Academic Program - UG

Syllabus 2025-26

V & VI Semester B.E.

Computer Science and Engineering

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 2025-26 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 fundamental 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.

SDM COLLEGE OF ENGINEERING AND TECHNOLOGY, DHARWAD

Department of Computer Science and Engineering

V Semester

Scheme of Teaching and Examinations 2025 – 26

Sl No	Course	Course Code	Course Title	Teaching Department	Teaching Hrs/Week			Examination				Credits
					Lecture	Tutorial	Practical	Duration in Hrs	CIE Marks	SEE Marks	Total Marks	
					L	T	P					
1	HSMS	22UCSC500	Software Engineering and Project Management	CSE	3	0	0	03	50	100	100	3
2	PCC	22UCSC501	Database Management Systems	CSE	4	0	0	03	50	100	100	4
3	PCC	22UCSC502	Computer Networks	CSE	4	0	0	03	50	100	100	4
4	PEC	22UCSE5XX	Program Elective Course – I	CSE	4	0	0	03	50	100	100	4
5	PCCL	22UCSL503	Python Programming Laboratory	CSE	0	0	2	03	50	50	100	1
6	PCCL	22UCSL504	Database Management Systems Laboratory	CSE	0	0	2	03	50	50	100	1
7	PROJ	22UCSL505	Minor Project-I	CSE	0	0	4	-	50	50	100	2
8	MC	22URMK506	Research Methodology and IPR		2	0	0	02	50	50	100	2
9	MC	22UESK507	Environmental studies	CH	1	0	0	01	50	50	100	1
10	HSMS	22USSK508	Soft Skills-I		0	0	2	-	50	-	50	Audit
11	MC	22UPYK509	Physical Education and Yoga	PE&Y	0	0	2	-	50	-	50	Audit
Total											1000	22
Program Elective Course –I												
12	PEC-I	22UCSE521	Internet of Things	CSE	3	0	2	03	50	100	100	4
13	PEC-I	22UCSE522	Operations Research	CSE	4	0	0	03	50	100	100	4
14	PEC-I	22UCSE523	Digital Image Processing	CSE	4	0	0	03	50	100	100	4

HSMS: Humanity and management Science course, PCC: Professional Core Course, PCCL: Professional Core Course laboratory, AEC: Ability Enhancement course, MC: Mandatory Course, L: Lecture, T: Tutorial, P: Practical, CIE: Continuous Internal Evaluation, SEE: Semester End Evaluation. K: This letter in the course code indicates common to all the stream of engineering. PEC: Program elective course, PROJ: Project. TD: Teaching department, PSB: Paper setting Board.
Professional Elective Courses (PEC): A professional elective (PEC) course is intended to enhance the depth and breadth of educational experience in the Engineering and Technology curriculum. Multidisciplinary courses are added supplement the latest trend and advanced technology in the selected stream of engineering. Each group will provide an option to select one course.
Minor-Project-I: The students are expected to identify the state-of-the-art technology in his/her domain of interest by an extensive literature survey and select a topic from an emerging area relevant to their branch/interdisciplinary and define the problem for the project work. The problem could be defined to develop prototypes for industrial needs. A team consisting of not more than 2-4 students shall be guided by a faculty member. This project work is to supplement and prepare the students to take up major project work at higher semesters. A committee constituted by HOD consisting of minimum 2 faculty members shall evaluate for CIE with suitable rubrics. The weightage of marks shall be 50% for the committee and 50% for the guide. There is a SEE (viva voce) examination which shall be examined by two internal examiners recommended by the HoD.
Soft Skills-I: Training on communication skills, proficiency in English language and aptitude ability is arranged involving external resource. The external resource person 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 50 marks. The arrangement for CIE evaluation is to be done by the department and maintain the relevant documents.
Physical Education and Yoga: All students have to register for any one of the courses namely National Service Scheme (NSS), Physical Education (PE) (Sports and Athletics), and Yoga (YOG) with the concerned course coordinator during the first week of respective semester. Activities shall be carried out between III semester to the VI semester (for 4 semesters). Successful completion of the registered course and requisite CIE score is mandatory for the award of the degree. The events shall be appropriately scheduled by the colleges and the same shall be reflected in the calendar prepared for the NSS, PE, and Yoga activities. These courses shall not be considered for vertical progression as well as for the calculation of SGPA and CGPA, but completion of the course is mandatory for the award of degree.
AICTE activity point: Every regular student, who is admitted to the 4-year degree program, is required to earn 100 activity points in addition to the total credits earned for the program. The activity points earned by the student shall be reflected on the students VIII semester grade card. The activities to earn the points can be spread over the duration of the program. However, minimum prescribed duration should be fulfilled. Activity points (non-credit) have no effect on SGPA/CGPA and shall not be considered for vertical progression. In case student fails to earn the prescribed activity points; VIII semester grade card shall be issued only after earning the required activity Points. Students shall be eligible for the award of degree only after the release of the VIII semester grade card.

SDM COLLEGE OF ENGINEERING AND TECHNOLOGY, DHARWAD
Department of Computer Science and Engineering
VI Semester
Scheme of Teaching and Examinations 2025 – 26

Sl No	Course	Course Code	Course Title	Teaching Department	Teaching Hrs/Week			Examination				Credits
					Lecture	Tutorial	Practical	Duration in Hrs	CIE Marks	SEE Marks	Total Marks	
					L	T	P					
1	PCC	22UCSC600	Object Oriented Systems Modelling and Design Patterns	CSE	4	0	0	03	50	100	100	4
2	PCC	22UCSC601	Automata Theory and Compiler Design	CSE	4	0	0	03	50	100	100	4
3	PCC	22UCSC602	Artificial Intelligence and Machine Learning	CSE	3	0	0	03	50	100	100	3
4	PEC	22UCSE6XX	Program Elective Course – II	CSE	3	0	0	03	50	100	100	3
5	PEC	22UCSE6XX	Program Elective Course – III	CSE	3	0	0	03	50	100	100	3
6	OEC	22UCSO6XX	Open Elective Course – I	CSE	3	0	0	03	50	100	100	3
7	PCCL	22UCSL603	Computer Networks Laboratory	CSE	0	0	2	03	50	50	100	1
8	PCCL	22UCSL604	Artificial Intelligence and Machine Learning Laboratory	CSE	0	0	2	03	50	50	100	1
9	PROJ	22UCSL605	Minor Project-II	CSE	0	0	4	-	50	50	100	2
10	HSMS	22USSK606	Soft Skills-II		0	0	2	-	50	-	50	Audit
11	MC	22UPYK607	Physical Education and Yoga	PE&Y	0	0	2	-	50	-	50	Audit
Total											1000	24

Program Elective Course – II												
12	PEC-II	22UCSE620	Advanced Data Structures and Algorithms	CSE	3	0	0	03	50	100	100	3
13	PEC-II	22UCSE621	Computer Graphics	CSE	3	0	0	03	50	100	100	3
Program Elective Course – III												
14	PEC-III	22UCSE630	Data Science and Applications	CSE	3	0	0	03	50	100	100	3
15	PEC-III	22UCSE631	Ad-hoc Networks	CSE	3	0	0	03	50	100	100	3
16	PEC-III	22UCSE632	Unix Systems Programming	CSE	3	0	0	03	50	100	100	3
Open Elective Course – I												
17	OEC-I	22UCSO640	Cloud Computing	CSE	3	0	0	03	50	100	100	3
18	OEC-I	22UCSO641	Network Management	CSE	3	0	0	03	50	100	100	3
19	OEC-I	22UCSO642	Object Oriented Programming with C++	CSE	3	0	0	03	50	100	100	3

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Professional Elective Courses (PEC): A professional elective (PEC) course is intended to enhance the depth and breadth of educational experience in the Engineering and Technology curriculum. Multidisciplinary courses are added supplement the latest trend and advanced technology in the selected stream of engineering. Each group will provide an option to select one course. The minimum numbers of students' strength for offering Open Elective Course are as prescribed by the DAP.

Open Elective Courses (OEC): Students belonging to a particular stream of Engineering and Technology are entitled to opt for the open electives offered by their parent Department and other departments provided that they satisfy the prerequisite condition if any. Registration to open electives shall be documented under the guidance of the Program Coordinator/ Advisor/Mentor. The minimum numbers of students' strength for offering Open Elective Course are as prescribed by the DAP.

Minor project-II: It is either a continuation of Mini-Project-I or a new project. The students are expected to identify the state-of-the-art technology in his/her domain of interest by an extensive literature survey and select a topic from an emerging area relevant to their branch/interdisciplinary and define the problem for the project work. The problem could be defined to develop prototypes for industrial needs. A team consisting of not more than 2-4 students shall be guided by a faculty member. This project work is to supplement and prepare the students to take up major project work at higher semesters. A committee constituted by HOD consisting of minimum 2 faculty members shall evaluate for CIE with suitable rubrics. The weightage of marks shall be 50% for the committee and 50% for the guide. There is a SEE (viva voce) examination which shall be examined by two internal examiners recommended by the HoD.

Soft Skills-II: Training on communication skills, proficiency in English language and aptitude ability is arranged involving external resource. The external resource person 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 50 marks. The arrangement for CIE evaluation is to be done by the department and maintain the relevant documents.

