NEW HORIZON COLLEGE OF ENGINEERING

Department of Computer Science and Engineering (Data Science)

Academic Year 2026-27



5th and 6th Semester Scheme and Syllabus

Batch: 2024-28
Credits: 160

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NEW HORIZON COLLEGE OF ENGINEERING

VISION

To emerge as an institute of eminence in the fields of engineering, technology and management in serving the industry and the nation by empowering studentswith a high degree of technical, managerial and practical competence.

MISSION

- To strengthen the theoretical, practical and ethical dimensions of the learning process by fostering a culture of research and innovation among faculty members and students.
- To encourage long-term interaction between the academia and industry through their involvement in the design of curriculum and its hands-on implementation.
- To strengthen and mould students in professional, ethical, social and environmental dimensions by encouraging participation in co-curricular and extracurricular activities

QUALITY POLICY

To provide educational services of the highest quality both curricular and co- curricular to enable students integrate skills and serve the industry and society equally well at global level.

VALUES

- Academic Freedom
- Integrity
- Inclusiveness
- Innovation
- Professionalism
- Social Responsibility

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING (DATA SCIENCE)

VISION

To emerge as a department of eminence in Computer Science and Engineering, specializing in the field of Data science, serving the Data-Driven computing Industry and the nation by empowering students with a high degree of technical and practical competence.

MISSION

- To strengthen the theoretical, practical and ethical dimensions of the learning process by nurturing a culture of research, innovation among faculty members and students in the field of Data Science.
- To build long-term interaction between the academia and industry, through their involvement in the design of the curriculum and its hands-on implementation.
- To strengthen and mould students in professional, ethical, social and environmental dimensions by encouraging participation in co-curricular and extracurricular activities.

Knowledge and Attitude Profile (WK)

WK1: A systematic, theory-based understanding of the natural sciences applicable to the discipline and awareness of relevant social sciences.

WK2: Conceptually-based mathematics, numerical analysis, data analysis, statistics and formal aspects of computer and information science to support detailed analysis and modelling applicable to the discipline.

WK3: A systematic, theory-based formulation of engineering fundamentals required in the engineering discipline.

WK4: Engineering specialist knowledge that provides theoretical frameworks and bodies of knowledge for the accepted practice areas in the engineering discipline; much is at the forefront of the discipline.

WK5: Knowledge, including efficient resource use, environmental impacts, whole-life cost, reuse of resources, net zero carbon, and similar concepts, that supports engineering design and operations in a practice area.

WK6: Knowledge of engineering practice (technology) in the practice areas in the engineering discipline.

WK7: Knowledge of the role of engineering in society and identified issues in engineering practice in the discipline, such as the professional responsibility of an engineer to public safety and sustainable development.

WK8: Engagement with selected knowledge in the current research literature of the discipline, awareness of the power of critical thinking and creative approaches to evaluate emerging issues.

WK9: Ethics, inclusive behavior and conduct. Knowledge of professional ethics, responsibilities, and norms of engineering practice. Awareness of the need for diversity by reason of ethnicity, gender, age, physical ability etc. with mutual understanding and respect, and of inclusive attitudes.

PROGRAM OUTCOMES (POs)

PO1 Engineering Knowledge: Apply knowledge of mathematics, science, computing, engineering fundamentals and an engineering specialization as specified in WK1 to WK4 respectively to develop the solution of complex engineering problems.

PO2 Problem Analysis: Identify, formulate, review research literature and analyze comple engineering problems reaching substantiated conclusions with considerations for sustainable development. (WK1 to WK4)

PO3 Design / Development of Solutions: Design creative solutions for complex engineering problems and design/develop systems to meet identified needs with consideration for the public health and safety, whole-life cost, net zero carbon, culture, society and environment as required. (WK5)

PO4 Conduct Investigations of Complex Problems: Conduct investigations of complex engineering problems using research-based knowledge including design of experiments, modelling, analysis & interpretation of data to provide valid conclusions. (WK8).

PO5 Modern tool usage: Create, select and apply appropriate techniques, resources and modern engineering & IT tools, including prediction and modelling recognizing their limitations to solve complex engineering problems. (WK2 and WK6)

PO6 The engineer and the World: Analyze and evaluate societal and environmental aspects while solving complex engineering problems for its impact on sustainability with reference to economy, health, safety, legal framework, culture and environment. (WK1, WK5, and WK7).

PO7 Ethics: Apply ethical principles and commit to professional ethics, human values, diversity and inclusion; adhere to national & international laws. (WK9)

PO8 Individual and Collaborative Teamwork: Function effectively as an individual, and as a member or leader in diverse/multi-disciplinary teams.

PO9 Communication: Communicate effectively and inclusively within the engineering community and society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations considering cultural, language, and learning differences.

PO10 Project Management and Finance: Apply knowledge and understanding of engineering management principles and economic decision-making and apply these to one's own work, as a member and leader in a team, and to manage projects and in multidisciplinary environments.

PO11 Life-Long Learning: Recognize the need for, and have the preparation and ability for i) independent and life-long learning ii) adaptability to new and emerging technologies and iii) critical thinking in the broadest context of technological change. (WK8)

PROGRAM SPECIFIC OUTCOMES (PSOs)

PSO1	Apply data analysis techniques, algorithmic expertise, and advanced modelling to effectively solve complex problems across various domains demonstrating their capacity to derive insights and propose innovative solutions in the realm of data-driven technologies.
PSO2	Collaborate proficiently with experts from diverse fields and actively engage in continuous professional growth in the domain of Computer Science and Engineering, specializing in the field of Data Science.

PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

PEO1	Develop proficiency as a Data Scientist with an ability to solve a wide range of computational problems in industry, government, or other work environments.
PEO2	Attain the ability to adapt quickly to new environments and technologies, assimilate new information, and work in multi-disciplinary areas with a strong focus on innovation and entrepreneurship.
PEO3	Possess the ability to think logically and the capacity to understand technical problems with computational systems.
PEO4	Possess the ability to collaborate as team members and team leaders to facilitate cutting-edge technical solutions for computing systems and thereby providing improved functionality.

NEW HORIZON COLLEGE OF ENGINEERING

B. E. in Computer Science & Engineering (Data Science)

Scheme of Teaching and Examinations for 2024- 2028 BATCH (2024 Scheme)

V Semester													
S. No.	**Course and Course Code**		**Course Title**	**BoS**	**Credit Distribution**				**Overall Credits**	**Contact Hours**	**Marks**		
					L	**T**	**P**	**S**			**CIE**	**SEE**	**Total**
1	IPCC	24CDS51	Internet of Things	DS	2	0	1	0	3	3	50	50	**100**
2	PCC	24CSK52	Design and Analysis of Algorithms	CS	3	0	0	0	3	3	50	50	**100**
3	PCCL	24CSLK52	Design and Analysis of Algorithms Lab	CS	0	0	1	0	1	2	50	50	**100**
4	PCC	24CDS53	Fundamentals of Data Science	DS	3	0	0	0	3	3	50	50	**100**
5	PCCL	24CDL53	Fundamentals of Data Science Lab	DS	0	0	1	0	1	2	50	50	**100**
6	AEC*	24CDS54	Introduction to DevOps	DS	3	0	0	0	3	3	50	50	**100**
7	AEC	24RMK55	Research Methodology and IPR	DS	1	0	0	0	1	1	50	50	**100**
8	AEC	24SDK56	Problem Solving Methodologies	DS	0	0	1	0	1	2	50	-	**50**
9	PROJ**	24CDS57	Societal Based Mini Project	DS	0	0	1	0	1	2	50	50	**100**
10	OEC*	26NHOP5XX	Industrial Open Elective Course-I	DS	3	0	0	0	3	3	50	50	**100**
11	NCMC	24NSS50	National Service Scheme	-	0	0	0	0	0	2	50	--	**50**
		24PED50	Physical Education and Sports	-									
		24YOG50	Yoga	-									
Total									**20**	**26**	**550**	**450**	**1000**

AEC* (Skill Based Core Course):
Credit for AEC* with 03 (L: T: P: S) credits can be considered as (3: 0: 0: 0). The teaching and learning of these Courses will be based on hands-on. The Course content will be from Industry Certification Course Content. The Course Assessment will be based on CIE and SEE in practical mode.

PCC: Professional Core Course, **PCCL**: Professional Core Course laboratory, **UHV**: Universal Human Value Course, **NCMC:** Non-Credit Mandatory Course, **AEC**: Ability Enhancement Course, **PEC**: Professional Elective Course, **IPCC**: Integrated Professional Core Course, **PROJ**: Mini Project work **L:** Lecture, **T**: Tutorial, **P**: Practical **S: SDA**: Self Study for Skill Development, **CIE**: Continuous Internal Evaluation, **SEE**:Semester End Evaluation

PCC: Professional Core Course, **PCCL**: Professional Core Course laboratory, **UHV**: Universal Human Value Course, **NCMC:** Non-Credit Mandatory Course, **AEC**: Ability Enhancement Course, **PEC**: Professional Elective Course, **PROJ**: Mini Project work **L:** Lecture, **T**: Tutorial, **P**: Practical **S: SDA**: Self Study for Skill Development, **CIE**: Continuous Internal Evaluation, **SEE**:Semester End Evaluation

Societal Based Mini Project **:

The Mini project can be done in any lab across college. A common slot in time table can be allotted across all departments.
Mini Project is a laboratory-oriented/hands on course that will provide a platform to students to enhance their practical knowledge and skills by the development of small systems/applications etc. Based on the ability/abilities of the student/s and recommendations of the mentor. A student can do mini project as

(i) A group of 2 if mini project work is single discipline (applicable to all IT allied branches)
(ii) A group of 3- 4 if mini project work is single discipline (applicable to all Core Branches)
(iii) A group of 3 - 4 students if the Mini Project work is a multidisciplinary (Applicable to all Branches)

CIE procedure for Mini-project:

(i) Single discipline: The CIE marks shall be awarded by a committee consisting of the Head of the concerned Department and two faculty members of the Department, one of them being the Guide. The CIE marks awarded for the Mini-project work shall be based on the evaluation of the project report, project presentation skill, and question and answer session in the ratio of 50:25:25. The marks awarded for the project report shall be the same for all the batches mates.

(ii) Interdisciplinary: Continuous Internal Evaluation shall be group-wise at the college level with the participation of all the guides of the project.

The CIE marks awarded for the Mini-project, shall be based on the evaluation of the project report, project presentation skill, and question and answer session in the percentage ratio of 50:25:25. The marks awarded for the project report shall be the same for all the batch mates.

Industrial Open Elective Courses-I:
Credit for OEC is 03 (L: T: P: S) can be considered as (3: 0: 0 : 0). The teaching and learning of these Courses will be based on hands-on. The Course Assessment will be based on CIE and SEE in practical mode. This Courses will be offered by Centre of Excellence to students of all the branches. Registration to Industrial open electives shall be documented and monitored on college level.

National Service Scheme /Physical Education/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 coordinator of the course during the first week of III semesters. 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.

Credit Definition: 1-hour Lecture (L) per week=1Credit 2-hoursTutorial(T) per week=1Credit 2-hours Practical / Drawing (P) per week=1Credit 2-hous Self Study for Skill Development (SDA) per week = 1 Credit	03-Credits courses are to be designed for 40 hours in Teaching-Learning Session 02- Credits courses are to be designed for 25 hours of Teaching-Learning Session 01-Credit courses are to be designed for 15 hours of Teaching-Learning Sessions

NEW HORIZON COLLEGE OF ENGINEERING

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Scheme of Teaching and Examinations for 2024- 2028 BATCH (2024 Scheme)

VI Semester													
S. No.	Course and Course Code		Course Title	BoS	Credit Distribution				Overall Credits	Contact Hours	Marks		
					L	T	P	S			CIE	SEE	Total
1	PCC	24CDS61	Artificial Intelligence & Machine Learning	DS	3	0	0	0	3	3	50	50	**100**
2	PCCL	24CDL61	Artificial Intelligence & Machine Learning Lab	DS	0	0	1	0	1	2	50	50	**100**
3	PCC	24CDS62	Computer Networks	DS	3	0	0	0	3	3	50	50	**100**
4	PCCL	24CDL62	Computer Networks Lab	DS	0	0	1	0	1	2	50	50	**100**
5	AEC*	24CDS63	Cyber Security Essentials	DS	3	0	0	0	3	3	50	50	**100**
6	PEC	24CDS64X	Professional Elective Course-II	DS	3	0	0	0	3	3	50	50	**100**
7	AEC	24CDS65X	Ability Enhancement Course – V	DS	0	0	1	0	1	2	50	50	**100**
8	NCMC	24SDK66	Advanced Problem Solving Methodologies	DS	0	0	0	0	0	2	50	--	**50**
9	PROJ	24CDS67	Capstone Project	DS	0	0	2	0	2	4	50	50	**100**
10	PCC	26NHOP6XX	Industrial Open Elective Course-II	Offering Dept.	3	0	0	0	3	3	50	50	**100**
11	NCMC	24NSS60	National Service Scheme	-	0	0	0	0	0	2	50	--	**50**
		24PED60	Physical Education	-									
		24YOG60	Yoga	-									
								Total	**20**	**29**	**550**	**450**	**1000**

PCC: Professional Core Course, **PCCL**: Professional Core Course laboratory, **NCMC:** Non-Credit Mandatory Course, **AEC**: Ability Enhancement Course, **PEC**: Professional Elective Course, **OEC**: Open Elective Course, **PROJ**: Project work**, L:** Lecture, **T**: Tutorial, **P**: Practical **S: SDA**: Self Study for Skill Development, C**IE**: Continuous Internal Evaluation, **SEE**:Semester End Evaluation.

Professional Elective Course-II			
24CDS641	Predictive Analytics	24CDS644	Automata Theory and Computability
24CDS642	Object Oriented Analysis & Design	24CDS645	Ethical AI
24CDS643	Scalable Data Science		

Ability Enhancement Course – V			
24CDS651	Advanced Java	24CDS654	Advanced Python Programming
24CDS652	Software Testing & Automation	24CDS655	Scala Programming
24CDS653	Fundamentals of Mobile Application Development		

Industrial Open Elective Courses-II:
Credit for OEC is 03 (L: T: P: S) can be considered as (3: 0: 0 : 0). The teaching and learning of these Courses will be based on hands-on. The Course Assessment will be based on CIE and SEE in practical mode. This Courses will be offered by Centre of Excellence to students of all the branches. Registration to Industrial open electives shall be documented and monitored on college level.

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 can be added to supplement the latest trend and advanced technology in the selected stream of engineering.

Capstone Project:

Students have to discuss with the mentor /guide and with their help he/she has to define the problem statement for the project.

