web services.	-	2	-
CO-5	Explain the evolution of ontologies with semantic interpretation of information.	-	12	-

POs/PSOs	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Mapping Level	3.0	2.0	2.0	-	1.0	-	-	-	-	-	-	2.0		-	3.0	-

Pre-requisites: Knowledge of HTML and Java

Contents:

Unit-I

The semantic web vision: Today's web, Semantic web Technologies, A layered approach, Structured web documents in XML, Introduction to RDF, RDF syntax, RDF schema, Axiomatic statements for RDF and RDF schema, Direct inference system on RDF and RDF schema.

9 Hrs

Unit-II

Ontology and Web ontology Language: Introducing OWL, Discovering the Various Species of OWL, Exploring the Foundations of OWL Understanding OWL Essentials, Making Simple Assertions, Inconsistency, Examining Property Characteristics, Complex Classes, Understanding Why OWL Is Different, Developing OWL Ontologies.

8 Hrs

Unit-III

Ontology building and inference by logic: Monotonic rules syntax and semantics, Nonmonotonic rules syntax, Rule markup in XML, Constructing and reusing ontologies, Semantic web knowledge management architecture, Querying using SPARQL, Jena ontology API, Reasoners.

8 Hrs

Unit-IV

Ontology scalable architectures and Discovering the semantic web services: Discovering the Roles, Creating Semantics for Enterprise Systems, Scaling Semantic Web Tools, Patterns of Architectural Usage and Application development using OWL API.

7 Hrs

Unit-V

Ontology evolution and Semantic knowledge: Ontology population and enrichment, Semantic representation of multimedia content, Ontology based semantics extraction from text and Images. A survey of semantic image and video annotation tools, Overview of linked data.

7 Hrs

Reference Books:

1. Grigoris Antoniou and Frank van Harmelen, "A Semantic Web Primer", 2nd Edition, MIT Press, Cambridge, MA 2008
2. Jeffrey T. Pollock, "Semantic Web For Dummies", Wiley Publishing, Inc 2009
3. John Hebel, Matthew Fisher, Ryan Blace, & Andrew PerezLopez, "Semantic Web Programming", Wiley Publishing, Inc.
4. Georgios Paliouras, Constantine Spyropoulos, & George Tsatsaronis (Eds.) "KnowledgeDriven Multimedia Information Extraction and Ontology Evolution", Springer, 2011