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V Semester

22UCSC500 Software Engineering and Project Management (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 software system development that enables students to develop high quality robust software system using engineering tools 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	**Explain** the properties of various critical systems and associated quality parameters.	-	1	-
CO-2	**Explain** the key practices of software development process models.	-	1	-
CO-3	**Identify** various system requirements and **prepare** Software Requirements Reports (SRS).	1,2,3,13,14	-	-
CO-4	**Prepare** Design models, system architecture, components and processes with quality and standards.	1,2,3,5,12,13,14, 15,16	-	-
CO-5	**Develop** software system using engineering techniques, industry relevant tools and programming features/techniques.	1, 2,3,8,9,13,14,15	-	-
CO-6	**Verify** and **validate** the given system using standard tools and techniques.	5,12,15	-	-
CO-7	**Prepare** the project plan and **Manage** project using standard tools, procedures and techniques.	5,8,9,10,11,12	-	-

POs/PSOs	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**
Mapping Level	2.6	3	3	-	3	-	-	3	3	3	3	3	3	3	3	3

Pre-requisites: Knowledge of

- Basics of computer systems and its uses
- Programming language (any)

Contents:

Unit-I

Overview: Introduction to software engineering, Professional and ethical responsibility. Socio-Technical systems: Emergent system properties; Systems engineering; Organizations, people and computer systems; Legacy systems.
Critical Systems, Software Processes: Critical Systems: A simple safety critical system; System dependability; Availability and reliability. Software Processes: Models, Process iteration, Process activities; The Rational Unified Process; Computer Aided Software Engineering. **7 Hrs**

Unit-II

Requirement Engineering: Software Requirements: Functional and Non-functional requirements; User requirements; System requirements; Interface specification; The software requirements document. Requirements Engineering Processes: Feasibility studies; Requirements elicitation and analysis; Requirements validation; Requirements management. **7 Hrs**

Unit-III

System models: System Models: Context models; Behavioral models; Data models; Object models; Structured methods.
Software Design and Development: Architectural Design: Architectural design decisions; System organization; Modular decomposition styles; Control styles. Object-Oriented design- UML diagrams. UI Design Issues. Design Patterns: MVC, Broker, Microkernel, Master & Slave, Whole & Part.
Rapid Software Development: Agile practices and associated industry relevant tools; Extreme programming; Rapid application development. Software Evolution: Program evolution dynamics; Software maintenance; Evolution processes; Legacy system evolution. **9 Hrs**

Unit-IV

Verification and Validation: Verification and Validation: Planning; Software inspections; Automated static analysis; Verification and formal methods. Software testing: System testing; Component testing; Test case design; Test automation. Testing Techniques: Equivalence Partitioning, Boundary Value Analysis, Cause Effect Graphing, Test Generation from Predicates, Statement testing, Branch Testing, Condition Testing, Path Testing, Procedural Call Testing, Scaffolding, Model Based Testing, Data Flow Testing. **9 Hrs**

Unit-V

Software Quality & Project Management: Various Software quality parameters and associated standards and procedures, Project Management activities; Project planning; Project scheduling; Risk management. Configuration Management, Managing People: Selecting staff; Motivating people; Managing people; The People Capability Maturity Model. Software Cost Estimation: Productivity; Estimation techniques, Project duration and staffing. **7 Hrs**

Reference Books:

1. Ian Somerville, “Software Engineering”, 10/E, Person Education, 2016.
2. Roger Pressman, “Software Engineering, Practitioners approach”, 7/E, McGraw-Hill, 2010.
3. Pankaj Jalote, “An Integrated Approach to Software Engineering”,2nd Edition, Narosa Publishing House.
4. Rajib Mall, “Fundamentals of Software Engineering”, 5th Edition, PHI-2022.
5. Frank Buschmann, RegineMeunier, Hans Rohnert, Peter Sommerlad & Michael Stal, “Pattern-Oriented Software Architecture, A System of Patterns”, Volume 1, John Wiley and Sons, 2006.

Suggested Assignments for CTA assessment:

Following are the list of assignments to be used for CTA assessment. However, course teachers, with written permission from DUGC may design higher level assignments.

1) Use of **Software tool to explore UML design models**.
2) **Implementation of Design patterns** in any suitable language using language primitives. Ex: MVC
3) Design and Development of **Reusable Objects.**
4) **Model Based Testing: Writing TEST Scripts** for the given model.
5) Use of **TESTING TOOLS**: Assertions in C language, Junit, selenium etc.
6) Use of **Project Management Tools**: GitHub / Jira etc…

Students are expected to do the work in a group of two. They are expected to maintain all their documents in GitHub repository and prepare report in the standard format suggested by the course teacher.

Problem scenario/ requirements, design, coding standard/style, robustness of the code ensured through test cases/scripts, proper UI design and report preparation are the basic parameters to be used to evaluate the performance of each student.

22UCSC501	Database Management Systems	(4-0-0) 4

Contact Hours: 52

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	-	1,2,13	-
CO-2	**Prepare** an ER model for the given business scenario.	1,2,3,13,14	15	-
CO-3	**Design** the database in the appropriate normal form.	1,2,3,13,14	15	-
CO-4	**Write** the relational algebraic queries to retrieve the required information.	1,2,3,13,14	15	-
CO-5	**Write** the SQL statements to create schema and retrieve the required information.	1,2,3,13,14	15	-
CO-6	**Write** the PL/SQL queries to retrieve the required information.	1,2,3,13,14	15	-
CO-7	**Write** the stored procedures/ functions to perform the required operation on the database.	1,2,3,13,14	15	-
CO-8	**Write** TRIGGERS to perform the required operation on the database.	1,2,3,13,14	15	-
CO-9	**Explain** the ACID properties and illustrate how the associated strategies ensures the valid state of the database.	-	1,2,13	-

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. **10 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. **10 Hrs.**

Unit-III

SQL: Data Definition and Data Types; DDL statements like creation and specification od 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. **12 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. **10 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. **10 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.

22UCSC502 Computer Networks (4-0-0) 4

Contact Hours: 52

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

- Evolution of network and Internet
- Protocols, applications pertaining to network and internet communication.
- Layered architecture, 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):

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 evolution and core operating principles of computer network in terms of architecture, functions, switching techniques and protocols.	-	1	2
CO-2	**Analyze** the communication channels for errors and explain the fundamental concepts of analog and digital communication and principles of switching techniques and their applications.	-	1	2, 13
CO-3	**Explain** the working principles of peer to peer and logical link control protocols and MAC protocols in building networked space.	-	1	2,13
CO-4	**Analyze and implement** the protocols and algorithms of packet-switching networks.	1	2	3, 13
CO-5	**Explain** the working of TCP/IP layered model of communication and analyze the traffic management and security.	1	1,2	3,13

POs/PSOs	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Mapping Level	2.2	1.4	1.0	-	-	-	-	-	-	-	-	-	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 layers, Unified View of Layers, Protocols, and Services

Overview of TCP/IP Architecture: TCP/IP Architecture, TCP/IP Protocol: How the layers work together, Protocol Overview; Application Layer Protocols and TCP/IP Utilities **12 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, Line Coding, Error Detection and Correction: Error Detection, Two-Dimensional Parity Checks, Internet Checksum, Polynomial Codes.

Switching Networks: Multiplexing: Frequency Division Multiplexing, Time Division Multiplexing, Wavelength - Division Multiplexing **10 Hrs**

Unit-III

Peer-to-Peer Protocols and Data Link Layer: Peer-to-Peer Protocols: Peer –to-Peer Protocols and Service Models; ARQ Protocols and Reliable Data Transfer Service: Stop-and-Wait ARQ, Go-Back-N ARQ, Selective Repeat ARQ; Other Peer-to-Peer Protocols; Data Link Controls: Framing; Point to Point Protocol; HDLC Data link Control.

Medium Access Control Protocols and Local Area Networks: The Medium Access Control Protocols: Multiple Access Communications; Random Access: ALOHA, Slotted ALOHA, CSMA, CSMA-CD; Scheduling Approaches to Medium Access Control: Reservation Systems, Polling, Token-Passing Rings **10 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, Applications of ATM. Traffic management using Fair queueing, RED, Leaky Bucket algorithm.