The objective of the Project is

- To encourage independent learning and the innovative attitude of the students.
- To develop interactive attitude, communication skills, organization, time management, and presentation skills.
- To impart flexibility and adaptability.
- To inspire team working.
- To expand intellectual capacity, credibility, judgment and intuition.
- To adhere to punctuality, setting and meeting deadlines.
- To install responsibilities to oneself and others.
- To train students to present the topic of project work in a seminar without any fear, face the audience confidently, enhance communication skills, involve in group discussion to present and exchange ideas.

CIE procedure for Project:

1. **Single discipline:** The CIE marks shall be awarded by a committee consisting of the Head of the concerned Department and two senior faculty members of the Department, one of whom shall be the Guide.
   The CIE marks awarded for the project, shall be based on the evaluation of the project Report, project presentation skill, and question and answer session in the percentage ratio of 50:25:25. The marks awarded for the project report shall be the same for all the batch mates.
2. **Interdisciplinary:** Continuous Internal Evaluation shall be group-wise at the college level with the participation of all guides of the college. Participation of external guide/s, if any, is desirable. The CIE marks awarded for the project work, shall be based on the evaluation of project Report, project presentation skill, and question and answer session in the percentage ratio of 50:25:25. The marks awarded for the project report shall be the same for all the batch mates.

   SEE procedure for Project: SEE for project will be conducted by the two examiners appointed by the University. The SEE marks awarded for the project shall be based on the evaluation of project Report, project presentation skill, and question and answer session in the percentage ratio of 50:25:25.

National Service Scheme /Physical Education/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 coordinator of the course during the first week of III semesters. 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.

Credit Definition: 1-hour Lecture (L) per week=1Credit 2-hoursTutorial(T) per week=1Credit 2-hours Practical / Drawing (P) per week=1Credit 2-hous Self Study for Skill Development (SDA) per week = 1 Credit	03-Credits courses are to be designed for 40 hours in Teaching-Learning Session 02- Credits courses are to be designed for 25 hours of Teaching-Learning Session 01-Credit courses are to be designed for 15 hours of Teaching-Learning Sessions

V Semester

INTERNET OF THINGS

Course Code	**24CDS51**	**CIE Marks**	**50**
L:T:P:S	**2:0:1:0**	**SEE Marks**	**50**
Hrs. / Week	**2+2**	**Total Marks**	**100**
Credits	**03**	**Exam Hours**	**03**

Course outcomes:
At the end of the course, the student will be able to:

24CDS51.1	Understand IoT fundaments and embedded systems design philosophies
24CDS51.2	Analyze the IoT based embedded framework and its requirements
24CDS51.3	Use the microcontroller architectures to develop and IoT applications
24CDS51.4	Characterize the connectivity and communication technologies for IoT eco system
24CDS51.5	Evaluate the contemporary technologies for IoT implementation
24CDS51.6	Examine associated IoT technologies for implementing smart applications

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**
24CDS51.1	2	2	2	2	2	-	-	-	-	-	3	3	3
24CDS51.2	2	3	2	2	2	-	-	-	-	-	3	3	3
24CDS51.3	3	3	3	3	3	-	-	-	-	-	3	3	3
24CDS51.4	2	3	2	2	2	-	-	-	-	-	3	3	3
24CDS51.5	2	2	3	2	2	-	-	-	-	-	3	3	3
24CDS51.6	2	3	2	2	2	-	-	-	-	-	3	3	3

MODULE-1	**FUNDAMENTALS OF IOT**	**24CDS51.1, 24CDS51.2**	**8 Hours**

Processors of IoT, Evolution of IoT, Enabling IoT, IoT networking components, Addressing Strategies in IoT, Sensors, Sensor Characteristics, Sensing Types, Actuators, Actuator types

Laboratory Component:

1. Arduino IDE Setup and Interfacing LEDs
2. Interfacing Push Buttons, and Buzzer with Arduino
3. Interfacing Analog Sensors (LM35/DHT11) with Arduino

Self-study	• Trace the evolution of the Internet from the traditional Internet to the Internet of Things. What technological advancements enabled this transition, and how has IoT transformed the way devices interact with humans and each other? • Compare and contrast the 3-layer and 5-layer IoT architectures. Explain the role of each layer and discuss how the additional layers in the 5-layer architecture improve scalability, security, and data management. • How do enabling technologies such as cloud computing, edge computing, wireless sensor networks, RFID, artificial intelligence, and big data analytics contribute to the IoT ecosystem? Illustrate your answer using a smart city application.
Text Book	Text Book 1: Chapter 4 & Chapter 5

MODULE-2	**EMBEDDED SYSTEMS**	**24CDS51.1, 24CDS51.2**	**8 Hours**

<table>
<tr><td colspan="4">Introduction to Embedded Systems, Philosophy, Characteristics of Embedded Systems, Design Challenges, Building an Embedded System, Embedded Systems Versus General Computing Systems, The Embedded System Design and Development Process, Embedded System Design Stages, System Design and Development, Life Cycle models</td></tr>
<tr><td colspan="4">Laboratory Component:
1. Interfacing OLED/LCD Display with Arduino
2. Interfacing Relay Module and Servo Motor for Device Automation
3. Interfacing Soil moisture sensor with Arduino</td></tr>
<tr><td>Self-study</td><td colspan="3">• Explain their characteristics, applications, advantages, and limitations with suitable examples.
• Explain the various stages involved, from requirement analysis to testing and deployment, highlighting the challenges faced at each stage.
• Identify the system requirements, hardware and software components, design challenges, and the life cycle model suitable for its development.</td></tr>
<tr><td>Text Book</td><td colspan="3">Text Book 2: Chapter 0 & 5.2 & 5.3</td></tr>
<tr><td>MODULE-3</td><td>EMBEDDED SYSTEMS PROGRAMMING</td><td>24CDS51.3</td><td>8 Hours</td></tr>
<tr><td colspan="4">Microcontrollers, ATmega328 block diagram, Printing on the serial console, LED interfacing, DHT sensor interfacing, Gas Sensor Interfacing, Ultrasonic Sensor interfacing, Servo motor interfacing, Raspberry Pi, RP2040 Microcontroller, LED interfacing, DHT interfacing, Pi Camera Interface, Client -server socket programming,</td></tr>
<tr><td colspan="4">Laboratory Component:
1. Interfacing float sensor with Arduino
2. Interfacing Smoke/Gas sensor with Arduino
3. Uploading Sensor Data from NodeMCU to Cloud Platform (ThingSpeak/Blynk/MQTT)</td></tr>
<tr><td>Case Study</td><td colspan="3">• A municipal corporation wants to monitor water levels, flow rates, and water quality across multiple reservoirs and distribution tanks. Sensors continuously collect data and send it to a cloud platform. City officials require real-time dashboards, alerts for abnormal conditions, and predictive analysis for water demand.
• A manufacturing plant wants to monitor critical machines using vibration, temperature, and current sensors. The system should detect anomalies, generate maintenance alerts, and minimize equipment downtime. Due to the large volume of sensor data, processing all data in the cloud may introduce delays.
• A hospital intends to monitor patients remotely using wearable devices that measure heart rate, blood pressure, oxygen saturation, and body temperature. The data must be available to doctors through a secure dashboard, while critical health events should trigger immediate alerts.</td></tr>
<tr><td>Text Book</td><td colspan="3">Text Book 2: 3.1, 3.3, 3.5, 3.7, 3.10</td></tr>
<tr><td>MODULE-4</td><td>IOT CONNECTIVITY TECHNOLOGIES AND COMMUNICATION TECHNOLOGIES</td><td>24CDS51.4, 24CDS51.5</td><td>8 Hours</td></tr>
<tr><td colspan="4">Connectivity Technologies: IEEE 802.15.4, Zigbee, Thread, ISA 100.11A, Wireless HART, RFID, NFC, DASH7, Z-Wave, Weightless, Sigfox, LoRa, NB-IoT, Wi-Fi, Bluetooth,
Communication Technologies: IPv6, 6LoWPAN, MQTT, CoAP, AMQP, XMPP, REST</td></tr>
<tr><td colspan="4">Laboratory Component:
1. Remote Monitoring and Control of Appliances Using NodeMCU and Mobile Dashboard
2. Interfacing LED and switch with Raspberry Pi
3. Interfacing Ultrasonic Sensor with Raspberry Pi</td></tr>
<tr><td>Case Study</td><td colspan="3">• Compare Wi-Fi, BLE, ZigBee, LoRaWAN, NB-IoT, and 5G for this application in terms of range, power consumption, data rate, and deployment cost.
• Which communication protocol (MQTT, CoAP, HTTP/HTTPS, or WebSockets) would be most suitable for transmitting sensor data? Justify your choice.</td></tr>
</table>

	• Discuss the advantages of using IPv6 over IPv4 in large-scale IoT deployments involving thousands of sensor nodes.		
Text Book	Text Book 3: Ex 1, 5, 6, 8,		
MODULE-5	**ASSOCIATED IOT TECHNOLOGIES**	**24CDS51.5, 24CDS51.6**	**8 Hours**
Vitualization, Cloud Models, Cloud Implementation, Sensor-Cloud, Fog Computing and Edge computing, Artificial Intelligence, Machine Learning, Industry 4.0, Digital Twin, Smart Home Systems, Smart Cities, Industrial IoT (IIoT), Healthcare IoT, Agriculture IoT			
Laboratory Component: 1. Interfacing IR sensor with Raspberry Pi 2. Interfacing PIR sensor with Raspberry Pi *3.* Development of IoT dashboard using Node-RED			
Applications	• Design a Smart Home IoT system that integrates lighting, HVAC, security cameras, and smart appliances. Explain the sensors, actuators, communication technologies, and automation logic required to achieve this goal. • Propose an IoT-based Smart City solution to address these challenges. Describe the data collected, communication infrastructure, cloud services, and expected benefits to citizens and administrators. • Develop an IIoT-based predictive maintenance system. Explain how sensor data can be collected, analyzed, and used to predict failures before they occur . • Design a Healthcare IoT architecture that enables continuous monitoring of patient vital signs and automatic alert generation during emergencies. Discuss data privacy and security considerations.		
Text Book	Text Book 1: Chapter 10 & Chapter 11		

CIE Assessment Pattern (50 Marks – Theory and Lab) –

RBT Levels		Marks Distribution		
		Test (s)	AAT1	AAT2
		25	05	20
L1	Remember	-	-	-
L2	Understand	10	-	5
L3	Apply	5	2.5	5
L4	Analyze	5	2.5	5
L5	Evaluate	5	-	5
L6	Create	-	-	-

SEE Assessment Pattern (50 Marks – Theory)

RBT Levels		Exam Marks Distribution (50)
L1	Remember	-
L2	Understand	15
L3	Apply	15
L4	Analyze	10
L5	Evaluate	10
L6	Create	--

Suggested Learning Resources:

Text Books:

1. Misra S, Mukherjee A, Roy A. Introduction to IoT. Cambridge University Press; 2021, ISBN: 9781108842952
2. Peckol, James K. Embedded systems: a contemporary design tool. John Wiley & Sons, Wiley, 2024, ISBN: 9789357463966
3. Vandana C.P, Baswaraju Swathi, Chitti Internet of Things Programming for Beginners. Walnut Publications, 2023, ISBN: 97839359111605

Reference Books:

4. Herrero, Rolando. "Practical internet of things networking." Textbooks in telecommunication engineering. Springer International Publishing, 2023
5. Gupta, Rajan, and Supriya Madan. Fundamentals of IoT: Get familiar with the building blocks of IoT (English Edition). BPB Publications, 2023.
6. Dow, Colin. Internet of things programming projects: build modern IoT solutions with the Raspberry Pi 3 and Python. Packt Publishing Ltd, 2018, ISBN: 978-1789134803

Web links and Video Lectures (e-Resources):

- **https://nptel.ac.in/courses/106105166**
- **https://nptel.ac.in/courses/106105195**
- **netacad.com/courses/introduction-iot**

Activity-Based Learning (Suggested Activities in Class)/ Practical Based learning

- Interfacing demonstration
- Mini project
- Ideathon

DESIGN AND ANALYSIS OF ALGORITHMS			
Course Code	**24CSK52**	**CIE Marks**	**50**
L:T:P:S	**3:0:0:0**	**SEE Marks**	**50**
Hrs / Week	**3**	**Total Marks**	**100**
Credits	**03**	**Exam Hours**	**03**

Course outcomes:
At the end of the course, the student will be able to:

24CSK52.1	Apply algorithmic design to solve simple to complex problems using various approaches for algorithm design
24CSK52.2	Analyze both brute force and divide-and-conquer design strategies to compute an algorithm's effectiveness in devising a solution.
24CSK52.3	Design and deploy from a variety of techniques to address searching and sorting challenges.
24CSK52.4	Implement both greedy and dynamic programming strategies for solving intricate problems
24CSK52.5	Evaluate backtracking and branch & bound methods for crafting solutions to real-time problems
24CSK52.6	Interpret the P, NP, and NP-complete complexity classes to scrutinize the constraints and boundaries of an algorithm's performance

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
24CSK52.1	3	-	-	-	-	-	-	-	-	-	1	3	-
24CSK52.2	-	3	2	-	-	-	-	-	-	-	1	3	-
24CSK52.3	-	3	3	-	3	-	-	-	-	-	1	3	-
24CSK52.4	-	-	3	-	3	-	-	-	-	-	1	3	1
24CSK52.5	-	-	-	3	2	1	-	-	-	-	2	3	1
24CSK52.6	-	. -	-	3	-	1	-	-	-	-	2	2	1

MODULE-1	**Exploring Algorithms and Analyzing Function Growth**	**24CSK52.1**	**8 Hours**

Algorithm introduction, Fundamentals of Algorithmic problem solving, fundamentals of analysis of algorithm efficiency, analysis framework, Asymptotic notations, Important problem types, Mathematical Analysis of Recursive Algorithms-factorial function, Tower of Hanoi, Binary Recursion, and Mathematical Analysis of Non-Recursive Algorithms-Maximum Element, Element uniqueness problem.

Self-study	Evaluate a real-world problem where the algorithm is applied and discuss its efficiency.
Text Book	Text Book 2: 1.1,1.2,1.3,2.2,2.3,2.4

MODULE-2	**Methods for Evaluating an Algorithm In Order To Devise A Solution**	**24CSK52.2**	**8 Hours**

Brute Force String matching algorithms – Naive string matching, Rabin Karp Knuth Morris Pratt. Exhaustive Search, Travelling Salesman problem and Knapsack problem. Divide & Conquer: Merge Sort ,Quick sort, selection sort and their performance analysis.

Case Study	Read the algorithm, write its pseudocode, implement and analyze its time and space complexity.
Text Book	Text Book 1:32.1,32.2,32.4 Text Book 2: 3.4,4.1,4.2

MODULE-3	**Exploring Search Algorithms and Balanced Trees**	**24CSK52.3**	**8 Hours**

Decrease and Conquer: Decrease by constant, Decrease by constant factor-Russian Peasant Multiplication, Fake-Coin Problem, variable size decrease- Breadth First search traversal, Depth First search traversal, Topological sorting. Transform & Conquer: AVL trees, Heap sort.

Case Study	Solve a practical problem using the algorithm and compare it with alternative methods.		
Text Book	Text Book 2: 3.1, 3.3, 3.5, 3.7, 3.10		
MODULE-4	**Optimizing Algorithms for Efficient Problem Solving**	**24CSK52.4**	**8 Hours**

Greedy Technique: Job sequence with deadlines, Minimum Spanning tree algorithms – Kruskal's & Prim's, Shortest Path algorithm – Dijkstra's, Huffman Trees and codes, Dynamic Programming: 0/1 Knapsack problems, Warshall's Algorithm, Floyd's algorithm

Case Study	Explore a case study on "Optimizing Algorithms for Efficient Problem Solving" in the context of job scheduling in a manufacturing facility.		
Text Book	Text Book 3: 4.1,4.2.4.4 Text Book 2:8.1,8.2,8.4,9.1,9.2,9.3,9.4		
MODULE-5	**Algorithmic Frontiers and Strategies**	**24CSK52.5, 24CSK52.6**	**8 Hours**

Backtracking: N Queens problem, subset sum problem, graph coloring, Hamiltonian Circuit Problem, Branch & Bound: Travelling Salesman problem, Assignment problem, Limitations of Algorithm Power: Decision Trees, Deterministic Polynomial (P), Non-Deterministic Polynomial (NP) , NP complete & NP Hard.

Self-study	Study reductions between NP-Complete problems and distinguish NP-Hard problems.
Text Book	Text Book 2: 12.1 to 12.10

CIE Assessment Pattern (50 Marks – Theory) –

RBT Levels		Marks Distribution		
		Test (s)	AAT1	AAT2
		25	15	10
L1	Remember	-	-	-
L2	Understand	-	-	-
L3	Apply	10	5	5
L4	Analyze	10	5	5
L5	Evaluate	5	5	-
L6	Create	-	-	-

SEE Assessment Pattern (50 Marks – Theory)

RBT Levels		Exam Marks Distribution (50)
L1	Remember	--
L2	Understand	--
L3	Apply	20
L4	Analyze	20
L5	Evaluate	10
L6	Create	--

Suggested Learning Resources:

Text Books:

1. Thomas H Cormen, Charles E Leiserson, Ronald R Rivest & Clifford Stein, "Introduction to Algorithms", fourth edition, 2022, MIT Press, ISBN:9780262367509.
2. Anany Levitin, "Introduction to the Design & Analysis of Algorithms", Third Edition, 2022, Pearson Education, ISBN: 978-9332585485.
3. Ellis Horowitz, Satraj Sahni and Rajasekaran, "Computer Algorithms/C++ ", fourth Edition, 2023, The Orient Blackswan, ISBN: 978-9386235145.

Reference Books:

1. Anuradha A. Puntambekar, “Analysis and Design of Algorithms”, 2022, Technical Publications, ISBN: 978-9333223867.
2. Design and Analysis of Algorithms, S. Sridhar, 2023, Oxford University Press, ISBN: 9789354977886.

Web links and Video Lectures (e-Resources):

- **https://www.javatpoint.com/daa-rabin-karp-algorithm**
- **https://www.javatpoint.com/daa-knuth-morris-pratt-algorithm**
- **https://www.javatpoint.com/greedy-algorithms**
- **https://www.javatpoint.com/dynamic-programming**
- **https://www.javatpoint.com/backtracking-introduction**
- **https://www.javatpoint.com/backtracking-introduction**
- **https://www.youtube.com/playlist?list=PLdo5W4Nhv31ZTn2P9vF02bkb3SC8uiUUn**

Activity-Based Learning (Suggested Activities in Class)/Practical-Based learning:

- Algorithmic Problem-Solving Sessions: conducting regular problem-solving sessions where students work in groups to solve algorithmic problems from basic to advance to devise solutions collaboratively.
- Algorithm Visualization and Simulation: Practice interactive algorithm visualization and simulation tools to visually observe how algorithms work in real-time. Modify algorithms by changing the input parameters and analyze the effects on algorithm performance. This approach promotes active engagement and allows to gain insights into algorithm behavior through experimentation.

DESIGN AND ANALYSIS OF ALGORITHMS LAB			
Course Code	**24CSLK52**	**CIE Marks**	**50**
L:T:P:S	**0:0:1:0**	**SEE Marks**	**50**
Hrs / Week	**2**	**Total Marks**	**100**
Credits	**01**	**Exam Hours**	**03**

Course outcomes:

At the end of the course, the student will be able to:

24CSLK52.1	Apply the divide-and-conquer design strategies to compute an algorithm's effectiveness in devising a solution. And string-matching problems through application of various algorithmic methods.
24CSLK52.2	Analyze decrease and conquer techniques to address graph traversal problems.
24CSLK52.3	Develop both greedy and dynamic programming strategies for solving intricate problems
24CSLK52.4	Implement backtracking and branch & bound methods for crafting solutions to real-time problems

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
24CSLK52.1	3	-	-	-	1	-	-	-	1	-	1	3	-
24CSLK52.2	-	3	-	-	1	-	-	-	1	-	1	3	-
24CSLK52.3	-	-	3	-	1	-	-	-	1	-	1	3	-
24CSLK52.4	-	-	3	-	2	-	-	-	1	-	1	3	1

Pgm. No.	List of Programs	Hours	COs
	Prerequisite		
	Demo of programming language tool Installation with Simple Programs. Design, develop, and implement the specified algorithms for the following problems using programming language under LINUX /Windows environment.	2	NA
	PART-A		
1	Develop a program to perform string matching using the Rabin-Karp Algorithm.	2	24CSLK52.1
2	Examine the time complexity of Merge Sort through the application of the divide and conquer technique	2	24CSLK52.1
3	Examine the time complexity of Quick Sort employing the divide and conquer technique.	2	24CSLK52.1
4	Develop a program for implementing the heap sort algorithm.	2	24CSLK52.2
5	A. Implement the Breadth-First Search (BFS) algorithm to traverse a graph from a given source vertex. The algorithm should visit all vertices level by level using a queue and display the order of traversal. B. Implement the Depth-First Search (DFS) algorithm to traverse a graph from a given source vertex. The algorithm should visit vertices by exploring as far as possible along each branch before backtracking using recursion or a stack.	2	24CSLK52.2
6	Given a connected Graph of some number of vertices, develop a program to find Minimum Spanning Tree of graph by applying Kruskal's algorithm.		24CSLK52.3
	PART-B		
7	Design a program that utilizes Prim's Algorithm to determine the minimum cost spanning tree within a given graph. This algorithm systematically selects edges while ensuring that the resulting tree remains connected and has the lowest possible total edge weight	2	24CSLK52.3
8	Develop a program to find shortest paths from source vertex to other vertices in a weighted connected graph, using Dijkstra's algorithm.	2	24CSLK52.3
9	Develop a program to implement the 0/1 Knapsack problem using Dynamic Programming.	2	24CSLK52.3
10	Develop a program to (a) Implement All-Pairs Shortest Paths problem using Floyd's algorithm.	2	24CSLK52.3

	(b) Find transitive closure of a graph using Warshall's algorithm.		
11	Write a program to color the nodes in the graph such that no two adjacent can have the same color using backtracking.	2	24CSLK52.4
12	Develop a comprehensive program that employs the Backtracking technique to solve the N Queens problem. This classic problem involves placing 'N' chess queens on an 'N x N' chessboard in such a way that no two queens threaten each other, ensuring that no queen can attack any other queen horizontally, vertically, or diagonally.	2	24CSLK52.4

PART-C
Beyond Syllabus Virtual Lab Content
(To be done during Lab but not to be included for CIE or SEE)

- **https://ds2-iiith.vlabs.ac.in/List%20of%20experiments.html**
- **https://daa-dei.vlabs.ac.in/exp/divide-conquer-sorting/html**
- **https://daa-dei.vlabs.ac.in/exp/greedy-coinchange/greehtml**
- **https://daa-dei.vlabs.ac.in/exp/dp-lcs/Dynamic Progra/html**

CIE Assessment Pattern (50 Marks – Lab)

RBT Levels		Test (s)	Weekly Assessment
		20	30
L1	Remember	--	-
L2	Understand	--	-
L3	Apply	5	10
L4	Analyze	10	10
L5	Evaluate	5	10
L6	Create	--	--

SEE Assessment Pattern (50 Marks – Lab)

RBT Levels		Exam Marks Distribution (50)
L1	Remember	--
L2	Understand	--
L3	Apply	20
L4	Analyze	20
L5	Evaluate	10
L6	Create	--

Suggested Learning Resources:
Reference Books:
1) Anany Levitin, "Introduction to the Design & Analysis of Algorithms", Third Edition, 2022, Pearson Education, ISBN: 978-9332585485.
2) Design and Analysis of Algorithms, S. Sridhar, 2023 Oxford University Press, ISBN: 9780198093695.

FUNDAMENTALS OF DATA SCIENCE			
Course Code	**24CDS53**	**CIE Marks**	**50**
L:T:P:S	**3:0:0:0**	**SEE Marks**	**50**
Hrs. / Week	**3**	**Total Marks**	**100**
Credits	**03**	**Exam Hours**	**03**

Course outcomes:
At the end of the course, the student will be able to:

24CDS53.1	Understand the probability, Statistics and Linear algebra concepts essential for data science.
24CDS53.2	Apply sampling and dimensionality reduction techniques to enhance data analysis and modelling
24CDS53.3	Analyze linear regression and multiple linear regression for model building and prediction.
24CDS53.4	Develop Classification & Clustering algorithms with practical applications across diverse datasets.
24CDS53.5	Evaluate the performance metrics associated with various models.
24CDS53.6	Interpret the optimization techniques used to enhance computational efficiency in data-driven decision-making processes.

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
24CDS53.1	2	2	-	-	-	-	-	-	-	-	3	3	3
24CDS53.2	3	-	-	-	-	-	-	-	-	-	3	3	3
24CDS53.3	2	3	-	-	-	-	-	-	-	-	3	3	3
24CDS53.4	2	-	3	3	-	-	-	-	-	-	3	3	3
24CDS53.5	2	-	-	3	-	-	-	-	-	-	3	3	3
24CDS53.6	2	-	-	3	-	-	-	-	-	-	3	3	3

MODULE-1	**FOUNDATIONS OF DATA SCIENCE**	**24CDS53.1**	**8 Hours**

Introduction to data science, Data mining and Data Warehousing, Descriptive analytics, Probability Theory, Probability distribution, Confidence interval for population mean and proportion, Hypothesis Testing and the power of Hypothesis Testing.

Case Study	Analyzing Online Customer Reviews for an E-commerce Company.
Text Book	Text Book 1: 1.1, Text Book 2: 4.1, 4.2, 4.3, Text Book 3: 2.1

MODULE-2	**DATA PREPROCESSING**	**24CDS53.2**	**8 Hours**

Types of Data, Sampling Theory, Sampling Techniques, Correlation, Feature Selection. Dimensionality Reduction Techniques: Projections, Eigen Value Decomposition, Principal Component Analysis (PCA).

Self-study	Experiment with Python libraries like scikit-learn and pandas that offer functionalities for data analysis and dimensionality reduction techniques.
Text Book	Text Book 1: 3.3, 3.4,3.5 , Text Book 2: 4.3,4.4, Text Book 3: 5.2

MODULE-3	**LINEAR REGRESSION**	**24CDS53.3 24CDS53.5**	**8 Hours**

Simple Linear Regression- Steps in building a regression model, Model diagnostics, Multiple Linear Regression

Developing Multiple Linear Regression, Co linearity, Residual Analysis, Detecting Influencers.			
Self-study	In a scenario where you are building a model to predict student loan repayment, what potential challenges might you encounter when collecting data and building the model		
Text Book	Text Book 1: 4.1 to 4.6, Text Book 2: 3.5 to 3.8		
MODULE-4	**CLASSIFICATION**	**24CDS53.4 24CDS53.5**	**8 Hours**
Classification Algorithms: Logistic Regression, Regularization techniques, Naïve Bayes, K- Nearest Neighbor, Ensemble methods, Hyper parameter tuning, Decision Trees, Random Forest.			
Text Book	Text Book 1:1.19, Text Book 2: 3.6 ,3.9,3.10		
MODULE-5	**CLUSTERING AND OPTIMIZATION**	**24CDS53.5, 24CDS53.6**	**8 Hours**
Clustering techniques- Hierarchical Clustering, Single – link, Complete linkage, and Clustering algorithms- K means, DB Scan, Jaccard Coefficient, Elbow technique. Optimization, Optimization techniques for Data Science.			
Text Book	Text Book 1: 3.5 , 3.6, 3.9 , 3.10		

CIE Assessment Pattern (50 Marks – Theory) –

RBT Levels		Marks Distribution		
		Test (s)	AAT1	AAT2
		25	15	10
L1	Remember	-	-	-
L2	Understand	10	-	5
L3	Apply	5	7.5	5
L4	Analyze	5	7.5	-
L5	Evaluate	5	-	-
L6	Create	-	-	-

SEE Assessment Pattern (50 Marks – Theory)

RBT Levels		Exam Marks Distribution (50)
L1	Remember	-
L2	Understand	15
L3	Apply	15
L4	Analyze	10
L5	Evaluate	10
L6	Create	--

Suggested Learning Resources:

Text Books:

1. Joel Grus, Data Science from Scratch: First Principles with Python, 2nd Edition, O'Reilly Media, 2023, ISBN: 978-1492041139
2. Introduction to Data Science: Practical Approach with R and Python, B. Uma Maheswari, R. Sujatha, 2021, ISBN-13 9789354640506
3. Mohammed J. Zaki & Wagner Meira Jr. Data Mining and Machine Learning: Fundamental Concepts and Algorithms , Cambridge University Press, 2023, ISBN:-13 9781108835414
4. Peter Bruce, Andrew Bruce, Peter Gedeck "Practical Statistics for Data Scientists" -3rd Edition, O'Reilly, 2023, ISBN: 9781098103002
5. Laura Igual & Santi Seguí, "Introduction to Data Science", Springer, 2022, ISBN:-13 9783030847731

Reference Books:

1. Douglas C. Montgomery, George C. Runger, "Applied Statistics and Probability for Engineers",

6th Edition, Wiley Publishers, 2016, ISBN-13, **978-8126562947**

2. McKinney W. "Python for data analysis: Data wrangling with Pandas, NumPy, and IPython." O'Reilly Media, Inc., 2012, ISBN-13, **978-9352136414.**
3. EMC Education Services , "Data Science & Big Data Analytics: Discovering, Analyzing, Visualizing and Presenting Data", John Wiley & Sons, Inc, 2015,ISBN:9781119183686.
4. Manaranjan Pradhan, U Dinesh Kumar, "Machine Learning using Python", First Edition, Wiley Publishers, 2019, ISBN-13, 978-8126579907**.**
5. Gilbert Strang, "Introduction to Linear Algebra, Fifth Edition", Wellesley-Cambridge Press and SIAM, 2016, ISBN : 978-09802327-7-6.