TCP / IP: TCP / IP architecture, The Internet protocol, IP addressing, subnet addressing, CIDR, IPv6, User datagram protocol, Transmission control protocol. Multicast routing **10 Hrs**

Unit-V

Internet Routing Protocols: RIP, OSPF, BGP, DHCP, NAT, Mobile IP**.** Virtual Private Networks. Overview of Security and cryptographic algorithms. **10 Hrs**

Reference Books:

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

22UCSL503 Python Programming Laboratory (0-0-2) 1

Contact Hours: 26

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

- Syntax and semantics of Python programming including lists, tuples and dictionaries
- File handling for CSV and PDF files in Python
- Scientific computing and graphing using Python
- Web interaction using Python
- Develop GUI applications using Python

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	**Write** programs to solve a given problem using basic syntax and semantics and **use** tuples, lists and dictionaries	14,15	13,16	4
CO-2	**Write** programs to solve problems that involve handling CSV and PDF files	14,15	13,3	16
CO-3	**Write** programs to solve a given problem using numpy library and plot the data using matplotlib library	14,15	13,3	16,5
CO-4	**Write** programs that utilize parses to parse web data	14,15	13,5	16,9
CO-5	**Develop** simple and fully featured GUI applications using EasyGUI and Tkinter	14,15	13,16	9

POs/PSOs	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**
Mapping Level	-	-	2.0	1.0	2.0	-	-	-	1.0	-	-	-	2.0	3.0	3.0	1.2

Pre-requisites: Knowledge of any programming language

Suggested Platforms: Python IDLE, Jupyter notebooks

Conduction of Practical Sessions:

Practical sessions shall include Python programs on the following:

1) Basic syntax and semantics of Python language [Textbook-1: Chapters-1 to 8]
2) Work with lists, tuples and dictionary to demonstrate various use cases [Textbook-1: Chapter-9]
3) Work with files, manipulate files, file operations on CSV files and create & modify PDF files [Textbook-1: Chapter-12, Chapter-14]
4) Explore numpy and matplotlib libraries to use arrays and visualize the data in the form of plots [Textbook-1: Chapter-17]
5) Parse website data using parsers and interact with forms and other website components [Textbook-1: Chapter-16]
6) Create simple GUI with EasyGUI and fully-featured GUI with Tkinter [Textbook-1: Chapter-18]

Reference books:

1) Fletcher Heisler, et. al., “A practical introduction to Python 3”, 4th edition, Real Python (https://realpython.com/), 2020, ISBN: 9781775093329 (paperback), ISBN: 9781775093336 (electronic)
2) Hans-Petter Halvorsen, “Python Programming”, 2019, https://www.halvorsen.blog, ISBN:978-82-691106-4-7
3) Fabrizo Romano, “Learning Python”, 2015, Packt Publishing, ISBN 978-1-78355-171-2
4) Igor Milovanović, et. al., “Python Data Visualization Cookbook”, 2nd edition, Packt Publishing, ISBN 978-1-78439-669-5

Additional external web resources:

1) “Learn Python - Free Interactive Python Tutorial,” Learnpython.org, 2019. https://www.learnpython.org/
2) “Learn Python Tutorials,” www.kaggle.com. https://www.kaggle.com/learn/python/
3) “Tutorial - Visualization with Python,” www.mit.edu., https://www.mit.edu/~amidi/teaching/data-science-tools/tutorial/data-visualization-with-python/ (accessed May 06, 2024).

22UCSL504	Database Management Systems Lab	(0-0-2)1

Contact Hours: 26

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:

Multiple standalone preparatory exercises to meet the course outcomes.

22UCSL505	Minor Project-I	(0-0-4) 2

Contact Hours: 52

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 (13,14)**		
		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.	-	3,5,7,12,1 3	-
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/PSOs	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**
Mapping Level	-	2	2	-	2	2	2	2	2	2	2	2	2	-	-	-

Guidelines for conduction:

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 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 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 O 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

Sl. No	Parameter for assessment	Marks
1	Requirements Analysis (SRS): Abstract and Detailed	10
2	Design Specification; Use of: UML diagrams, architecture diagram, ER diagram, Patterns etc…Proper cohesiveness and coupling of various components in the system design.	10
3	Use of Tools and standards.	05
4	Implementation: Code documentation, style, robustness, maintainability, Testability, Usability (User Experience) etc	10
5	Testing: for every scenario of all use cases identified.	05
6	Final Oral Presentation (viva-voce) (IEEE Standards for slides, oral presentation techniques etc…)	05
7	Project Reports- Final and Intermediate if any: preparation using LATEX and plagiarism check	05

Note:

1. Sufficiency 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.

22URMK506 Research Methodology and IPR (2-0-0) 2

Contact Hours: 26

Course Learning Objectives (CLOs):

The students are expected to learn about the need and types of research, problem formulation, literature review, measurement, scaling, data collection, testing of hypothesis, result interpretation and report writing. Also expected to learn about the importance of IPR and trade mark.

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)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	**Formulate** the research problem, carryout literature survey and decide the methodology.	-	2	-
CO-2	**Importance** of Literature survey and need to identify gaps	-	2	5
CO-3	**Describe** measurement and scaling and data collection &report writing	-	-	3
CO-4	**Basic** concepts concerning IPR and copy rights	-	4	-
CO-5	**Explain** the need for Trademark and IT act.	-	5	-

POs/PSOs	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
Mapping Level	-	2	1	2	1.5	-	-	-	-	-	-	-

Pre-requisites:

Design and Analysis of Engineering subjects related issues

Contents:

Unit-I

Research Methodology: Introduction, meaning of research, objectives of research, motivation in research, types of research, research approaches, significance of research, research methods versus methodology.
Defining the Research Problem: Research problem, selecting the problem, necessity of defining the problem, technique involved in defining a problem, an illustration.

5 Hrs.

Unit-II

Reviewing the literature: Importance of the literature review in research, How to review the literature, searching the existing literature, reviewing the selected literature and writing about the literature reviewed.

Research Design: Meaning of research design, need for research design, features of a good design, important concepts relating to research design. **5 Hrs.**

Unit-III

Data Collection: Collection of primary data, observation method, interview method, collection of data through questionnaires.

Testing of Hypotheses: What is a Hypothesis? Basic concepts concerning testing of hypotheses, procedure for hypothesis testing, flow diagram for hypothesis testing, measuring the power of a hypothesis test, tests of hypotheses

Interpretation and Report Writing: Meaning of interpretation, technique of interpretation, precaution in interpretation, significance of report writing. **6 Hrs.**

Unit-IV

Meaning and conception of IPR, competing, rationale for protection, international conventions, world court.
Copy right: Historical evolution of the law on copy right, meaning, content
Patents: Meaning of Patent, purpose and policy object of patent law, gains to inventor, application of patents, joint application, discovery and invention, patentable and non-patentable inventions. **5 Hrs.**

Unit-V

Trademarks: Definitions and conceptions of Trademark, advantages of registration, marks which are not registrable, known and well-known trademarks, application for registration and procedure for registration, procedure and certification of Trademarks.
The Information Technology Act:
Definitions, certifying authority, meaning of compromise of digital signature, offences and penalties, applicability of IPRs, cybercrimes, adjudicating officer, violation,

damages and penalties, Cyber regulation appellate tribunal, World Wide Web and domain names and cyber flying, Self-study. **5 Hrs.**

Reference Books:

1) C.R. Kothari, Gaurav Garg, Research Methodology: Methods and Techniques, New Age International, 4th Edition, 2018.
2) Ranjit Kumar, Research Methodology a step-by-step guide for beginners, SAGE Publications, 3rd Edition, 2011.
3) Fink A, Conducting Research Literature Reviews: From the Internet to Paper, Sage Publications, 2009.
4) N. K. Acharya, Text book on Intellectual Property Rights, 4th Edition, Asia Law House, Hyderabad.

22UESK507 Environmental Studies (1-0-0) 1

Contact Hours: 13

Course Learning Objective (CLO):

1. The Students are to learn in this course about the need of balanced ecosystem, effects of human activities on environment, optimized use of natural resources including energy extraction and current Environmental issues.

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 (13-15)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	Discuss the concept of ecosystem and effects of human activities on environment.		7	
CO-2	Describe the adverse effects on health and society due to erratic exploitation of natural resources.			6
CO-3	Understand various types of energy, sources of energy.		6	
CO-4	Explain different types of Pollution and concept of Global warming, Ozone layer depletion.		7	
CO-5	Discuss the current developments towards NGO to protect environment.		6	

POs	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Mapping Level	-	-	-	-	-	1.6	2	-	-	-	-	-	-	-	-

Course content:

Unit - I

Environment and Effects of Human activities on Environment: Introduction, Ecosystem – Types & Structure of Ecosystem, Impacts of Agriculture & Housing, Mining & Transportation. Environmental Impact Assessment, Sustainable Development. **3 Hrs**.

Unit - II

Natural Resources : Introduction Water resources – Availability & Quality aspects, Water borne diseases, Fluoride problem in drinking water. Material Cycles - Carbon cycle and Nitrogen cycle. **3 Hrs.**

Unit - III

Energy in Ecological System: Different types of energy, Conventional sources & Non Conventional sources of energy. Solar energy, Hydro electric energy, Wind energy, Nuclear energy, Biomass & Biogas, Fossil Fuels, Hydrogen as an alternative energy. **3 Hrs.**

Unit - IV

Environmental Pollution: Water Pollution, Land Pollution, Air Pollution, Global Warming, Ozone layer depletion. **2 Hrs.**

Unit - V

Current Environmental Issues & Environmental Protection: Environmental Acts & Regulations, Role of Nongovernmental Organizations (NGOs). Introduction to GIS & Remote Sensing, Applications of GIS & Remote Sensing. **2 Hrs.**

Reference Books:

1) P. Meenakshi, “Elements of Environmental Science and Engineering”, Prentice Hall of India Private Limited, New Delhi, 2006.
2) Benny Joseph “Environmental Studies”, Tata McGraw – Hill Publishing Company Limited, 2010.
3) Raj Gopalan “Environmental Studies” Oxford University press, New Delhi, 3rd Edition, 2016.
4) Kaushik and Kaushik “Perspectives in Environmental Studies “, New Age International Private Limited, 2005. D. L. Manjunath “Environmental Studies “, Pearson, Noida, 2016.