Web links and Video Lectures (e-Resources):

- **https://machinelearningmastery.com/**
- **https://towardsdatascience.com/data-science/home**
- **https://www.mastersindatascience.org/**
- **https://onlinecourses.nptel.ac.in/noc20_cs46/preview**

Activity-Based Learning (Suggested Activities in Class)/ Practical Based learning

- Problem solving exercises
- Case Studies

FUNDAMENTALS OF DATA SCIENCE LAB

Course Code	**24CDL53**	**CIE Marks**	**50**
L:T:P:S	**0:0:1:0**	**SEE Marks**	**50**
Hrs. / Week	**2**	**Total Marks**	**100**
Credits	**01**	**Exam Hours**	**03**

Course outcomes:
At the end of the course, the student will be able to:

24CDL53.1	Understand basic operations of NumPy, Pandas, and Matplotlib.
24CDL53.2	Analyze sample datasets using regression models.
24CDL53.3	Develop clustering and classification algorithms on publicly available datasets
24CDL53.4	Evaluate the performance metrics associated with various models.

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
24CDL53.1	**2**	**-**	-	-	-	**-**	**-**	**-**	**-**	**-**	**3**	**3**	**3**
24CDL53.2	**2**	**3**	2	2	-	**-**	**-**	**-**	**-**	**-**	**3**	**3**	**3**
24CDL53.3	**2**	**3**	3	2	-	**-**	**-**	**-**	**-**	**-**	**3**	**3**	**3**
24CDL53.4	**2**	**-**	-	3	-	**-**	**-**	**-**	**-**	**-**	**3**	**3**	**3**

Pgm. No.	List of Programs	Hours	COs
	Prerequisite		
	• Mathematics- Probability, statistics and calculus • Object- oriented programming languages like java, C, Python • Structured Query Language (SQL) for database queries	3	NA
	PART-A		
1	Using NumPy library write a python program to demonstrate a) arange, linspace, logspace Function b) Array indexing c) Slicing Arrays d) Joining Arrays e) Splitting and Searching Arrays	2	24CDL53.1
2	Using pandas in python demonstrate the following operations for the sample dataset given, 1) Indexing of Data frame 2) Grouping and aggregating 3) Adding and removing attributes 4) Joining data frames 5) Filtering the data 6) Handling missing values.	2	24CDL53.1
3	Write a Python Program to import any CSV file to Pandas Data Frame and perform the following: 1) Visualize the first and last 10 records 2) Get the shape, index and column details 3) Select/Delete the records(rows)/columns based on conditions.	2	24CDL53.1

	4) Perform ranking and sorting operations. 5) Do required statistical operations on the given columns. • Find the count and uniqueness of the given categorical values. Rename single/multiple columns.		
4	Using pandas and Matplotlib demonstrate the following operations for the sample dataset given, i) Bar chart and Histogram ii) Comparing Distribution iii) Box plot and mention quartiles.	2	24CDL53.2
5	1) Develop a program to implement Simple Linear Regression model and evaluate the model by evaluate the performance by Mean Squared Error (MSE), Mean Absolute Error (MAE). 2) Develop a program to implement Multiple Linear Regression model and evaluate the model by verifying the performance by R-square (Coefficient of Determination)	2	24CDL53.2
6	Develop a program to implement Logistic Regression and indicate the class label for the test dataset. (Computing coefficients (weights) using gradient descent).	2	24CDL53.2
PART-B			
7	Develop a program to implement Naive Bayes classifier model and analyze the model using confusion matrix	2	24CDL53.3 24CDL53.4
8	Develop a function or class decision_tree (x_train, y_train) that implements a Decision Tree classifier. • Use the trained Decision Tree model to predict class labels for a test dataset (x_test). Compute a confusion matrix to evaluate the model's performance.	2	24CDL53.3 24CDL53.4
9	Develop a program to implement Random Forest classifier model and analyze the model using Receiver Operating Characteristic (ROC) Curve and Area Under the Curve (AUC).	2	24CDL53.3 24CDL53.4
10	Develop a program to implement KNN classifier model and analyse the model using Classification Report.	2	24CDL53.3 24CDL53.4
11	Develop a program to implement K Means clustering model for the given value of K, where K is number of clusters.	2	24CDL53.3 24CDL53.4
12	Develop a program to implement Hierarchical clustering model for the given value of N, where N is number of clusters.	2	24CDL53.3 24CDL53.4

PART-C
Beyond Syllabus Virtual Lab Content
(To be done during Lab but not to be included for CIE or SEE)

1. https://cloudlabs.ai/virtual-labs
2. **https://labex.io/free-labs/pandas**

CIE Assessment Pattern (50 Marks – Lab)

RBT Levels		Test (s)	Weekly Assessment
		20	**30**
L1	**Remember**	**-**	**-**
L2	**Understand**	**-**	**-**
L3	**Apply**	**10**	10
L4	**Analyze**	**5**	10
L5	**Evaluate**	**5**	10
L6	**Create**	**-**	**-**

SEE Assessment Pattern (50 Marks – Lab)

RBT Levels		Exam Marks Distribution (50)
L1	**Remember**	**-**
L2	**Understand**	
L3	**Apply**	**20**
L4	**Analyze**	**20**
L5	**Evaluate**	**10**
L6	**Create**	

Suggested Learning Resources:

Reference Books:

1. U Dinesh Kumar, "Business Analytics : The Science of Data Driven decision making", First Edition, Wiley Publishers, 2017, ISBN-13, 978-8126568772.
2. N Jiawei Han, Micheline Kamber , Jian Pei Professor, "Data Mining: Concepts and Techniques", Third Edition, Morgan Kaufmann Series,2011, ISBN-13, 978-9380931913.

INTRODUCTION TO DEVOPS

Course Code	**24CDS54**	**CIE Marks**	**50**
L:T:P:S	**3:0:0:0**	**SEE Marks**	**50**
Hrs / Week	**3**	**Total Marks**	**100**
Credits	**03**	**Exam Hours**	**03**

Course outcomes:
At the end of the course, the student will be able to:

24CDS54.1	Apply DevOps principles and use Maven and Gradle tools for build automation, dependency management, and project configuration in Java applications.
24CDS54.2	Apply Git and GitHub for version control, branch management, collaboration, and repository management in software development projects.
24CDS54.3	Design and implement Continuous Integration (CI) pipelines using Jenkins for automated building, testing, and deployment of applications.
24CDS54.4	Design, deploy and manage cloud resources using AWS services such as IAM, EC2, and S3 while adhering to security and access control practices.
24CDS54.5	Apply containerization concepts using Docker for image management, container lifecycle operations, and application portability.
24CDS54.6	Implement automated software delivery workflows and CI/CD pipelines by integrating DevOps tools such as Maven/Gradle, GitHub, Jenkins, AWS, and Docker.

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
24CDS54.1	3	-	-	-	3	-	-	-	-	-	2	2	-
24CDS54.2	3	-	-	-	3	-	-	-	-	-	2	2	-
24CDS54.3	-	-	3	-	3	-	-	-	-	-	2	2	-
24CDS54.4	-	-	3	-	3	-	-	-	-	-	2	2	-
24CDS54.5	3	-	-	2	3	-	-	-	-	-	2	2	-
24CDS54.6	-	-	3	2	3	-	-	-	-	-	2	2	-

MODULE-1	**BUILD AUTOMATION WITH MAVEN AND GRADLE**	**24CDS54.1**	**8 Hours**

Fundamentals of DevOps, Introduction and Working with Maven: Creating a Maven Project, Understanding the POM File, Dependency Management and Plugins. Introduction and Working with Gradle: Setting up a Gradle Project, Understanding Build Scripts (Groovy and Kotlin DSL), Dependency Management and Task Automation.

Hands-on

1. Install Maven and verify the setup using command-line tools.
2. Create a Java application using Maven and manage dependencies through the POM file.
3. Create the same application using Gradle and automate build tasks.

Case Study	Migration of Enterprise Java Projects from Maven to Gradle for Faster Build and Deployment Processes
Text Book	Text book 1: Ch. 1,5,6

MODULE-2	**VERSION CONTROL WITH GIT & GITHUB**	**24CDS54.2**	**8 Hours**

Version Control Systems (VCS): centralized vs distributed, ,Configuration of Git, Basic Git commands: init, add, commit, status, log. Branching and merging, Working with remote repositories: push, pull, fetch, Fundamentals of GitHub.			
Hands-on 1. Install Git on your system and configure your username and email. 2. Create a local Git repository using git init and perform at least three commits. 3. Create a repository on GitHub and push the local repository to the remote GitHub repository.			
Applications	Student Project Version Control Using Git and GitHub: Using Git to manage project versions through commits and GitHub to store and share the project remotely.		
Text Book	Text book 1: Ch. 2		
MODULE-3	**CONTINUOUS INTEGRATION WITH JENKINS**	**24CDS54.3**	**8 Hours**
Introduction to Jenkins: What is Jenkins?, Installing Jenkins on Local or Cloud Environment, Configuring Jenkins for First Use. Continuous Integration with Jenkins: Setting Up a CI Pipeline, Integrating Jenkins with Maven/Gradle, Running Automated Builds and Tests.			
Hands-on 1. Install and configure Jenkins on a local machine or cloud environment. 2. Create and configure a Jenkins job. 3. Build and test a Java application using Jenkins CI pipelines.			
Case Study	Java Application Continuous Integration Using Jenkins: Using Jenkins to automate the building and testing of a Java application through a CI pipeline.		
Text Book	Text book 2: Ch. 2, 3, 4		
MODULE-4	**AWS FOR DEVOPS**	**24CDS54.4**	**8 Hours**
Introduction to AWS for DevOps: Overview of AWS Cloud Services, AWS Global Infrastructure, IAM and Security Fundamentals, Introduction to EC2and S3			
Hands-on 1. Create and configure an AWS account and explore the AWS Management Console. 2. Launch and manage EC2 instances for application deployment. 3. Create and configure Amazon S3 buckets for storage.			
Applications	Online Food Ordering System Using AWS**:** Deploying a food ordering application on EC2 and storing restaurant images and menu files in Amazon S3.		
Text Book	Text book 3: Ch. 1,2		
MODULE-5	**INTRODUCTION TO DOCKER**	**24CDS54.5, 24CDS54.6**	**8 Hours**
Docker Hub and Image Management: Docker Hub overview, Public and Private Repositories, Searching and Downloading Images, Pulling Images from Docker Hub, Tagging and Pushing Custom Images to Docker Hub.			
Hands-on 1. Explore Docker Hub and identify popular Docker images. 2. Use basic Docker commands to manage images and containers. 3. Pull an image from Docker Hub and push a custom Docker image to a Docker Hub repository.			
Case Study	Banking Application Containerization**:** Using Docker to containerize and deploy a banking application consistently across different environments.		
Text Book	Text book 4: Ch. 6		
Students will be required to:			

1. Students form their own team for Project with 2 members.
2. Preparation of detailed design for the project.
3. Implementation of the sub-modules and their integration for their project.
4. Testing and validation.
5. Prepare and submit the project report and slides at the end of the semester exam.

CIE Assessment Pattern (50 Marks – Lab)

		Tests (s)	Online Learning Certification	Weekly Assessment
		25	15	10
L1	Remember	-	-	-
L2	Understand	5	5	-
L3	Apply	5	5	5
L4	Analyze	5	5	5
L5	Evaluate	5	-	-
L6	Create	5	-	-

SEE Assessment Pattern (50 Marks – Lab)

RBT Levels		Exam Marks Distribution (50)
L1	Remember	-
L2	Understand	5
L3	Apply	10
L4	Analyze	15
L5	Evaluate	10
L6	Create	10

Text Books:

1. Chin, S., McKay, M., Ruiz, I., & Sadogursky, B., DevOps Tools for Java Developers: Best Practices from Source Code to Production Containers, O'Reilly Media, 2022, ISBN-13: 978-1492084020
2. Dingare, P. P., CI/CD Pipeline Using Jenkins Unleashed: Solutions While Setting Up CI/CD Processes, Apress, 202,ISBN: 978-1484275078
3. Adam Bertram, AWS Certified DevOps Engineer – Professional: Certification and Beyond, Packt Publishing, 2021, ISBN 978-1801071512
4. Poulton, N., Docker Deep Dive, Second Edition, Packt Publishing, 2023, ISBN: 978-9355424259

Reference Books:

1. Learning DevOps: Continuously Deliver Better Software – Second Edition Packt Publishing, 2022, ISBN: 978-1801818964
2. Prem Kumar Ponuthorai and Jon Loeliger, Version Control with Git, 3rd Edition, O'Reilly Media, 2022, ISBN: 978-1492091196

Web links and Video Lectures (e-Resources):

- https://www.coursera.org/learn/continuous-integration-and-continuous-delivery-ci-cd
- https://www.coursera.org/projects/implementing-cicd-with-jenkins-creating-pipeline-as-code
- https://www.coursera.org/learn/docker-fundamentals-course
- https://www.jenkins.io/doc/book/
- https://docs.gradle.org/current/userguide/userguide.html?utm_source=chatgpt.com

Activity-Based Learning (Suggested Activities in Class)/ Practical Based learning

- Case Studies
- Class Presentations

RESEARCH METHODOLOGY AND IPR

Course Code	**24RMK55**	**CIE Marks**	**50**
L: T: P: S	**1:0:0:0**	**SEE Marks**	**50**
Hours / Week	**01**	**Total Marks**	**100**
Credits	**01**	**Exam Hours**	**02**

Course outcomes:
At the end of the course, the student will be able to:

24RMK55.1	Define research problems and formulate research questions and research objectives.
24RMK55.2	Demonstrate research processes, critical thinking, and academic writing skills.
24RMK55.3	Understand the statutory provisions and different forms of Intellectual Property Rights (IPRs).
24RMK55.4	Identify the significance and procedures of patents, including patent filing and protection.

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
24RMK55.1	3	3	2	2	2	–	–	1	2	–	**2**
24RMK55.2	3	3	2	2	2	–	–	1	2	–	**2**
24RMK55.3	3	3	2	1	1	–	1	1	2	–	**2**
24RMK55.4	3	3	2	1	–	–	1	1	2	–	**2**

MODULE-1	**FORMULATION OF RESEARCH PROBLEM**	**24RMK55.1**	**3 Hours**

Research– Meaning and Objectives–Types of Research–Research Approaches-Research Process–Literature Review–Research Problem– Identification and Defining the Research Problem.

Text Book	Text Book 1: Ch. 1, 2

MODULE-2	**RESEARCH DESIGN PROCEDURES**	**24RMK55.2**	**3 Hours**

Meaning of Research Design – Features of a Good Design –Concepts Related to Research Design– Different Research Designs – Basic Principles of Experimental Designs.

Case Study	To find the solution for the given research problem using different types of research methods
Text Book	Text Book 1: Ch. 3

MODULE-3	**INTERPRETATION AND REPORT WRITING**	**24RMK55.1 24RMK55.2**	**3 Hours**

Meaning and Technique of Interpretation – Precautions in interpretation – Different Steps in Report Writing – Layout of a Research Report– Types of Report – Mechanics of Writing a Research Report –Conclusion-Referencing in Academic Writing –Bibliography.

Text Book	Text Book 2: Ch. 14

MODULE-4	**INTRODUCTION TO IPR**	**24RMK55.3**	**3 Hours**

Introduction and Significance of Intellectual Property Rights –Types of Intellectual Property Rights–Rationale for Protection of IPR–IPR in India and Abroad–Forms of IPR – Royalty – Copyright – Trademark – Patents – Industrial Designs –Application of Different Forms of IPR– Future Aspects of IPR– Some Examples of IPR.

Text Book	Text Book 2: Ch. 1 and 2

MODULE-5	BASICS OF PATENTS	24RMK55.3, 24RMK55.4	3 Hours

Patents and its Basics – Patentable and Non-Patentable Inventions–Patent Application Process (National and International level) –Drafting and Filing a Patent –Types of Patent Applications–Patent Documents–Specification and Claims–Assignment, Licensing, Infringement–Different Layers of International Patent System

Case Study	Analyze different domains of filed patents
Text Book	Text Book 2: Ch. 1 and 2

CIE Assessment Pattern (50 Marks – Theory)

RBT Levels		Marks Distribution		
		Test (s)	Patent drafting	Review paper writing
		25	15	10
L1	Remember	5	-	-
L2	Understand	5	-	-
L3	Apply	5	-	-
L4	Analyze	5	5	5
L5	Evaluate	5	5	5
L6	Create	-	5	-

SEE Assessment Pattern (50 Marks – Theory)

RBT Levels		Exam Marks Distribution (50)
L1	Remember	10
L2	Understand	10
L3	Apply	10
L4	Analyze	10
L5	Evaluate	10
L6	Create	--

Suggested Learning Resources:

Text Books:

1) Kothari, C.R., Research Methodology: Methods and Techniques, New Age International, 2024, ISBN-9789389802559
2) Ramakrishna Chintakunta, A Text book of Intellectual Property rights, Blue Hill Publication, ASIN: B09T6YDB5N, 2022

Reference Books:

1) Garg, B.L., Karadia, R., Agarwal, F. and Agarwal, U.K, An Introduction to Research Methodology, RBSA Publishers. 2022, ISBN-13:978-8176111652
2) Ranjith Kumar, Research methodology, Saga publications,5th edition, 2024, ISBN- 9781529788785**.**
3) Sinha, S.C. and Dhiman, A.K., Research Methodology, EssEss Publications. 2 volumes, 2022. ISBN: 81-7000-324-5(Vol-I), 81-7000-334-2 (Vol-II)
4) Asha Vijay Durafe, Dhanashree K. Toradmalle , Intellectual Property Rights, Dreamtech Press,2024, ISBN: 9789351195191**.**

Web links and Video Lectures (e-Resources):

- https://www.youtube.com/watch?v=GSeeyJVD0JU
- https://www.youtube.com/watch?v=nv7MOoHMM2k
- https://www.youtube.com/watch?v=BGSgZ1J8-yQ
- https://onlinecourses.nptel.ac.in/noc22_ge08/preview
- https://www.coursera.org/learn/research-methods
- https://www.wipo.int/academy/en/

Activity-Based Learning (Suggested Activities in Class)/ Practical Based learning

- Video Sessions
- Organizing Group Wise Discussions
- Paper Presentation
- Review paper writing
- Patent drafting

PROBLEM SOLVING METHODOLOGIES

Course Code	**24SDK56**	**CIE Marks**	**50**
L:T:P:S	**0:0:1:0**	**SEE Marks**	**-**
Hrs / Week	**2**	**Total Marks**	**50**
Credits	**1**	**Exam Hours**	**02**

Course outcomes:
Upon successful completion of this course, the student will be able to:

24SDK56.1	Demonstrate proficiency in solving quantitative aptitude problems using fundamental concepts
24SDK56.2	Apply advanced quantitative techniques to address and solve complex real-world problems.
24SDK56.3	Develop and enhance logical reasoning skills essential for problem-solving in various competitive examinations.
24SDK56.4	Cultivate critical and creative thinking skills necessary for analytical reasoning and problem-solving.

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
24SDK56.1	**3**	**3**	**-**	**-**	**2**	**-**	**-**	**-**	**-**	**-**	**-**
24SDK56.2	**3**	**3**	**-**	**-**	**2**	**-**	**-**	**-**	**-**	**-**	**-**
24SDK56.3	**3**	**3**	**-**	**-**	**2**	**-**	**-**	**-**	**-**	**-**	**-**
24SDK56.4	**3**	**3**	**-**	**-**	**2**	**-**	**-**	**-**	**-**	**-**	**-**

MODULE-1	**Critical Thinking through Quantitative Analysis**	**24SDK56.1 24SDK56.2**	**6 Hours**

Number systems: LCM and HCF of numbers, Squaring and Cubing Techniques, Multiplication Tricks, Divisibility rules, Digit sum method, Speed Math, Simplifications, Approximations.

Percentages: Conversion of Fraction to Percentage Table, Percentage Change, Net percentage change/Effective percentage change, Successive Percentage, Concept of more/less percentage, Percentage of percentage, Product constancy, Increased/decreased by P%, Percentage Changes in Numerator and Denominator, Successive Percentage.

Averages: Basic concept, Consecutive Numbers, Non-Consecutive Numbers, Equation Concept, True/False concept, Including/Excluding concept, Replacement concept, Average Speed concept.

MODULE-2	**Numerical Techniques for Problem Solving**	**24SDK56.1 24SDK56.2**	**6 Hours**

Profit and Loss: Basic concept, Profit Percentage, Loss Percentage, Profit/Loss Percentage, Overall Profit/Loss, Dishonest shopkeeper, More/less loss concept, Discounts

Ratio and Proportion: Concept Explanation, Duplicate Ratio, Triplicate Ratio, Direct Proportion, Indirect Proportion, Double rule of three or compound proportion, Ratio in investment, Ratio in partnership, Ratio in averages, Ratio in profit and loss, Ratio in interest rates.

Ages: Ratio and sum of ages, Ratio and Product of Ages, Ratio of Present and Future Ages, Ratio of Past and Present Ages.

Partnership: Simple Partnership, Compound Partnership, Partnership at Will, Partnership for a Fixed Term, Particular Partnership, General Partnership, Limited Partnership, Limited Liability Partnership.

MODULE-3	**Quantitative Techniques**	**24SDK56.1 24SDK56.2**	**6 Hours**

Time and Work: Unit work, Combined work, Individual efficiency, Group efficiencies, Time taken by an individual or a group, Work done by an individual or a group, Total work done, Chain Rule Concept, Pipes and Cisterns, 4 Rules of Pipes and Cistern.

Gamification: Switch Grid, Geo Sudoku, Grid Lock, Number Challenge, Cognitive reasoning games.

Cognitive Ability: Statements & Conclusions, Statements & Assertions, Statements & Assumptions, Causes & Effects and Flow Charts.

MODULE-4	Analytical Reasoning and Creative Problem Solving	24SDK56.3 24SDK56.4	6 Hours

Number Series - Missing numbers, Incomplete series - Odd-even series, primes, Fibonacci series, Arithmetic progression, Geometric progression, Harmonic progression, Squares and cubes, Operations on digits, Exponential series, Increasing multiplication, Hybrid series.

Alphabetical Series- Missing alphabets, incomplete letter series - series of words, series of letters, arrangement of words/letters, letters marked with corresponding numbers sequence, positions of letters, ranking of the word in dictionary; Mixed Series - Missing numbers and words/letters, complete the series. **Analogies:** Alphabet Classification, Word Classification, Number Classification.

Coding and Decoding: Coding based on order, Letter to Letter Mapping, Letter to number mapping, Letter to digit mapping, Re-ordering sequences; Word sequencing, Match the word to code, Symbol Coding.

MODULE-5	Problem Solving through Logical Analysis	24SDK56.3 24SDK56.4	6 Hours

Directions: Eight Directions, Distance, Displacement, Starting and ending points, Referential directions, Directions of shadows, Axis based problems, Actual and conditional directions.

Seating Arrangements: Linear arrangement, Square Arrangement, Rectangular Arrangement, Circular arrangement, Vertical arrangement, Seating arrangement in a photograph, Tabular arrangement, Hexagonal Seating Arrangement, Complex arrangement, Miscellaneous arrangements.

Blood Relations: Relations defined, Generation Verticals, Family Tree, Single Person Blood Relations, Mixed/Chain Blood Relations, Symbol based Blood Relation.

CIE Assessment Pattern (50 Marks – Theory)

RBT Levels		Marks Distribution
		Tests
		50
L1	Remember	10
L2	Understand	10
L3	Apply	20
L4	Analyze	10
L5	Evaluate	-
L6	Create	-

Suggested Learning Resources:

Text Books:

1. Quantitative Aptitude for Competitive Examinations — R.S. Aggarwal
2. How to Prepare for Quantitative Aptitude for CAT — Arun Sharma

Reference Books:

1. Quantum CAT — Sarvesh K. Verma

2. Fast Track Objective Arithmetic — Rajesh Verma
3. Quantitative Aptitude for Placements — Dinesh Khattar

Web links and Video Lectures (e-Resources):

- Freshersworld: Aptitude & Reasoning
  https://www.youtube.com/results?search_query=Freshersworld+Aptitude+Reasoning
- Adda24/7: Aptitude & Reasoning
  https://www.youtube.com/results?search_query=Adda247+Quantitative+Aptitude+Reasoning

Activity-Based Learning (Suggested Activities in Class)/ Practical Based learning

Activity	Aptitude Topic	Description
Math Relay Race	Percentages, Profit & Loss, Time & Work	• Divide students into teams. Each student solves one question and passes the sheet to the next teammate. The first team to finish with the most correct answers wins.
Puzzle & Seating Challenge	Seating Arrangements, Logical Reasoning	• Give each team a seating arrangement or logic puzzle. Teams compete to solve it within a fixed time.
DI Detective	Data Interpretation	• Provide charts, graphs, or tables. Students answer questions individually or in groups, explaining how they arrived at their answers.
Human Number Line	Number System, Averages, Ratio & Proportion	• Students hold number cards and physically arrange themselves to solve ordering, averages, ratios, or sequence-based problems.
Aptitude Quiz Bowl	Mixed Aptitude Topics	• Conduct a quiz with multiple rounds (MCQs, rapid fire, visual reasoning, puzzles, and calculation challenges). Award points to teams and maintain a leaderboard.

SOCIETAL BASED MINI PROJECT			
Course Code	**24CDS57**	**CIE Marks**	**50**
L: T:P:S	**0:0:1:0**	**SEE Marks**	**50**
Hrs. / Week	**02**	**Total Marks**	**100**
Credits	**01**	**Exam Hours**	**03**

Course outcomes:
At the end of the course, the student will be able to:

24CDS57.1	Identify suitable problem statements and its requirements, with the use of technical knowledge gained.
24CDS57.2	Analyze a comprehensive project plan, outlining tasks, timelines, and resource allocation.
24CDS57.3	Develop a system architecture and design that aligns with project goals.
24CDS57.4	Apply programming skills to transform design into a functional software solution
24CDS57.5	Develop and execute a rigorous testing strategy to identify and rectify bugs and issues
24CDS57.6	Demonstrate their communication skill effectively with technical oral presentation and well-structured documents.

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
24CDS57.1	3	3	3	3	-	-	-	-	3	3	3	3	3
24CDS57.2	3	3	3	3	-	2	2	2	3	3	3	3	3
24CDS57.3	3	3	3	3	3	-	-	-	3	3	3	3	3
24CDS57.4	3	3	3	3	3	-	-	-	3	3	3	3	3
24CDS57.5	3	3	3	3	3	-	-	-	3	3	3	3	3
24CDS57.6	-	-	-	3	3	2	2	2	3	3	3	3	3

Societal Based Mini Project Roadmap: Guiding Principles for Mini Project Success

Project Overview:

- Clearly define the project's scope, objectives, and expected outcomes.
- Provide a brief description of the problem the project aims to solve or the functionality it should implement.

Project Milestones:

- Set clear project milestones and deadlines for various phases, such as planning, design, implementation, testing, and presentation.

Project Requirements:

- List the specific features or functionality that students need to implement in their projects.
- Clearly state any constraints or limitations they should be aware of during development.

Technology Stack for Development:

- Specify the programming languages, frameworks, libraries, and tools that students should use for the project.
- Ensure that the technology stack aligns with the learning goals and skills you intend for students to develop.

Testing and Quality Assurance:

- Incorporate testing practices into their development process.
- Specify the types of testing (e.g., unit testing, integration testing)

Collaboration and Communication:

- If the project involves teamwork, outline expectations for collaboration, including communication channels and responsibilities within the team.

Documentation:

- Emphasize the importance of thorough documentation throughout the project.
- Require students to maintain documentation for code, design, and usage instructions.

Presentation:

- Require students to present their projects to the class, explaining their design choices, challenges faced, and how they overcame them.

Note: Students can choose any known platform and domain knowledge studied and gained in their previous semester for doing their Mini Project.

NATIONAL SERVICE SCHEME

Course Code	**24NSS50**	**CIE Marks (each Semester)**	**50**
L:T:P:S	**0:0:0:0**	**SEE Marks**	**--**
Hrs / Week	**2**	**Total Marks**	**50 x 4 = 200**
Credits	**00**	**Exam Hours**	**02**

Course outcomes:
At the end of the course, the student will be able to:

24NSS50.1	Understand the importance of his / her responsibilities towards society.
24NSS50.2	Analyse the environmental and societal problems/issues and will be able to design solutions for the same.
24NSS50.3	Evaluate the existing system and to propose practical solutions for the same for sustainable development. Implement government or self-driven projects effectively in the field.
24NSS50.4	Develop capacity to meet emergencies and natural disasters & practice national integration and social harmony in general.