22USSK508	Soft skills - I	(0-0-2) Audit

Contact Hours: 26

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)/ (13,14)**		
		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	-

PO's	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
Mapping Level	-	-	-	-	-	-	-	-	2.0	2.0	-	1.0	-	-	-

Contents:

Number System, Linear Equations + Assessment Test ▪ HCF and LCM, Ratios & Proportions + Assessment Test ▪ Percentage, Profit & Loss + Assessment Test ▪ Time, Work & Distance + Assessment Test ▪ Simple and compound Interest, Averages and Mixtures + Assessment Test ▪ Permutations, Probability + Assessment Test ▪ Data analysis **14Hrs.**

Cyptarithmetic ▪ Analytical Puzzles ▪ Classification Puzzles ▪ Mathematical Puzzles ▪ Human Relations ▪ Directional tests ▪ Coding and decoding ▪ Series completion – Verbal and Non-verbal ▪ Questions from recent recruitment tests. **12 Hrs**.

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.

22UPYK509	Physical Education and Yoga	(0-0-2) Audit

Contact Hours: 26

Course Learning Objectives:

The course focuses on overall development and important of Physical Education & Yoga day to day life.

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)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO1	Gaining the importance of Physical Education & yoga	12		8, 9
CO2	Understanding the benefits & preventive measures of health	12	6	8, 9
CO3	Gaining the knowledge of yoga	12		8, 9
CO4	Understanding the importance of Human Body conditioning & Sports training	12		8, 9
CO5	Get awareness of Modern technology in sports	12		5, 8, 9

POs	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
Mapping Level	-	-	-	-	1	2	-	1	1	-	-	3

Contents

Unit-I

Introduction to Physical Education: Meaning and importance, definition, components, benefits of physical education. **4 Hrs.**

Unit-II

Health and Wellness, Anatomy and Physiology: Meaning and importance, definition, components, benefits, health habits, basics of diseases and preventive measures, mental health, physical health, social health, spiritual health. Meaning and definition, first aid, injuries and preventions. **5 Hrs.**

Unit-III

Introduction of Yoga: Origin and history of Yoga, meaning and definition, benefits, Importance prayer Suryanamaskara,

Asana:- Trikonasana, Ardha Chakrasana, Baddha konasana, Utkatasana.

Pranayama:- Bhramari Pranayamai, Kapalbhati Pranayama.

Mudras:- Chinmaya mudra & Nasika mudra. **5 Hrs.**

Unit-IV

Sports Training: Meaning and definitions, warming up, cooldown, methods of exercises, stretching, speed, endurance, flexibility, agility, Athletics, Netball, Kabaddi, Football Tug ofwar, Throwball Rules and regulation of all games. **5 Hrs.**

Unit-V

Modern Technology in Sports and Games: Meaning and definitions, objectives, assisting umpires/ referees, hawk-eye technology, sports specific, computer software, technology in playfields, athletes clothing and equipment, graphics of sports and games, artificial intelligence. **5 Hrs.**

References:

1) Petipus, et al., Athlete's Guide to Career Planning, Human Kinetics, 1997
2) The Human Body in Health and Disease with Access 8th Edition 2023.
3) Anatomy and Physiology, Shri K.G. Nadgir College of Physical Education. Dharwad.
4) Health & Wellness Shri K.G. Nadgir College of Physical Education. Dharwad.
5) Nagendra HR., The art and science of Pranayama, 2009
6) Iyengar BKS., The illustrated Light on Yoga(English), 2005

22UCSE521 Internet of Things (3-0-2) 4

Contact Hours: 39L+26P

Course Learning Objectives (CLOs): This course provides the basic understanding of IoT technology, communication protocols, sensors 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 basics of networking and emergence of IoT.	-	5	1, 12
CO-2	**Explain** the use of sensors and actuators in IoT ecosystem.	-	5	1, 12
CO-3	**Explain** the use cases of IoT and the use of sensors & actuators in IoT ecosystem.	-	5, 13	1, 12
CO-4	**Explain** the use cases of IoT in various domains and **perform** analytics using ML algorithms	-	5, 13	1, 12

CO-5	**Develop** IoT applications using Arduino and Raspberry Pi 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 any programming language

Contents:

Unit-I

Basics of Networking: Introduction, network types, layered network modelsn **05 Hrs**

Predecessors of IoT: WSNs, M2M communications, cyber physical systems; **Emergence of IoT:** Introduction, evolution of IoT, enabling IoT and interdependence of technologies, IoT networking components **05 Hrs**

Unit-II

IoT sensing and actuation: Introduction, sensors, sensor characteristics, sensorial deviations, sensing types, sensing considerations, actuator types, actuator characteristics **05 Hrs**

IoT connectivity and communication technologies: IEEE 802.15.4, Zigbee, WirelessHART, RFID, NFC, Z-wave, LoRa, Wi-Fi, Bluetooth; infrastructure protocols, discovery protocols, data protocols, identification protocols, semantic protocols **05 Hrs**

Unit-III

Associated IoT technologies: Cloud computing: introduction, virtualization, cloud models, SLAs, cloud implementation, sensors-as-a-service **05 Hrs**

Fog Computing: introduction, fog computing architecture, fog computing in IoT, applications of fog computing **05 Hrs**

Unit-IV

Use cases of IoT: Agricultural IoT, Vehicular IoT, Healthcare IoT **04 Hrs**

Paradigms, challenges and the Future: evolution of new IoT paradigms; challenges associated with IoT; emerging pillars of IoT **03 Hrs**

IoT Analytics: Introduction, algorithms of ML, performance metrics of ML algorithms **04 Hrs**

Unit-V

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 **03 Hrs**

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; 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 **04 Hrs**

Raspberry Pi: Installation; remotely accessing the Raspberry Pi; accessing GPIO pins; configuring WiFi on Raspberry Pi; experiments with Raspberry Pi **04 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) Working with Raspberry Pi, interfacing different sensors with Raspberry Pi and demonstrating networking using Raspberry Pi.

Reference Books:

1) Sudip Misra, Anandarup Mukherjee, Arijit Roy, "Introduction to IoT", Cambridge university press, 2021

2) Arshdeep Bahga, Vijay Madisetti ,"Internet of Things – A Hands-on Approach", Universities Press, 2015

3) Ammar Rayes, Samer Salam, "Internet of Things From Hype to Reality – The Road to Digitalization", 2/E, Springer Nature Switzerland AG 2017, 2019

Additional References:

1) SWAYAM course on "Introduction to internet of things" by Prof. Sudip Misra

22UCSE522 Operations Research (4-0-0) 4

Contact Hours: 52

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	-	1,2,3	16

	method and **perform** sensitivity analysis.			
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 and 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.

10 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. **10 Hrs.**

Unit-III

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

10 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.

12 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.

10 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.

22UCSE523	Digital Image Processing	(4-0-0) 4

Contact Hours: 52

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

- To learn fundamental theories and techniques of digital image processing.
- To acquire the skill necessary to explore advanced topics of digital image processing.

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 principles of Digital Image Processing.	-	1,2	3,5,13,14
CO-2	**Demonstrate** the image enhancement techniques that include primitives image sensing and acquisition techniques, image formation, image representation & relationship between the pixels.	13,14	1,2,3	15
CO-3	**Explain** the basic principles of mathematical morphology & **write** program to **extract** the characteristic features of image using morphological operations.	13,14	1,2,3	15
CO-4	**Apply** segmentation techniques for a given application scenario.	13,14	1,2,3	15
CO-5	**Explain** and **implement** the core principles of image representation techniques.	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	1.8	-	1.0	-	-	-	-	-	-	-	2.6	2.6	1.0	-

Pre-requisites: Knowledge of

- Basics of Statistics
- Linear Algebra

Contents:

Unit-I

Digital Image Fundamentals - Introduction, Applications, Fundamental Steps in Digital Image Processing, Elements of visual perception, Image sensing and acquisition, Image Sampling and Quantization, Basic relationships between pixels.

10 Hrs.

Unit-II

Intensity Transformations and Spatial Filtering - Basic Intensity Transformation Functions, Histogram Processing; Fundamentals of Spatial Filtering., Smoothing and Sharpening Spatial filters. **10 Hrs.**

Unit-III

Morphological Image Processing- Erosion and Dilation, Opening and Closing, Hit or Miss Transforms, Basic Morphological Algorithms, GrayScale Morphology. **10 Hrs.**

Unit-IV

Image Segmentation- Point, Line, and Edge Detection, Thresholding, Region-Based Segmentation, Segmentation Using Morphological Watersheds. **12 Hrs.**

Unit-V

Representation and Description- Image Representation, Boundary and Regional Descriptors. **10 Hrs.**

Reference Books:

1) Rafel C Gonzalez & Richard E Woods, “Digital Image Processing”, 3rd Edition, Pearson Education, 2016.
2) Milan Sonka, Vaclav Hlavac & Roger Boyle, “Image Processing, Analysis and Machine Vision”, 2nd Edition, Thomoson Learning, 2001.
3) Anil K Jain, “Fundamentals of Digital Image Processing”, Prentice-Hall of India Pvt. Ltd., 1997.
4) B.Chanda & Dutta Majumder, “Digital Image Processing and Analysis”, Prentice-Hall, India, 2002.