Mapping of Course Outcomes to Program Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
24NSS50.1	-	-	-	-	-	3	3	2	-	-	1
24NSS50.2	-	-	-	-	-	3	3	2	-	-	1
24NSS50.3	-	-	-	-	-	3	3	2	-	-	1
24NSS50.4	-	-	-	-	-	3	3	2	-	-	1

Semester/ Course Code	CONTENT	COs	HOURS
3RD 24NSS30	**1.** Organic farming, Indian Agriculture (Past, Present and Future) Connectivity for marketing **2.** Waste management–Public, Private and Govt organization, 5R's. **3.** Setting of the information imparting club for women leading to contribution in social and economic issues.	24NSS30.1, 24NSS30.2, 24NSS30.3, 24NSS30.4	30 HRS
4TH 24NSS40	**4.** Water conservation techniques – Role of different stakeholders– Implementation. **5.** Preparing an actionable business proposal for enhancing the village income and approach for implementation. **6.** Helping local schools to achieve good results and enhance their enrolment in Higher/ technical/ vocational education.	24NSS40.1, 24NSS40.2, 24NSS40.3, 24NSS40.4	30 HRS
5TH 24NSS50	**7.** Developing Sustainable Water management system for rural areas and implementationapproaches. **8.** Contribution to any national level initiative of Government of India. Foreg. Digital India, Skill India, Swachh Bharat, Atmanirbhar Bharath, Make in India, Mudra scheme, Skill developmentprograms etc. **9.** Spreading public awareness under rural outreach programs. (minimum 5 programs).	24NSS50.1, 24NSS50.2, 24NSS50.3, 24NSS50.4	30 HRS
6TH 24NSS60	**10.** Organize National integration and social harmony events / workshops / seminars. (Minimum TWO programs). **11.** Govt. school Rejuvenation and helping them to achieve good infrastructure.	24NSS60.1, 24NSS60.2, 24NSS60.3, 24NSS60.4	30 HRS

CIE Assessment Pattern (50 Marks – Activity based) –

CIE component for every semester	Marks
Presentation - 1 Selection of topic, PHASE - 1	10

Commencement of activity and its progress - PHASE - 2	10
Case study-based Assessment Individual performance	10
Sector wise study and its consolidation	10
Video based seminar for 10 minutes by each student at the end of semester with Report.	10
Total marks for the course in each semester	**50**

- Implementation strategies of the project (NSS work).
- The last report should be signed by NSS Officer, the HOD and principal.
- At last report should be evaluated by the NSS officer of the institute.
- Finally, the consolidated marks sheet should be sent to the university and also to be made available at LIC visit.

Suggested Learning Resources:

Reference Books:

1. NSS Course Manual, Published by NSS Cell, VTU Belagavi.
2. Government of Karnataka, NSS cell, activities reports and its manual.
3. Government of India, NSS cell, Activities reports and its manual.

Pre-requisites to take this Course:

1. Students should have a service-oriented mindset and social concern.
2. Students should have dedication to work at any remote place, anytime with available resources and proper time management for the other works.
3. Students should be ready to sacrifice some of the time and wishes to achieve service-oriented targets on time.

Pedagogy:

- In every semester from 3rd semester to 6th semester, each student should do activities according to the scheme and syllabus.
- At the end of every semester student performance has to be evaluated by the NSS officer for the assigned activity progress and its completion.
- At last, in 6th semester consolidated report of all activities from 3rd to 6th semester, compiled report should be submitted as per the instructions.
- State the need for NSS activities and its present relevance in the society and provide real-life examples.
- Support and guide the students for self-planned activities.
- NSS coordinator will also be responsible for assigning homework, grading assignments and quizzes, and documenting students' progress in real activities in the field.
- Encourage the students for group work to improve their creative and analytical skills.

Plan of Action:

- Student/s in individual or in a group Should select any one activity in the beginning of each semester till end of that respective semester for successful completion as per the instructions of NSS officer with the consent of HOD of the department.
- At the end of every semester, activity report should be submitted for evaluation.
- Practice Session Description:
    - Lecture session by NSS Officer
    - Students Presentation on Topics
    - Presentation - 1, Selection of topic, PHASE – 1
    - Commencement of activity and its progress - PHASE – 2
    - Execution of Activity
    - Case study-based Assessment, Individual performance
    - Sector/ Team wise study and its consolidation
    - Video based seminar for 10 minutes by each student at the end of semester with Report.

Sl No	Topic	Groupsize	Location	Activity execution	Reporting	Evaluation of the Topic
1.	Organic farming, IndianAgriculture (Past, Present and Future) Connectivity for marketing.	May be individual or team	Farmers land/Villages/ roadside / Community area / College campus	Site selection /proper consultation/ Continuous monitoring/ Information board	Report should be submitted byindividual to the concerned evaluation authority	Evaluation as per the rubrics of scheme and syllabus by NSS officer
2.	Waste management– Public, Private and Govtorganization, 5 R's.	May be individual or team	Villages/ City Areas / Grama panchayat/ public associations/ Government Schemes officers/ campus	Site selection /proper consultation/Co ntinuous monitoring/ Information board	Report should be submitted byindividual to the concerned evaluation authority	Evaluation as per the rubrics of scheme and syllabus by NSS officer
3.	Setting of the information imparting club for women leading to contributionin social and economic issues.	May be individual or team	Women empowerment groups/ Consulting NGOs & Govt Teams / College campus	Group selection/pro per consultation/ Continuous monitoring/ Information board	Report should be submitted byindividual to the concerned evaluation authority	Evaluation as per the rubrics of scheme and syllabus by NSS officer
4.	Water conservation techniques – Role of different stakeholders– Implementation.	May be individual or team	Villages/ City Areas / Grama panchayat/ public associations/ Government Schemes officers/ campus	site selection / proper consultation/ Continuous monitoring/ Information board	Report should be submitted byindividual to the concerned evaluation authority	Evaluation as per the rubrics of scheme and syllabus by NSS officer
5.	Preparing an actionable business proposal for enhancing the village income and approach for implementation.	May be individual or team	Villages/ City Areas / Grama panchayat/ public associations/ Government Schemes officers/ campus	Group selection/pro per consultation/ Continuous monitoring/ Information board	Report should be submitted byindividual to the concerned evaluation authority	Evaluation as per the rubrics of scheme and syllabus by NSS officer

6.	Helping local schools toachieve good results and enhance their enrolment in Higher/ technical/ vocational education.	May be individual or team	Local government / private/ aided schools/Government Schemes officers	School selection/proper consultation/ Continuous monitoring/ Information board	Report should be submitted byindividual to the concerned evaluation authority	Evaluation as per the rubrics of scheme and syllabus by NSS officer
7.	Developing SustainableWater management system for rural areas and implementation approaches.	May be individual or team	Villages/ City Areas / Grama panchayat/ public associations/ Government Schemes officers/ campus	site selection/properconsultation/ Continuous monitoring/ Information board	Report should be submitted byindividual to the concerned evaluation authority	Evaluation as per the rubrics of scheme and syllabus by NSS officer
8.	Contribution to any national level initiative of Government of India.For eg. Digital India, Skill India, Swachh Bharat, Atmanirbhar Bharath, Make in India, Mudra scheme,Skill development programs etc.	May be individual or team	Villages/ City Areas / Grama panchayat/ public associations/ Government Schemes officers/ campus	Group selection/proper consultation/ Continuous monitoring / Information board	Report should be submitted byindividual to the concerned evaluation authority	Evaluation as per the rubrics of scheme and syllabus by NSS officer
9.	Spreading public awareness under ruraloutreach programs. (minimum5 programs)	May be individual or team	Villages/ City Areas / Grama panchayat/ public associations/ Government Schemes officers/ campus	Group selection/proper consultation/ Continuous monitoring / Information board	Report should be submitted byindividual to the concerned evaluation authority	Evaluation as per the rubrics of scheme and syllabus by NSS officer
10.	Organize National integration and socialharmony events / workshops / seminars. (Minimum 02 programs).	May be individual or team	Villages/ City Areas / Grama panchayat/ public associations/ Government Schemes officers/ campus	Place selection/proper consultation/ Continuous monitoring / Information board	Report should be submitted byindividual to the concerned evaluation authority	Evaluation as per the rubrics of scheme and syllabus by NSS officer

	11.	Govt. school Rejuvenation and helping them to achieve good infrastructure.	May be individual or team	Villages/ City Areas / Grama panchayat/ public associations/ Government Schemes officers/ campus	Place selection/proper consultation/ Continuous monitoring / Information board	Report should be submitted byindividual to the concerned evaluation authority	Evaluation as per the rubrics of scheme and syllabus by NSS officer	

PHYSICAL EDUCATION AND SPORTS			
Course Code	**24PED50**	**CIE Marks (each semester)**	**50**
L:T:P:S	**0:0:0:0**	**SEE Marks**	**--**
Hrs / Week	**2**	**Total Marks**	**50 x 4= 200**
Credits	**00**	**Exam Hours**	**02**

Course outcomes:
At the end of the course, the student will be able to:

24PED50.1	Understand the fundamental concepts and skills of Physical Education, Health, Nutrition and Fitness
24PED50.2	Create consciousness among the students on Health, Fitness and Wellness in developing and maintaining a healthy lifestyle
24PED50.3	Perform in the selected sports or athletics of student's choice and participate in the competition at regional/state / national / international levels.
24PED50.4	Understand the roles and responsibilities of organization and administration of sports and games

Mapping of Course Outcomes to Program Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
24PED50.1	-	-	-	-	-	2	-	3	3	-	-	2
24PED50.2	-	-	-	-	-	2	-	3	3	-	-	2
24PED50.3	-	-	-	-	-	2	-	3	3	-	-	2
24PED50.4	-	-	-	-	-	2	-	3	3	-	-	2

Semester	CONTENT	COs	HOURS
3RD 24PED30	**Module 1: Orientation** A. Lifestyle, B. Fitness C. Food & Nutrition D. Health & Wellness E. Pre-Fitness test.	24PED30.1, 24PED30.2	5 HRS
	Module 2: General Fitness & Components of Fitness A. Warming up (Free Hand exercises) B. Strength – Push-up / Pull-ups C. Speed – 30 Mtr Dash D. Agility – Shuttle Run E. Flexibility – Sit and Reach F. Cardiovascular Endurance – Harvard step Test	24PED30.2, 24PED30.3	15 HRS
	Module 3: Recreational Activities A. Postural deformities. B. Stress management. C. Aerobics. D. Traditional Games.	24PED30.3, 24PED30.4	10 HRS
4TH 24PED40	**Module 1: Ethics and Moral Values** A. Ethics in Sports B. Moral Values in Sports and Games	24PED40.1, 24PED40.2	5 HRS
	Module 2: Specific Games (Anyone to be selected by the student) A. Volleyball – Attack, Block, Service, Upper Hand Pass and Lower hand Pass. B. Throwball – Service, Receive, Spin attack, Net Drop & Jump throw. C. Kabaddi – Hand touch, Toe Touch, Thigh Hold, Ankle hold and	24PED40.3	20 HRS

	Bonus. D. Kho-Kho – Giving Kho, Single Chain, Pole dive, Pole turning, 3-6 Up. E. Table Tennis – Service (Fore Hand & Back Hand), Receive (Fore Hand & Back Hand), Smash. F. Athletics (Track / Field Events) – Any event as per availability of Ground.		
	Module 3: Role of Organization and administration	24PED40.4	5 HRS
5TH 24PED50	**Fitness Components:** Meaning and Importance, Fit India Movement, Definition of fitness, Components of fitness, Benefits of fitness, Types of fitness and Fitness tips. **Practical Components:** Speed, Strength, Endurance, Flexibility, and Agility **Athletics**: 1. Track -Sprints: • Starting Techniques: Standing start and Crouch start (its variations) use of Starting Block. • Acceleration with proper running techniques. • Finishing technique: Run Through, Forward Lunging and Shoulder Shrug. 2. Jumps- Long Jump: Approach Run, Take-off, Flight in the air (Hang Style/Hitch Kick)and Landing 3. Throws- Shot Put: Holding the Shot, Placement, Initial Stance, Glide, Delivery Stance and Recovery (Perry O'Brien Technique) **Handball OR Ball Badminton** **Handball:** A. Fundamental Skills 1. Catching, Throwing and Ball control, 2. Goal Throws: Jumpshot, Centershot, Diveshot, Reverseshot. 3. Dribbling: High and low. 4. Attack and counter attack, simple counter attack, counter attack from two wings and center. 5. Blocking, Goal Keeping and Defensive skills. 6. Game practice with application of Rules and Regulations. B. Rules and their interpretations and duties of officials **Ball badminton:** A. Fundamental Skills 1. Basic Knowledge: Various parts of the Racket and Grip. 2. Service: Short service, Long service, Long-high service. 3. Shots: Overhead shot, Defensive clearshot, Attacking clearshot, Dropshot, Netshot, Smash. 4. Game practice with application of Rules and Regulations. B. Rules and their interpretation and duties of officials.	24PED50.1, 24PED50.2, 24PED50.3, 24PED50.4	Total 30 Hrs/ Semester 2 Hrs/week
6TH 24PED60	**Athletics**: 1. Track -110 Mtrs and 400Mtrs: • Hurdling Technique: Lead leg Technique, Trail leg Technique, Side Hurdling, Over the Hurdles • Crouch start (its variations) use of Starting Block. • Approach to First Hurdles, In Between Hurdles, Last Hurdles to Finishing. 2. Jumps- High jump: Approach Run, Take-off, Bar Clearance (Straddle) and Landing.	24PED60.1, 24PED60.2, 24PED60.3, 24PED60.4	Total 30 Hrs/ Semester 2 Hrs/week

3. Throws- Discus Throw: Holding the Discus, Initial Stance Primary Swing, Turn, Release and Recovery (Rotation in the circle).

Football OR Hockey

Football:

A. Fundamental Skills

1. Kicking: Kicking the ball with inside of the foot, Kicking the ball with Full Instep of the foot, Kicking the ball with Inner Instep of the foot, Kicking the ball with Outer Instep of the foot and Lofted Kick.
2. Trapping: Trapping- the Rolling ball, and the Bouncing ball with sole of the foot.
3. Dribbling: Dribbling the ball with Instep of the foot, Dribbling the ball with Inner and Outer Instep of the foot.
4. Heading: In standing, running and jumping condition.
5. Throw-in: Standing throw-in and Running throw-in.
6. Feinting: With the lower limb and upper part of the body.
7. Tackling: Simple Tackling, Slide Tackling.
8. Goal Keeping: Collection of Ball, Ball clearance-kicking, throwing and deflecting.
9. Game practice with application of Rules and Regulations.

A. Rules and their interpretation and duties of officials.

Hockey:

A. Fundamental Skills

1. Passing: Short pass, Longpass, pushpass, hit
2. Trapping.
3. Dribbling and Dozing
4. Penalty stroke practice.
5. Penalty corner practice.
6. Tackling: Simple Tackling, Slide Tackling.
7. Goal Keeping, Ball clearance- kicking, and deflecting.
8. Game practice with application of Rules and Regulations.

B. Rules and their interpretation and duties of officials

CIE Assessment Pattern (50 Marks – Practical) –

CIE to be evaluated every semester end based on practical demonstration of Sports and Athletics activities learnt in the semester.