VI Semester

22UCSC600 Object Oriented Modeling and Design Patterns (4-0-0) 4

Contact Hours: 52

Course Learning Objectives (CLOs): This is a 4 credit, 52 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 in solving problems.	1,2,3,13	14,15,16	-
CO-2	**Analyze** problem scenario and **identify** classes/ Objects, their properties and associations.	1,2,3,13	14,15,16	-
CO-3	**Analyze** problem scenario and **model** the system using UML diagrams.	1,2,3,13	14,15,16	-
CO-4	**Evaluate** the quality of Object Oriented system in-terms of cohesion, coupling, sufficiency, completeness and primitiveness.	1,2,3,13	14,15,16	-
CO-5	**Implement** Object Oriented model in any Object Oriented language.	1,2,3,13	14,15,16	-
CO-6	**Identify** and **apply** the appropriate patterns in solving problems.	-	1,2,3,13, 14,15,16	-
CO-7	**Propose** the appropriate strategies to incorporate standard quality parameters in the design of a system.	-	16	-

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

Pre-requisites: Knowledge of Object Oriented Programming Language (any) Software Engineering

Contents:

Unit-I

Review: Object Oriented Concepts and principles.

Basic class modeling: Object Orientation, developments themes; Modeling as Design Technique: abstraction; Class Modeling, Object and class concepts, Link and associations, Generalization and inheritance; Navigation of class models.

10 Hrs.

Unit-II

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

Advanced state modeling, interaction modeling: Nested state diagrams; nested states; signal generalization; concurrency; a sample state model; relation of class and state models; 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: Implementation of OO design in appropriate language **12 Hrs.**

Unit-III

Patterns–Part 1: Introduction; layers, pipes and filters, blackboard. Distributed systems: broker; interactive systems: MVC, presentation-abstraction-control. Adaptable systems: microkernel; reflection. **10 Hrs.**

Unit-IV

Patterns—Part 2:

Structural: whole – part/ Composite; organiz**a**tion of work: master - slave; Adapter, Bridge, Façade, Flyweight, Access control**:** proxy.

Others: Command Processor, View Handler, Forward Receiver, Client-Dispatcher-Server and publish Subscriber. Chain of Responsibility, State, Visitors, Template Methods **10 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. **10 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) Rajib Mall, “Fundamentals of Software Engineering”, 5th Edition, PHI, 2018.
4) Erich Gamma, Richerd Helm, Ralph Johnson, John Vlissides, “ Design Patterns”, Perason Eduvcation-2001.
5) Len Bass, Paul Clements & Rick Kazman, “Software Architecture in Practice”, 2/E, Pearson Education, 2003.
6) Grady Booch et al, “Object-Oriented Analysis and Design with Applications”, 3/E, Pearson Education, 2007.
7) Ali Bahrami, “Object oriented systems development”, McGraw-Hill, 1999.
8) Mary Shaw and David Garlan, “Software Architecture Perspectives on an Emerging Discipline”, Prentice-Hall of India, 2007.

Suggested Assignments for CTA assessment:

Following are the list of assignments to be used for CTA assessment. However, course teachers, with written permission from DUGC may design higher level assignments.

1. Use of **Software tool to explore UML design models**.
2. **Implementation of Design patterns** in any suitable language using language primitives. Ex: MVC
3. Design and Development of **Reusable Objects.**
4. **Model Based Testing: Writing TEST Scripts** for the given model.

Students are expected to do the work in a group of two. They are expected to maintain all their documents in GitHub repository and prepare report in the standard format suggested by the course teacher.

Problem scenario/ requirements, design, coding standard/style, robustness of the code ensured through test cases/scripts, proper UI design and report preparation are the basic parameters to be used to evaluate the performance of each student.

22UCSC601 Automata Theory and Compiler Design (4-0-0) 4

Contact Hours: 52

Course Learning Objectives (CLOs):

This is a 4-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):

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	**Construct** a finite automaton for a given pattern and **explain** its working principles.	-	1,2,3,13	-
CO-2	**Write** regular expressions for given	-	1,2,3,13	-

	patterns and **explain** different techniques and principles used.			
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/PSOs	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**
Mapping Level	1.9	2.0	2.0	-	-	-	-	-	-	-	-	-	2.1	2.0	1.0	-

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. **11 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 **11 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 **10 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. **10 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**.** **10 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", 2/E (Revised), Tata McGraw - Hill, 2009 reprint.

22UCSC602 Artificial Intelligence and Machine Learning (3-0-0) 3

Contact Hours:39

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

- To introduce the basic concepts, theories and state-of-the-art techniques of artificial intelligence and machine learning.
- Enable student with knowledge enough to be a self-learner in exploring the application of machine learning /AI algorithms in the different fields of science, medicine, finance etc.

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 search techniques for any real time problems.	-	3,4	1,2
CO-2	**Apply** Knowledge representation using First order logic for making decisions.	-	3,4	1,2

CO-3	**Apply** regression and classification techniques for prediction	-	3,4	-
CO-4	**Apply** the concepts of machine learning to the real-world problems.	-	3,4	-
CO-5	**Demonstrate** machine learning techniques to solve complex problems.	3		

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

Pre-requisites: Knowledge of Python Programming Fundamentals

Contents:

Unit-I

Introduction: AI Problems Underlying Assumption, AI Techniques, Criteria for Success.
State Space Search & Heuristic Search Techniques: Defining the Problems as A State Space Search, Production Systems, Searching Techniques like Informed and Uniformed Search.

Generate And-Test: Hill Climbing, Best-First Search, Problem Reduction, Constraint Satisfaction, and Means-ends Analysis**.** **8 Hrs.**

Unit-II

Knowledge Representation: Issues, Representations and Mappings, Approaches to Knowledge Representation.
Using Predicate Logic: Representing, Computable Functions and Predicates, Resolution. Representing Knowledge Using Rules, Procedural Versus Declarative Knowledge, Forward Versus Backward Reasoning. **8 Hrs.**

Unit-III

Linear Regression: Multivariate Regression, Logistic regression, Polynomial Regression.
Linear Models for Classification: Decision Trees, Regression Trees, K-nearest neighbors (KNN) algorithm. Bayes Theorem**.** **8 Hrs.**

Unit-IV

Unsupervised learning and clustering – k-means clustering, hierarchical clustering, generative adversarial network, Dimensionality Reduction **7 Hrs.**

Unit-V

Perceptron: Neural Networks - Introduction, Early Models, Perceptron Learning, Backpropagation, Initialization, Training & Validation, Support Vector Machines, Introduction, Early Models**.** **8 Hrs.**

Reference Books:

1) Elaine Rich and Kevin Knight "Artificial Intelligence", 2/E, Tata Mcgraw-Hill, 2005.
2) Stuart Russel and Peter Norvig, "Artificial Intelligence: A Modern Approach", 3/E, Prentice Hall, 2009.
3) Trevor Hastie, Robert Tibshirani, and Jerome H. Friedman "The Elements of Statistical Learning".
4) Christopher Bishop, "Pattern Recognition and Machine Learning" Mitchell Tom "Machine Learning", McGraw Hill, 1997.

22UCSL603 Computer Networks Laboratory (0-0-2) 1

Contact Hours: 26

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):

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	**Configure** the Cisco networking devices like routers, switches, and hubs etc using commands.	13,14	1,2,3	5,15
CO-2	**Simulate** different topologies/network using Cisco Packet Tracer application.	13,14	1,2,3	5,15
CO-3	**Manage** IP addresses and troubleshooting	13,14	1,2,3	5,15
CO-4	**Manage** applications like Web, Email, DHCP, DNS and FTP.	13,14	1,2,3	5,15
CO-5	**Study** on Industry relevant tools to perform traffic management.	13,14	1,2,3	5,15
CO-6	**Write** C program using RFCs to implement standard protocol using TCP / IP.	13,14	1,2,3	5,15

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

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

Contents:

Sl. No.	Term Work
T1	**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 **Learning Outcomes: [CO-1,2]**
T2	**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 **Learning Outcomes: [CO-1,2]**
T3	**Troubleshooting IPv4 and IPv6 Addressing** Part 1: Troubleshoot First Issue Part 2: Troubleshoot Second Issue Part 3: Troubleshoot Third Issue **Learning Outcomes:[CO-2,3]**
T4	**Configuring IPv6 Addresses on Network Devices** Part 1: Set Up Topology and Configure Basic Router and Switch Settings Part 2: Configure IPv6 Addresses Manually Part 3: Verify End-to-End Connectivity **Learning Outcomes:[CO-2,3]**
T5	**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 **Learning Outcomes:[CO-1,2,3]**
T6	**Web and Email** Part 1: Configure and Verify Web Services Part 2: Configure and Verify Email Services **Learning Outcomes:[CO-3,4]**
T7	**DHCP and DNS Servers** Part 1: Configure Static IPv4 Addressing Part 2: Configure and Verify DNS Records **Learning Outcomes:[CO-3,4]**

T8	**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 **Learning Outcomes:[CO-3,4]**
T9	**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. **Learning Outcomes:[CO-1,2,3,4]**
T10	**Study** on Industry relevant tools to perform traffic management. **Learning Outcomes:[CO-5]**
T11	**Write** C program using RFCs to implement standard protocol using TCP / IP. **Learning Outcomes:[CO-6]**

22UCSL604 Artificial Intelligence and Machine Learning Lab (0-0-2) 1

Contact Hours: 26

Course Learning Objectives (CLOs): This course is in line with the theory course Artificial Intelligence & Machine Learning (22UCSC602). It focuses on hands on experience on creation of data models, database design, programming using appropriate technology.