CIE	Marks
Participation of student in all the modules	10
Quizzes – 2, each of 7.5 marks	15
Final presentation / exhibition / Participation in competitions/ practical on specific tasks assigned to the students	25
Total	**50**

Suggested Learning Resources:

Reference Books:

1. Saha, A.K. Sarir Siksher Ritiniti, Rana Publishing House, Kalyani.
2. Bandopadhyay, K. Sarir Siksha Parichay, Classic Publishers, Kolkata.
3. Petipus, et.al., Athlete's Guide to Career Planning, Human Kinetics.

4. Dharma, P.N. Fundamentals of Track and Field, Khel Sahitya Kendra, New Delhi.
5. Jain, R. Play and Learn Cricket, Khel Sahitya Kendra, New Delhi.
6. Vivek Thani, Coaching Cricket, Khel Sahitya Kendra, New Delhi.
7. Saha, A.K. Sarir Siksher Ritiniti, Rana Publishing House, Kalyani.
8. Bandopadhyay, K. Sarir Siksha Parichay, Classic Publishers, Kolkata
9. Naveen Jain, Play and Learn Basketball, Khel Sahitya Kendra, New Delhi.
10. Dubey H.C., Basketball, Discovery Publishing House, New Delhi.
11. Rachana Jain, Teach Yourself Basketball, Sports Publication.
12. Jack Nagle, Power Pattern Offences for Winning basketball, Parker Publishing Co., New York.
13. Renu Jain, Play and Learn Basketball, Khel Sahitya Kendra, New Delhi.
14. SallyKus, Coaching Volleyball Successfully, Human Kinetics.

YOGA			
Course Code	**24YOG50**	**CIE Marks**	**50**
L:T:P:S	**0:0:0:0**	**SEE Marks**	**--**
Hrs / Week	**2**	**Total Marks**	**50 x 4 = 200**
Credits	**00**	**Exam Hours**	**02**

Course outcomes:
At the end of the course, the student will be able to:

24YOG50.1	Understanding the origin, history, aim and objectives of Yoga
24YOG50.2	Become familiar with an authentic foundation of Yogic practices
24YOG50.3	Practice different Yogic methods such as Suryanamaskara, Pranayama and some of the Shat
24YOG50.4	Use the teachings of Patanjali in daily life.

Mapping of Course Outcomes to Program Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
24YOG50.1	-	-	-	-	-	3	-	-	-	-	1
24YOG50.2	-	-	-	-	-	3	-	-	-	-	1
24YOG50.3	-	-	-	-	-	3	-	-	-	-	1
24YOG50.4	-	-	-	-	-	3	-	-	-	-	1

Semester / Course Code	CONTENT	COs	HOURS
3rd 24YOG30	**Introduction of Yoga:** Aim and Objectives of yoga, Prayer: Yoga, its origin, history and development. Yoga, its meaning, definitions. Different schools of yoga, importance of prayer **Brief introduction of yogic practices for common man:** Yogic practices for common man to promote positive health **Rules and regulations:** Rules to be followed during yogic practices by practitioner **Misconceptions of yoga:** Yoga its misconceptions, Difference between yogic and non-yogic practices. **Suryanamaskara:** 1. Suryanamaskar prayer and its meaning, Need, importance and b of Suryanamaskar. 2. Suryanamaskar 12 count,2rounds **Different types of Asanas**: 1. Sitting: Padmasana, Vajrasana, Sukhasana 2. Standing: Vrikshana, Trikonasana, Ardhakati Chakrasana 3. Prone line: Bhujangasana, Shalabhasana 4. Supineline: Utthitadvipadasana, Ardhahalasana, Halasana	24YOG30.1, 24YOG30.2, 24YOG30.3, 24YOG30.4	Total 32 Hrs/ Semester 2 Hrs/week
4TH 24YOG40	**Suryanamaskara:** Suryanamaskar 12 count,4rounds **Brief introduction and importance of:** **Kapalabhati:** Revision of Kapalabhati -40strokes/min3rounds **Different types of Asanas**: 1. Sitting: Paschimottanasana, Ardha Ushtrasana, Vakrasana, Aakarna Dhanurasana 2. Standing: Parshva Chakrasana, Urdhva Hastothanasana, Hastapadasana 3. Prone line: Dhanurasana 4. Supine line: Karna Peedasana, Sarvangasana, Chakraasana **Patanjali's Ashtanga Yoga**: Asana, Pranayama **Pranayama:** Chandra Bhedana, Nadishodhana, Surya Bhedana	24YOG40.1, 24YOG40.2, 24YOG40.3, 24YOG40.4	Total 32 Hrs/ Semester 2 Hrs/week

5TH 24YOG50	**Kapalabhati:** Revision of Kapalabhati - 60strokes/min3rounds **Brief introduction and importance of:** **Different types of Asanas**: 1. Sitting: Yogamudra in Padmasana, Vibhakta Paschimottanasana, Yogamudra in Vajrasana 2. Standing: Parivritta Trikonasana, Utkatasana, Parshvakonasana 3. Prone line: Padangushtha Dhanurasana, Poorna Bhujangasana / Rajakapotasana 4. Supine line: Navasana/Noukasana, Pavanamuktasana, Sarvanga **Patanjali's Ashtanga Yoga**: Pratyahara, Dharana **Pranayama:** Ujjayi, Sheetali, Sheektari	24YOG50.1, 24YOG50.2, 24YOG50.3, 24YOG50.4	Total 32 Hrs/ Semester 2 Hrs/week
6TH 24YOG60	**Kapalabhati:** Revision of Kapalabhati – 80 strokes/min3rounds **Brief introduction and importance of:** **Different types of Asanas**: 1. Sitting: Bakasana, Hanumanasana, Ekapada Rajakapotasana 2. Standing: Parivritta Trikonasana, Utkatasana, Parshvakonasana 3. Supine line: Setubandhasana, Shavasanaa (Relaxation posture) 4. Balancing: Sheershasana **Patanjali's AshtangaYoga**: Dhyana (Meditation), Samadhi **Pranayama:** Bhastrika, Bhramari, Ujjai **Shat Kriyas:** Jalaneti and sutraneti, Sheetkarma Kapalabhati	24YOG60.1, 24YOG60.2, 24YOG60.3, 24YOG60.4	Total 32 Hrs/ Semester 2 Hrs/week

CIE Assessment Pattern (50 Marks – Practical)

CIE to be evaluated every semester based on practical demonstration of Yogasana learnt in the semester and internal tests (objective type)

CIE	Marks
Avg of Test 1 and Test 2	25
Demonstration of Yogasana	25
Total	**50**

Suggested Learning Resources:

Reference Books:

4. Swami Kuvulyananda: Asma (Kavalyadhama, Lonavala)
5. Tiwari, O P: Asana Why and How
6. Ajitkumar: Yoga Pravesha (Kannada)
7. Swami Satyananda Saraswati: Asana Pranayama, Mudra, Bandha (Bihar School of yoga, Munger)
8. Swami Satyananda Saraswati: Surya Namaskar (Bihar School of yoga, Munger)
9. Nagendra H R: The art and science of Pranayama
10. Tiruka: Shatkriyegalu (Kannada)
11. Iyengar B K S: Yoga Pradipika (Kannada)
12. Iyengar B K S: Light on Yoga (English)

Web links and Video Lectures (e-Resources):

- https://youtu.be/KB-TYlgd1wE
- https://youtu.be/aa-TG0Wg1Ls

VI Semester

ARTIFICIAL INTELLIGENCE & MACHINE LEARNING			
Course Code	**24CDS61**	**CIE Marks**	**50**
L:T:P:S	**3:0:0:0**	**SEE Marks**	**50**
Hrs. / Week	**3**	**Total Marks**	**100**
Credits	**03**	**Exam Hours**	**03**

Course outcomes:
At the end of the course, the student will be able to:

24CDS61.1	Apply search techniques and concept learning for finding optimal solutions and inferring Boolean-Valued function
24CDS61.2	Analyze the heuristic algorithms and learning algorithms over a range of available options to obtain better and faster decisions
24CDS61.3	Develop Decision tree learning and Bayesian Learning to make useful predictions
24CDS61.4	Evaluate the probabilistic framework using learning techniques to predict target variables
24CDS61.5	Compute new data points using memory-based learning
24CDS61.6	Examine the new query instance using instance-based learning

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
24CDS61.1	3	2	-	-	-	-	-	-	-	-	3	3	3
24CDS61.2	2	3	-	-	-	-	-	-	-	-	3	3	3
24CDS61.3	2	-	3	-	-	-	-	-	-	-	3	3	3
24CDS61.4	2	2	-	3	-	-	-	-	-	-	3	3	3
24CDS61.5	2	2	2	2	-	-	-	-	-	-	3	3	3
24CDS61.6	2	2	-	3	-	-	-	-	-	-	3	3	3

MODULE-1	**INTRODUCTION TO AI**	**24CDS61.1 24CDS61.2**	**8 Hours**

Introduction to artificial intelligence, Well-Posed Learning Problems, designing a Learning System, Choosing the training experience, Choosing the target function, choosing a representation for the target function, Choosing a function approximation algorithm, Perspectives and issues in Machine Learning, problem spaces and search, Heuristic search techniques

Applications	8 Puzzle problem (Text Book is missing)
Text Book	Textbook 1: Chapter 1, Textbook 2: Chapter 1,2,3

MODULE-2	**CONCEPT LEARNING**	**24CDS61.1 24CDS61.2**	**8 Hours**

Knowledge representation issues, Predicate logic, Representation knowledge using rules. Concept Learning: Concept learning task, Concept learning as search, Find-S algorithm, Candidate Elimination Algorithm, Inductive bias of Candidate Elimination Algorithm			
Applications	A candidate elimination approach to rule learning in version space		
Text Book	Textbook 1: Chapter 2 . Textbook 2: Chapter 4, 5, 6		
MODULE-3	**DECISION TREE LEARNING IN MACHINE LEARNING**	**24CDS61.3 24CDS61.4**	**8 Hours**
Decision Tree Learning: Introduction, Decision tree representation, Appropriate problems, ID3 algorithm. Artificial Neural Network: Introduction, NN representation, Appropriate problems, Perceptrons, Back propagation algorithm.			
Case Study	Decision Tree Algorithm in Healthcare Applications		
Text Book	Textbook 1: Chapter 3,4		
MODULE-4	**BAYESIAN LEARNING**	**24CDS61.3 24CDS61.4**	**8 Hours**
Bayesian Learning: Introduction, Bayes theorem, Bayes theorem and concept learning, ML and LS error hypothesis, ML for predicting, MDL principle, Bates optimal classifier, Gibbs algorithm, Navie Bayes classifier, BBN, EM Algorithm			
Text Book	Text Book 1: Chapter 6		
MODULE-5	**INSTANCE- BASED LEARNING**	**24CDS61.5, 24CDS61.6**	**8 Hours**
Instance-Base Learning: Introduction, k-Nearest Neighbour Learning, Locally weighted regression, Radial basis function, Case-Based reasoning. Reinforcement Learning: Introduction, The learning task, Q-Learning.			
Case Study	Personal Well-Being Analysis through the Integration of Instance-Based Learning with Interpretable AI Techniques		
Text Book	Text Book 1: Chapter 3		

CIE Assessment Pattern (50 Marks – Theory) –

RBT Levels		Marks Distribution		
		Test (s)	AAT1	AAT2
		25	15	10
L1	Remember	-	-	-
L2	Understand	10	-	-
L3	Apply	5	7.5	5
L4	Analyze	5	7.5	5
L5	Evaluate	5	-	-
L6	Create	-	-	-

SEE Assessment Pattern (50 Marks – Theory)

RBT Levels		Exam Marks Distribution (50)
L1	**Remember**	**-**
L2	**Understand**	**15**
L3	**Apply**	**15**
L4	**Analyze**	**10**
L5	**Evaluate**	**10**
L6	**Create**	**--**

Suggested Learning Resources:

Textbooks:

1) Tom M. Mitchell, Vineeth N Balasubramanian, "Machine Learning", 2nd Edition, McGraw Hill Education, 2026, ISBN-13, 978-9364446037
2) Elaine Rich, Kevin K and S B Nair, "Artificial Intelligence", 4th Edition, McGraw Hill Education, 2024, ISBN-13 978-8196544577.

Reference Books:

3) Saroj Kaushik, Artificial Intelligence, Cengage learning, 2011,ISBN-13, 978-813151099.
4) Stuart Rusell, Peter Norving , Artificial Intelligence: A Modern Approach, Pearson Education 4th Edition,2022, ISBN-13: 978-8120323827.
5) AurÈlienGÈron, "Hands-On Machine Learning with Scikit-Learn and Tensor Flow: Concepts, Tools, and Techniques to Build Intelligent Systems", 1st Edition, Shroff/O'Reilly Media, 2017, ISBN-13, 978-9355421982.
6) Trevor Hastie, Robert Tibshirani, Jerome Friedman, The Elements of Statistical Learning, 2nd edition, springer series in statistics, 2017,ISBN-13, 978-0387848570.