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	**Represent** the Knowledge for the given scenario using appropriate tools techniques and language.	-	3,4,5	-
CO-2	**Identify** data preprocessing requirement of a given data set for the learning algorithms.	-	3,4,5	-
CO-3	**Demonstrate** of the strengths and weaknesses of regression and classification approaches in machine learning.	-	3,4,5	-
CO-4	**Demonstrate** unsupervised algorithms for clustering requirement on a data set from the real world using python.	-	3,4,5	-

CO-5	**Represent** the Knowledge for the given scenario using appropriate tools techniques and language.	-	3,4,5	-

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	-	-	-	-	-	-	-	-	-	-	-

Pre-requisites: Knowledge of

1. Logic
2. Discrete Mathematics
3. Programming Fundamentals

Course Contents

This course is in line with the theory course Artificial Intelligence & Machine Learning (18UCSC700). There will be one problem with the **Knowledge Representation** and four problems on **Machine Learning** (Linear Regression, Multilinear regression, Polynomial regression, Decision Tree, K-means clustering). The problems to be composed by the faculty are announced to the students. The student will analyze the problem, justify the requirement of AI Approach for the solution, choose the platform or technology for implementations and demonstrate all the steps involved like pre-processing the dataset, importing the dataset, Spitting the dataset into the training set and test set, training the model on the training dataset, predicting the test set results, Visualising the Training set results, Visualising the test set results, etc where ever applicable. The students will submit implementation, conduction and observation write up for each problem. An internal examination and 5 problems work will be used to grade the student's performance in this course.

22UCSL605 Minor Project-II (0-0-4) 2

Contact Hours: 52

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	1,2,8	6,7
CO-2	**Analyze** the problem scenario and **Design** the solutions to complex engineering problem using software engineering principles or appropriate research methodology.	11,12, 13	2,3,5,8,16	6,7
CO-3	**Identify** and **Implement** a feasible solution using appropriate technology, tools, procedures and techniques.	11,12,14	3,4,5,8,16	-
CO-4	**Verify** and **Validate** the proposed system for correctness and to demonstrate compliance with the design and hence the stated requirements/ research gap.	11,12,15	5,8,16	-
CO-5	**Prepare** the report and **communicate** effectively through presentation.	10,11	8,9	-

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

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 demonstrates 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	10

	techniques etc…)	
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.

22USSK606 Soft Skills –II (0-0-2) Audit

Contact Hours: 26

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) / (13-16)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	**Demonstrate** the skill in sentence completion and faster reading of passages	-	10	-
CO-2	**Use** the English language with proficiency	-	10	12
CO-3	**Demonstrate** the capability of interview facing ability	-	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:

Vocabulary ▪ Formatting and feeding correct structures ▪ Synonyms and Antonyms ▪ Analogies ▪ Sentence Completion ▪ Error Detection and Correction ▪ Faster reading of Passages ▪ Essays ▪ Carryover plan - Dictionary Usage **10 Hrs**

Understanding Discussions ▪ Parameters measured in GDs ▪ Video Analysis of GDs ▪ Knowledge base and Ideas ▪ Taking the initiative ▪ Introduction and Conclusion **6 Hrs**

Most common personal interview questions ▪ What companies expect ▪ Showing Commitment and Learning Ability ▪ Handling difficult questions ▪ Understanding interviewer psychology ▪ Situation Reaction and Presence of Mind ▪ Dressing right ▪ Interview etiquette. **10 Hrs**

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.

22UPYK607 Physical Education and Yoga (0-0-2) Audit

Contact Hours: 26

Course Learning Objectives:

The course focuses on overall development and important of Physical Education & Yoga day to day life.

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)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	Gaining the importance of Physical Education & yoga	12		8, 9
CO-2	Understanding the benefits & preventive measures of health	12	6	8, 9
CO-3	Gaining the knowledge of yoga	12		8, 9
CO-4	Understanding the importance of Human Body conditioning & Sports training	12		8, 9
CO-5	Get awareness of Modern technology in sports	12		5, 8, 9

POs	1	2	3	4	5	6	7	8	9	10	11	12
Mapping Level	-	-	-	-	1	2	-	1	1	-	-	3

Contents

Unit-I

Introduction to Physical Education: Meaning and importance, definition, components, benefits of physical education. **4 Hrs.**

Unit-II

Health and wellness, Anatomy and Physiology: Meaning and importance, definition, components, benefits, health habits, basics of diseases and preventive measures, mental health, physical health, social health, spiritual health, Meaning and definition, first aid, injuries and preventions. **5 Hrs.**

Unit-III

Introduction of Yoga: Origin and history of Yoga, meaning and definition, benefits, importance prayer Suryanamaskara,

Asana:- Padahastasana, Ardha matsyendrasana, Halasana, Navasana. Pranayama:- Sitali Pranayama & Nadishodhana Pranayama.

Mudras:- Prana mudra & Adhi mudra. **5 Hrs.**

Unit-IV

Sports Training: Meaning and definitions, warming up, cooldown, methods of exercises, stretching, speed, endurance, flexibility, agility, Athletics, Football, Badmintion, Chess, Teakwondo, Rules and regulation of all games. **5 Hrs.**

Unit-V

Modern technology in sports and games: Meaning and definitions, objectives, assisting umpires/ referees, hawk-eye technology, sports specific, computer software, technology in playfields, athletes clothing and equipment, graphics of sports and games, artificial intelligence. **5Hrs.**

22UCSE620 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 different domains including project management.	-	2,13	1,11

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", 3/E, 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", 3/E, Pearson Education, 2011

22UCSE621 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

22UCSE630	Data Science and Applications	(3-0-0) 3

Contact Hours: 39

Course Learning Objectives (CLOs): This course is a 3-credit undergraduate course focusing on the different types of data, data preprocessing and analysis techniques. The details of python language are discussed to enable the students to perform data analytics.

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	Understanding the data science project life cycle and its applications		1	2
CO-2	Apply the preprocessing methods to the raw data to make it available for analysis.	-	1,2,4	-
CO-3	Use the Python language to perform the data visualization and the analysis using fundamental statistical techniques	-	1,3	5,14
CO-4	Extract meaningful insights from the data and transform the data using dimensionality reduction techniques		1,2	3
CO-5	Analyze the large-scale data that is derived from social networks	-	1,2	3

POs/PSOs	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**
Mapping Level	2.0	1.7	1.3	2	1	-	-	-	-	-	-	-	-	1	-	-

Pre-requisites: Knowledge of Statistics Contents

Contents:

Unit-I

Introduction: Evolution, Roles, Stages in Data Science Project, Applications, Data Security and Privacy Issues. Big Data and Data Science hype, Understanding Big Data: Data, Data Storage and Analysis, Comparison with Other Systems – RDBMS, Grid Computing, Volunteer Computing. **7 Hrs.**

Unit-II

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

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

Data Analysis Techniques: Descriptive analysis, Diagnostic, Predictive, Prescriptive, Exploratory Analysis Mechanistic Analysis **9 Hrs.**

Unit-III

Python Programming for Data Science: Pandas data frame and data frame related operations - Reading files, Exploratory data analysis, Data preparation and preprocessing, Data visualization - Loading the data, Plotting the Data Statistics and Machine Learning: BaSic Statistics, Regression, Classification, Clustering

9 Hrs.

Unit-IV

Feature Generation and Feature Selection (Extracting Meaning from Data): Motivating application: user (customer) retention. Feature Generation (brainstorming, role of domain expertise, and place for imagination), Feature Selection algorithms. Filters; Wrappers; Dimensionality Reduction, Singular Value Decomposition, Principal Component Analysis **7 Hrs.**

Unit-V

Mining Social-Network Graphs: Social networks as graphs, Clustering of graphs, Direct discovery of communities in graphs, Partitioning of graphs**.** **7 Hrs.**

Reference Books:

1) Chirag Shah, “A Hands on Introduction to Data Science”, Cambridge University Press, 2020
2) Doing Data Science Cathy O’Neil and Rachel Schutt, Straight Talk from The Frontline O’Reilly 2014
3) Mining of Massive DatasetsV2.1 Jure Leskovek, AnandRajaraman and Jeffrey Ullman Cambridge University Press, 2nd Edition 2014
4) Mastering python for data science, Samir Madhavan

22UCSE631 Ad-hoc Networks (3-0-0) 3

Contact Hours: 39

Course Learning Objectives (CLOs): This course covers major aspects of wireless ad hoc networks, from design through performance issues to application requirements. It starts with characteristics features, applications of wireless ad hoc networks, different types of routing protocols and understanding the security issues and various QoS requirements.

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 design issues of protocol stack.	-	3,13	-
CO-2	**Compare** the architecture and working of various MAC layer protocols.	-	16	1,14
CO-3	**Apply** the knowledge of different routing mechanisms for the better routing decisions in WANETs.	3,13,16	-	-
CO-4	**Apply** the knowledge of different transport layer protocols for ensuring reliable communication in WANETs.	3,13	16	15
CO-5	**Identify** the challenges in security and QoS issues in WANETs and explain suitable solutions for the same.	-	2	1,16

POs/PSOs	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**
Mapping Level	1.0	2.0	2.7	-	-	-	-	-	-	-	-	-	2.7	1.0	1.0	1.7

Pre-requisites: Knowledge of

- Data Communications
- Computer Networks
- C programming

Contents:

Unit-I

Adhoc Networks: Introduction, Issues in Adhoc wireless networks, Adhoc wireless internet.

MAC–1: MAC Protocols - Introduction, Issues in designing a MAC protocol, Design goals of a MAC protocol for Adhoc wireless networks. **7 Hrs.**

Unit-II

MAC–2: Classification of MAC protocols, Contention based protocols with reservation mechanisms; Contention based MAC protocols with scheduling mechanism, MAC protocols that use directional antennas, Other MAC protocols. **7 Hrs.**

Unit-III

Routing: Proactive and Reactive Routing Protocols, Hybrid routing protocol, Routing protocols with effective flooding mechanisms, Hierarchical routing protocols, Power aware routing protocols. **9 Hrs.**

Unit-IV

Transport Layer: Protocols - Introduction, Issues in designing a transport layer protocol, Design goals of a transport layer protocol, Classification of transport layer solutions, TCP over Ad hoc wireless Networks, Other transport layer protocols. **9 Hrs.**

Unit-V

Security: Introduction, Network security requirements, Issues & challenges in security provisioning, Network security attacks, Key management, Secure routing.
QoS: Introduction, Issues and challenges in providing QoS, Classification of QoS solutions, MAC layer solutions, network layer solutions. **7 Hrs.**

Reference Books:

1) C. Siva Ram Murthy & B. S. Manoj, "Adhoc Wireless Networks", 2nd Edition, Pearson Education, 2005.
2) Ozan K. Tonguz and Gianguigi Ferrari & John Wiley, "Ad hoc Wireless Networks", 2006.
3) Xiuzhen Cheng, Xiao Hung, Ding Zhu Du, & Kluwer, "Ad hoc Wireless Networking", Academic Publishers, 2004.
4) C.K. Toh, "Adhoc Mobile Wireless Networks, Protocols and Systems", Prentice Hall PTR, 2007.

22UCSE632 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 ANSI and POSIX standards used in UNIX operating system and programming	-	1	13
CO-2	**Explain** the UNIX file types and **demonstrate** the use of UNIX file APIs in programming.	13,14	1,2,3	15
CO-3	**Identify** the process management activities of UNIX and **write** programs that make use of processes and their environment.	13,14	1,2,3	15
CO-4	**Describe** the use of signals in	13,14	1,2,3	15

	UNIX and **illustrate** the use of signals in programs.			
CO-5	**Explain** the need of daemons in UNIX and **identify** the use of daemons in UNIX OS.	13,14	1,2,3	15
CO-6	**Explain** inter process communication mechanisms of UNIX and **write** programs to demonstrate IPCs for client-server interactions.	13,14	1,2,3	15
CO-7	**Describe** the ANSI and POSIX standards used in UNIX operating system and programming.	-	1	13

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

22UCSO640 Cloud Computing (3-0-0) 3

Contact Hours: 39

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

Discuss the concepts, characteristics, delivery models and benefits of cloud computing and explore the key technical, organizational and compliance challenges of cloud computing. Explore virtualization and security issues that arise in cloud computing.

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 uses of cloud computing and Identify the architecture, infrastructure and delivery models of cloud computing.	-	1,4	5
CO-2	Explain cloud computing philosophy & computing paradigms.	-	2,4,5	-
CO-3	Demonstrate the working of VM and VMM on any cloud platforms (public/private), and run a software service on that.	-	4,8	7
CO-4	Explain the policies and procedures for cloud resource management.	-	1,2,4	5
CO-5	Explain and build simple security models using cloud security principles.	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, Cloud Infrastructure: Cloud computing, Cloud computing delivery models and services, Ethical issues, Cloud vulnerabilities, Cloud computing at Amazon, Cloud computing the Google perspective, Microsoft Windows Azure and online services, Open- source software platforms for private clouds, Cloud storage diversity and vendor lock-in, Energy use and ecological impact, Service level agreements, User experience and software licensing. Exercises and problems. **7 Hrs.**

Unit-II

Cloud Computing: Application Paradigms.: Challenges of cloud computing, Architectural styles of cloud computing, Workflows: Coordination of multiple activities, Coordination based on a state machine model: The Zookeeper, The Map Reduce programming model, A case study: The Gre The Web application, Cloud for science and engineering, High- performance computing on a cloud, Cloud computing for Biology research, Social computing, digital content and cloud computing. **8 Hrs.**

Unit-III

Cloud Resource Virtualization: Virtualization, Layering and virtualization, Virtual machine monitors, Virtual Machines, Performance and Security Isolation, Full virtualization and Para virtualization, Hardware support for virtualization, Case Study: Xen a VMM based Para virtualization, Optimization of network virtualization, vBlades, Performance comparison of virtual machines, The dark side of virtualization. **8 Hrs.**

Unit-IV

Cloud Resource Management and Scheduling: Policies and mechanisms for resource management, Application of control theory to task scheduling on a cloud, Stability of a two- level resource allocation architecture, Feedback control based on dynamic thresholds, Coordination of specialized autonomic performance managers, A utility-based model for cloud-based Web services, Resourcing bundling: Combinatorial auctions for cloud resources, Scheduling algorithms for computing clouds, Fair queuing, Start-time fair queuing, Borrowed virtual time, Cloud scheduling subject to deadlines, Scheduling MapReduce applications subject to deadlines, Resource management and dynamic scaling. **8Hrs.**

Unit-V

Cloud Security, Cloud Application Development: Cloud security risks, Security: The top concern for cloud users, Privacy and privacy impact assessment, Trust, Operating

system security, Virtual machine Security, Security of virtualization, Security risks posed by shared images, Security risks posed by a management OS, A trusted virtual machine monitor, Amazon web services: EC2 instances, Connecting clients to cloud instances through firewalls, Security rules for application and transport layer protocols in EC2, How to launch an EC2 Linux instance and connect to it, How to use S3 in java, Cloud-based simulation of a distributed trust algorithm, A trust management service, A cloud service for adaptive data streaming, Cloud based optimal FPGA synthesis.

8 Hrs.

Reference Books:

1) Cloud Computing: Theory and Practice, Dan C Marinescu Elsevier (MK), 2013.
2) Computing Principles and Paradigms, RajkumarBuyya , James Broberg, Andrzej Goscinsk,i Willey, 2014.
3) Cloud Computing Implementation, Management and Security John W Rittinghouse, James F Ransome, CRC Press, 2013.

22UCSO641 Network Management (3-0-0) 3

Contact Hours: 39

Course Learning Objectives (CLOs): This course, at under graduate level for 3 credits, explains the issues for network management arising from a range of security threats, including viruses and denial-of-service attacks. Develop a strategy for ensuring appropriate levels of security in a system designed for a particular purpose.

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** network communication architecture and goals	2,13	-	-
CO-2	**Explain** and **apply** Management information Tree (MIT)	13,14	3, 4	5
CO-3	**Explain** structure of management through Management Information Base	13	4	3
CO-4	**Explain** Remote Monitoring, and concept of broadband, security.	-	4,5	7
CO-5	**Design** and **develop** network management solutions for the given scenario like Inventory management, fault location and management, performance management, accounting management, report management.	-	10	-

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	1.5	-	1.0	-	-	2.0	-	-	3.0	3.0	-	-

Pre-requisites: Knowledge of Computer Networks

Contents:

Unit-I

Introduction: Some Common Network Problems; Challenges of Information Technology Managers, Network Management: Goals, Organization, and Functions Goal of Network Management, Network Provisioning, Network Operations and the NOC, Network Installation and Maintenance; Network and System Management, Network Management System platform, Current Status and Future of Network Management

Basic Foundations: Standards, Models, and Language: Network Management Standards, Network Management Model, Organization Model, Information Model – Management Information Trees, Managed Object Perspectives, Communication Model; ASN.1 Terminology, Symbols and Conventions, Objects and Data Types, Object Names, An Example of ASN.1Prere from ISO 8824; Encoding Structure; Macros, Functional Model. **8 Hrs.**

Unit-II

SNMPv1 Network Management : Organization and Information Models : Managed Network: The History of SNMP Management, Internet Organizations and standards, Internet Documents, The SNMP Model, The Organization Model, System Overview, The Information Model – Introduction, The Structure of Management Information, Managed Objects, Management Information Base **8 Hrs.**

Unit-III

SNMPv1 Network Management: Communication and Functional Models: The SNMP Communication Model – The SNMP Architecture, Administrative Model, SNMP Specifications, SNMP Operations, SNMP MIB Group, and Functional Model.

SNMP Management- RMON: Remote Monitoring, RMON SMI and MIB, RMONI1 RMON1 Textual Conventions, RMON1 Groups and Functions, Relationship Between Control and Data Tables, RMON1 Common and Ethernet Groups, RMON Token Ring Extension Groups, RMON2 – The RMON2 Management Information Base, RMON2. **8 Hrs.**

Unit-IV

Broadband Network Management: ATM Networks: Broadband Networks and Services, ATM Technology – Virtual Path Virtual Circuit, TM Packet Size, Integrated Service, SONET, ATM LAN Emulation, Virtual LAN; ATM Network Management – The ATM Network Reference Model, The Integrated Local Management Interface, The ATM Management Information Base, The Role of SNMP and ILMI in ATM Management, M1 Interface: Management of ATM Network Element, M2 Interface: Management of Private Networks, M3 Interface: Customer Network Management of Public Networks, M4 Interface: Public Network Management, Management of LAN Emulation. ADSL Architecture, ADSL Channeling Schemes, ADSL Encoding Schemes; ADSL Management ADSL Network Management Elements **8 Hrs.**

Unit-V

Network Management Tools: Introduction to various network management tools. Server Management: Application Servers, Web Server. Device configuration like Fire wall settings, Hot Spot, Gate Ways, Switches etc. **7 Hrs.**

Experiments:

1. Analyze bandwidth throughput etc. for a given network.
2. Analyze different protocols performance like TCP and UDP for a given point-to-point network.
3. Analyze routing protocol performance.

Reference Books:

1) Mani Subramanian, “Network Management Principles and Practice”, 2nd Edition, Pearson Education Publication, 2010.
2) Jianguo Ding, “Advances in Network Management”, 1st Edition, Auerbach Publications, 2016.
3) Allan Leinwand, Karen Fang Conroy, & Karen Fang, “Network Management: A Practical Perspective”, Addison Wesley, 1996
4) Alexander Clemm, “Network Management Fundamentals”, Cisco, 1st Edition, 2016.

22UCSO642 Object Oriented Programming (OOP) with C++ (3-0-0) 3

Contact Hours: 39

Course Learning Objectives (CLOs):

Understand the fundamentals of object-oriented programming in C++, including defining classes, invoking member methods, using class libraries, etc. Students will be able to handle exceptions in the programs using appropriate mechanisms.

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to POs (1-12)/ PSOs (13-14)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	**Illustrate** the concepts of object-oriented programming, C++ language constructs and **design** classes for any given problem.	1, 2	3, 13	12,14
CO-2	**Illustrate** and **apply** dynamic memory management, constructors and destructors.	1	13	12,14
CO-3	**Illustrate** and **implement** inheritance and understand the benefits of the same.	1, 2	3, 13	12,14
CO-4	**Illustrate** and **implement dynamic** polymorphism using virtual functions and implement operator overloading concepts.	1, 2	13	12,14
CO-5	**Design** and **implement** template functions and **use** exception handling mechanisms.	3	1, 2	12,13,14

Course Outcomes (COs):

POs/PSOs	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**
Mapping Level	2.8	2.75	2.33	-	1.5	-	1.0	-	-	2.0	-	1.0	1.8	1.0

Pre-requisites: Basic programming skills

Contents:

Unit-I

Introduction to C++: A Review of Structures, Procedure-Oriented Programming Systems, Object-Oriented Programming Systems, Comparison of C++ with Console Input/ Output in C++, Variables in C++, Reference Variables in C++, Function

Prototyping, Function Overloading, Default Values for Formal Arguments of Functions, Inline Functions.

Class and Objects: Introduction to Classes and Objects Member Functions and Member Data, Objects and Functions, Objects and Arrays. Namespaces, Nested Classes. **8 Hrs.**

Unit-II

Dynamic Memory Management: Introduction, Dynamic Memory Allocation, Dynamic Memory Deallocation, The set new _ handler() function.
Constructors and Destructors: Constructors, Destructors, The Philosophy of OOPS. **8 Hrs.**

Unit-III

Inheritance: Introduction to Inheritance, Base Class and Derived Class Pointers, Function Overriding, Base Class Initialization, The Protected Access Specifier, Deriving by Different Access Specifiers, Different Kinds of Inheritance, Order of Invocation of Constructors and Destructors. **8 Hrs.**

Unit-IV

Virtual Functions and Dynamic Polymorphism: The Need for Virtual Functions, Virtual Functions, The Mechanism of Virtual Functions, Pure Virtual Functions, Virtual Destructors and Virtual Constructors.
Operator Over loading: Operator Overloading, Overloading the Various Operators - Type conversion. **8 Hrs.**

Unit-V

Templates: Introduction, Function Templates, Class Templates.
Exception Handling: Introduction, C-Style Handling of Error generating Codes, C++Style Solution - the try/throw/catch Construct. Limitation of Exception Handling. **7 Hrs.**

Reference Books:

1) Sourav Sahay, Object-Oriented Programming with C++, Oxford University Press,2006
2) Stanley B. Lippman, Josee Lajoie, Barbara E. Moo, C++ Primer, 4th Edition, Addison Wesley, :2005
3) Herbert Schildt, The Complete Reference C++, 4th Edition. TMH, 2005
4) Balagurusamy, OOPs with C++, 3rd Edition, McGraw-Hill, 2006.

CIE and SEE Evaluation (from 2023-24 batch)

Courses with LTP 3-0-0 and 4-0-0 or 2-2-0/3-2-0

Continuous Internal Evaluation (CIE):

- Two Internal Assessments and one Improvement test each of 20 marks and one hour duration.
- Two higher scores from three tests are taken representing 40 marks.
- Question Paper pattern for Internal Assessment: 3 questions of 10 marks each with maximum of two sub divisions. Q.3 is compulsory and one question to be answered from Q.1 and Q.2.
- Course Teacher Assessment (CTA): Minimum two components such as quiz, seminar, written assignment, any technical activity related to course each of 5marks. Total CTA marks-10
- CIE=40 (from tests)+10(from CTA) =50 marks

Semester End Examination (SEE):

- SEE is conducted for100 marks with 3 hours duration. It is reduced to 50 marks.
- Question Paper pattern for SEE: Five units with built in choice. Each question with maximum of three sub divisions.
- Two questions are to be set from each unit with built in choice, for example Q1 or Q2 in unit –I, Q 3 or Q 4 in unit-II and so on.
- A total of 5 full questions to be answered choosing one full question from each unit. All five units are to be answered compulsorily.
- Each question is of 20 marks.
- The Question paper is to be set for duration of 3 hours both for 3 and 4 credits courses.
- The Question paper is to be set for 100 marks for 3 and 4 credits courses.

ASC(IC)/PCC with LTP 2-0-2, 3-0-2 and 2-2-2

Continuous Internal Evaluation (CIE):

Theory CIE component:

- Two Internal Assessments and one Improvement test each of 20 marks and one hour duration.
- Two higher scores from three tests are taken representing 40 marks.
- Question Paper pattern for Internal Assessment: 3 questions of 10 marks each with maximum of two sub divisions. Q.3 is compulsory and one question to be answered from Q.1 and Q.2.

Course Teacher Assessment (CTA): Totally based on conduction of experiments as set by the course teacher.

Laboratory component assessment:

- 5 marks: for conduction, regularity, involvement, journal writing, etc. Minimum 75% of attendance is compulsory. If the performance is not satisfactory in laboratory the student shall be detained and required to reregister for the course as a whole whenever offered next.
- 5 marks: Lab Test. A Lab test as per the class time table has to be conducted at the end for50 marks and scale down to 5 marks.
- CIE for integrated course =40 (from IA tests)+10 (from CTA i.e. lab component) =50 marks.
- There will not be any remuneration for Final Lab Test since it is CTA of integrated course.
- Copy of the Marks list to be sent to the concerned course instructor immediately after the completion of test for that batch. Original Marks list to be maintained in the department.
- CIE=40(from tests)+10(from CTA i.e. lab component) =50 marks

Semester End Examination (SEE):

- SEE is conducted for100 marks with 3 hours duration. It is reduced to 50 marks.
- Question Paper pattern for SEE: Five units with built in choice. Each question with maximum of three sub divisions.
- Two questions are to be set from each unit with built in choice, for example Q1 or Q2 in unit –I, Q 3 or Q 4 in unit-II and so on.
- A total of 5 full questions to be answered choosing one full question from each unit. All five units are to be answered compulsorily.
- Each question is of 20 marks.
- The Question paper is to be set for duration of 3 hours both for 3 and 4 credits courses.
- The Question paper is to be set for 100 marks for 3 and 4 credits courses.

AEC/HSMS/UHV Courses with LTP 1-0-0:

Continuous Internal Evaluation (CIE)

- Two Internal Assessments and one Improvement test each of 20 marks and one hour duration.
- Two higher scores from three tests are taken representing 40 marks.
- Question Paper pattern for Internal Assessment: MCQ 20 questions
- Course Teacher Assessment (CTA): Minimum two components such as quiz, seminar, written assignment, any technical activity related to course etc. each of 5marks. Total CTA marks-10
- CIE=40(from tests)+10(from CTA) =50 marks

Semester End Examination (SEE):

- SEE is conducted for 50 marks of 1 hour duration. There will be 50 MCQs.

- Question Paper pattern for SEE: The question paper will contain 12 MCQ questions drawn from each Unit.
- Students have to answer maximum of 10 questions from each unit.
- All five units are to be answered compulsorily.

For NSS/Physical Education/Yoga Audit Courses with LTP 0-0-2

Continuous Internal Evaluation (CIE)

- All students have to register for any one course in each semester of III to VI with concerned course instructor.
- The department must make a faculty coordinator for the above audit courses and the details of the students must be maintained.
- The concerned course instructor must define the set of activities and its schedule of the conduction in NSS, PE and Yoga by taking approval from Dean Academic Program.
- The course instructor has to conduct the events as per the schedule and maintain the attendance for the same. 75% attendance is mandatory.
- The course instructor must assess the students by conducting the MCQ test for 50 marks to be conducted during the improvement test for other courses.
- The course instructor must send the marks and attendance register to the respective departments.
- The faculty coordinator of the department must maintain the same and arrange for sending the marks to CoE.