Web links and Video Lectures (e-Resources):

- **https://nptel.ac.in/courses/106102220**
- **https://www.kaggle.com/kanncaa1/machine-learning-tutorial-for-beginners**
- **https://www.toptal.com/machine-learning/machine-learning-theory-an-introductory-primer**
- **https://pythonprogramming.net/machine-learning-tutorial-python-introduction/**
- **https://machinelearningmastery.com/start-here/**

Activity-Based Learning (Suggested Activities in Class)/ Practical Based learning

- Using Teachable Machine with Google
- NPTEL Videos

ARTIFICIAL INTELLIGENCE & MACHINE LEARNING LAB			
Course Code	**24CDL61**	**CIE Marks**	**50**
L:T:P:S	**0:0:1:0**	**SEE Marks**	**50**
Hrs. / Week	**2**	**Total Marks**	**100**
Credits	**01**	**Exam Hours**	**03**

Course outcomes:
At the end of the course, the student will be able to:

24CDL61.1	Analyze search algorithms and learning algorithms for a training data set
24CDL61.2	Apply Heuristic search techniques and various learning techniques for efficient computing
24CDL61.3	Implement various artificial intelligence and machine learning algorithms
24CDL61.4	Evaluate machine learning models for solving classification and prediction problems

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
24CDL61.1	2	3	2	2	-	-	-	-	-	-	3	3	3
24CDL61.2	3	2	2	-	-	-	-	-	-	-	3	3	3
24CDL61.3	2	-	3	2	-	-	-	-	-	-	3	3	3
24CDL61.4	2	2	2	3	-	-	-	-	-	-	3	3	3

Pgm. No.	List of Programs	Hours	COs
	Prerequisite		
	• Introduction to Python programming • Use of numpy libraries • pandas libraries • Use of visualization tool kit	3	NA
	PART-A		
1	Implement the A* Search algorithm for finding the shortest path in a weighted graph.	2	24CDL61.1 24CDL61.2
2	Implement AO* (AO-star) Search algorithm for finding the shortest path in a weighted graph.	2	24CDL61.1 24CDL61.2
3	For a given set of training data examples stored in a .CSV file, implement and demonstrate the Candidate-Elimination algorithm to output a description of the set of all hypotheses consistent with the training examples.		24CDL61.1 24CDL61.2
4	Write a program to demonstrate the working of the decision tree based ID3 algorithm. Use an appropriate data set for building the decision tree	2	24CDL61.1 24CDL61.2

	and apply this knowledge to classify a new sample		
5	Develop an Artificial Neural Network by implementing the backpropagation algorithm and test the same using appropriate data sets.	2	24CDL61.1 24CDL61.2
6	Write a program to implement the Naïve Bayesian classifier for a sample training data set stored as a .CSV file. Compute the accuracy of the classifier, considering few test data sets.	2	24CDL61.1 24CDL61.2
PART-B			
7	Demonstrate the Bias-Variance Trade-off in a machine learning model, provide visualizations and insights.	2	24CDL61.3 24CDL61.4
8	Demonstrate Association Rule Mining using the FP-Growth Algorithm. Utilize a suitable dataset to identify frequent item sets and generate association rules.	2	24CDL61.3 24CDL61.4
9	Implement the non-parametric Locally Weighted Regression algorithm in order to fit data points. Select appropriate data set for your experiment and draw graphs.	2	24CDL61.3 24CDL61.4
10	Develop a Convolutional Neural Network (CNN) and test it using appropriate datasets. Implement key components such as convolutional layers, pooling layers, and fully connected layers. Evaluate the CNN's performance on tasks such as image classification	2	24CDL61.3 24CDL61.4
11	Implement the Q-Learning algorithm to learn the optimal policy in a reinforcement learning environment.	2	24CDL61.3 24CDL61.4
12	Develop a simple rule-based chatbot to respond to predefined user inputs. Analyze the chatbot's responses for different conversation scenarios.	2	24CDL61.3 24CDL61.4

PART-C
Beyond Syllabus Virtual Lab Content
(To be done during Lab but not to be included for CIE or SEE)

1. Parallel and distributed processing - I: Interactive activation and competition models https://cse22-iiith.vlabs.ac.in/exp/parallel-distributed-processing-i/theory.html
2. Competitive learning neural networks for pattern clustering https://cse22-iiith.vlabs.ac.in/exp/pattern-clustering/
3. Solution to travelling salesman problem using self-organizing maps : https://cse22-iiith.vlabs.ac.in/exp/self-organizing-maps/

CIE Assessment Pattern (50 Marks – Lab)

RBT Levels		Test (s)	Weekly Assessment
		20	30
L1	Remember	-	-
L2	Understand	-	-
L3	Apply	10	10
L4	Analyze	5	10
L5	Evaluate	5	10
L6	Create	-	-

SEE Assessment Pattern (50 Marks – Lab)

RBT Levels		Exam Marks Distribution (50)
L1	**Remember**	**-**
L2	**Understand**	**-**
L3	**Apply**	**20**
L4	**Analyze**	**20**
L5	**Evaluate**	**10**
L6	**Create**	

Suggested Learning Resources:

Reference Books:

1. Tom M. Mitchell, Vineeth N Balasubramanian, "Machine Learning", 2nd Edition, McGraw Hill Education, 2026, ISBN-13, 978-9364446037
2. Bishop, Christopher. Pattern Recognition and Machine Learning,Springer nature publications, 2 0 0 9 , ISBN-13, 978-1493938438.
3. Aurélien Géron, O'Reilly Media. Hands-On Machine Learning with Scikit-Learn and TensorFlow, Concepts, Tools, and Techniques to Build Intelligent Systems,2017. ISBN-13, 978-9355421982.

COMPUTER NETWORKS

Course Code	**24CDS62**	**CIE Marks**	**50**
L:T:P:S	**3:0:0:0**	**SEE Marks**	**50**
Hrs / Week	**3**	**Total Marks**	**100**
Credits	**03**	**Exam Hours**	**03**

Course outcomes:
At the end of the course, the student will be able to:

24CDS62.1	Understand the concept of layering in networks
24CDS62.2	Analyze the functions of protocols of each layer of TCP/IP protocol suite.
24CDS62.3	Illustrate the End-to-End flow of information
24CDS62.4	Analyze the functions of network layer and the various routing protocols
24CDS62.5	Examine the functions and protocols of the Transport layer
24CDS62.6	Implement network applications and end to end Data Communication

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
24CDS62.1	2	2	1	1	-	-	-	-	-	-	3	3	3
24CDS62.2	-	3	1	-	-	-	-	-	-	-	3	3	3
24CDS62.3	2	2	1	2	-	-	-	-	-	-	3	3	3
24CDS62.4	2	3	1	-	-	-	-	-	-	-	3	3	3
24CDS62.5	2	2	-	3	-	-	-	-	-	-	3	3	3
24CDS62.6	2	2	3	2	-	-	-	-	-	-	3	3	3

MODULE-1	**INTRODUCTION TO DATA COMMUNICATION CONCEPTS**	**24CDS62.1**	**8 Hours**

Introduction to networks: Network hardware, Network software, Reference models, Physical layer connectivity (wired/wireless communication) with device standards. Data Communication - Networks – Network Types – Protocol Layering – TCP/IP Protocol suite –OSI Model – Introduction to Sockets - Application

Case Study	Case Study: · Evolution of the Internet: How TCP/IP became the global networking standard and enabled the growth of the Internet.
Text Book	Textbook 1: Ch.1.2 to 1.4, Ch.2.2 to 2.3

MODULE-2	**DATA LINK LAYER**	**24CDS62.2**	**8 Hours**

The Data link layer: Design issues of DLL, Error detection and correction, Elementary data link protocols, Sliding window protocols. The medium access control sublayer: The channel allocation problem, Multiple access protocols.

Case Study	Ethernet vs Wi-Fi – How modern networks use CSMA/CD and CSMA/CA for collision handling.		
Text Book	Textbook 1: Ch.3.1 to 3.4, Ch.4.1, 4.2		
MODULE-3	**NETWORK LAYER**	**24CDS62.3**	**8 Hours**
The Network Layer: Network Layer Design Issues, Routing Algorithms, Flow and Congestion Control Algorithms, QoS.			
Application	Configure static and dynamic routing (RIP/OSPF) using Cisco Packet Tracer.		
Text Book	Textbook 1: Ch 6.1 to 6.4 and 6.5.1 to 6.5.7		
MODULE-4	**TRANSPORTATION LAYER**	**24CDS62.4**	**8 Hours**
The Transport Layer: The Transport Service, Elements of transport protocols, Congestion control, the Internet transport protocols.			
Case Study	Case Study: · TCP vs UDP in Video Streaming and Online Gaming – Why different transport protocols are used.		
Text Book	Text Book 1: 5.1,5.2,5.3,5.4,5.5,5.6, Text Book 2: 10.1, 10.3, 10.5, 10.7		
MODULE-5	**APPLICATION LAYER**	**24CDS62.5, 24CDS62.6**	**8 Hours**
Application Layer: Principles of Network Applications, The Web and HTTP, Electronic Mail in the Internet, DNS—The Internet's Directory Service.			
Application:	Develop a simple HTTP client/server using Python sockets or Flask to understand request-response communication.		
Text Book	Textbook 2: Ch 10.1,10.3		

CIE Assessment Pattern (50 Marks – Theory) –

RBT Levels		Marks Distribution		
		Test (s)	AAT1	AAT2
		25	15	10
L1	Remember	-	-	-
L2	Understand	10	-	-
L3	Apply	5	7.5	5
L4	Analyze	5	7.5	5
L5	Evaluate	5	-	-
L6	Create	-	-	-

SEE Assessment Pattern (50 Marks – Theory)

RBT Levels		Exam Marks Distribution (50)
L1	Remember	-
L2	Understand	15
L3	Apply	15
L4	Analyze	10
L5	Evaluate	10
L6	Create	--

Suggested Learning Resources:

Text Books:

1) Tanenbaum, Andrew S., et al. Computer Networks, Global Edition. United Kingdom, Pearson Education, 2021, ISBN-9781292374017.
2) Forouzan, Behrouz A. Data Communications and Networking: With TCP/IP Protocol Suite. United States, McGraw-Hill, 2021, ISBN-13, 978-1260597820.

Reference Books:

1) Forouzan, Behrouz A. Data Communications and Networking: With TCP/IP Protocol Suite. United States, McGraw-Hill, 2021, ISBN-13, 978-1260597820.
2) Peterson, Larry L. and Davie, Bruce S.. Computer Networks: A Systems Approach. Netherlands, Elsevier Science, 2011, ISBN-13: 978-0-12-370548-8

Web links and Video Lectures (e-Resources):

- https://www.netacad.com/courses/networking-basics?courseLang=en-US
- http://www.digimat.in/nptel/courses/video/106105081/L25.html
- https://skillsforall.com/course/getting-started-cisco-packet-tracer
- https://www.open.edu/openlearn/science-maths-technology/computing-and-ict

Activity-Based Learning (Suggested Activities in Class)/ Practical Based learning

- Case Studies: Simulation of Personal area network, home area network, achieve QoS etc.

Note: - Note: For the Simulation experiments modify the topology and parameters set for the experiment and take multiple rounds of reading and analyze the results available in log files and plot graphs and reports using any open-source software/python programming.

COMPUTER NETWORKS LAB

Course Code	**24CDL62**	**CIE Marks**	**50**
L:T:P:S	**0:0:1:0**	**SEE Marks**	**50**
Hrs / Week	**2**	**Total Marks**	**100**
Credits	**01**	**Exam Hours**	**03**

Course outcomes:
At the end of the course, the student will be able to:

24CDL62.1	Apply the Linux commands to capture ping and protocols for network design
24CDL62.2	Analyze the network layers to data link layer
24CDL62.3	Implement socket programming for TCP/IP for file transferring
24CDL62.4	Examine the effectiveness of policies for various scenarios

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
24CDL62.1	3	2	2	1	1	-	-	-	-	-	-	**3**	**3**
24CDL62.2	2	3	2	2	1	-	-	-	-	-	-	**3**	**3**
24CDL62.3	2	2	3	2	2	-	-	-	-	-	-	**3**	**3**
24CDL62.4	2	2	2	3	2	-	-	-	-	-	-	**3**	**3**

Pgm. No.	List of Programs	Hours	COs
	Prerequisite		
	• Basics of programing • HTTP programming	3	NA
	PART-A		
1	Examine the commands like tcpdump, netstat, ifconfig, nslookup and traceroute. Capture ping and traceroute PDUs using a network protocol analyzer.	2	24CDL62.1
2	Write a HTTP web client program to download a web page using TCP sockets.	2	24CDL62.1
3	Create a simple program to simulate basic Data Link Layer (DLL) functionalities such as framing, error detection, and flow control. The goal is to understand how data packets are prepared, transmitted, and verified at the DLL.	2	24CDL62.2
4	Develop a simple data link layer that performs the flow control using the sliding window protocol, and loss recovery using the Go-Back-N mechanism.	2	24CDL62.3
5	Implement the data link layer framing methods such as character,	2	24CDL62.2

	character stuffing and bit stuffing		
6	Examine static routes and dynamic routing protocols (such as RIP, OSPF) on routers, and analyze their performance and behavior in a simulated network environment.	2	24CDL62.2
PART-B			
7	Design and implement network topologies (star, ring, mesh) using simulation tools.	2	24CDL62.2
8	Implement a specific application layer protocol (e.g., HTTP, FTP) using socket programming, simulate client-server communication, and analyze protocol messages exchanged between endpoints.	2	24CDL62.2
9	Evaluate the performance of TCP/IP in terms of reliability, throughput, and latency using network simulation tools, and compare its behaviour under various network conditions to understand its impact on application performance.	2	24CDL62.3
10	Implement TCP socket programming to enable file transfer between a client and server. Develop functionalities for file upload, download, and error handling, while analyzing the reliability and efficiency of TCP in file transfer scenarios.	2	24CDL62.3
11	Implement Quality of Service (QoS) policies on a network router to prioritize traffic based on specific criteria such as packet classification, traffic shaping, and bandwidth allocation.	2	24CDL62.4
12	Evaluate the effectiveness of QoS policies in ensuring optimal performance for different types of network traffic (e.g., VoIP, video streaming) under varying traffic loads and congestion scenarios.	2	24CDL62.4

PART-C
Beyond Syllabus Virtual Lab Content
(To be done during Lab but not to be included for CIE or SEE)

1. https://cn-iitr.vlabs.ac.in/
2. https://skillsforall.com/course/getting-started-cisco-packet-tracer
3. https://www.open.edu/openlearn/science-maths-technology/computing-and-ict

CIE Assessment Pattern (50 Marks – Lab)

RBT Levels		Test (s)	Weekly Assessment
		20	30
L1	Remember	-	-
L2	Understand	-	-
L3	Apply	10	10
L4	Analyze	5	10
L5	Evaluate	5	10
L6	Create	-	-

SEE Assessment Pattern (50 Marks – Lab)

RBT Levels		Exam Marks Distribution (50)
L1	**Remember**	**-**
L2	**Understand**	
L3	**Apply**	**20**
L4	**Analyze**	**20**
L5	**Evaluate**	**10**
L6	**Create**	

Suggested Learning Resources:

1. Forouzan, Behrouz A. Data Communications and Networking: With TCP/IP Protocol Suite. United States, McGraw-Hill, 2021, ISBN-13, 978-1260597820.
2. Peterson, Larry L. and Davie, Bruce S.. Computer Networks: A Systems Approach. Netherlands, Elsevier Science, 2011, ISBN-13: 978-0-12-370548-8

CYBER SECURITY ESSENTIALS			
Course Code	**24CDS63**	**CIE Marks**	**50**
L:T:P:S	**3:0:0:0**	**SEE Marks**	**50**
Hrs / Week	**3**	**Total Marks**	**100**
Credits	**3**	**Exam Hours**	**3**

Course outcomes:
At the end of the course, the student will be able to:

24CDS63.1	Understand the fundamental concepts, principles, and threat landscape of cybersecurity.
24CDS63.2	Apply network security mechanisms and protocols to protect systems from network-based attacks.
24CDS63.3	Analyze cryptographic techniques, authentication mechanisms, and access control models for securing information systems.
24CDS63.4	Design security assessment workflows using industry-standard cybersecurity tools.
24CDS63.5	Evaluate information security governance, incident response, and business continuity strategies for effective security management.
24CDS63.6	Interpret emerging cybersecurity challenges and legal/regulatory frameworks to ensure ethical and compliant practices.

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
24CSE63.1	-	-	-	-	-	-	-	-	-	-	-	2	-
24CSE63.2	3	-	-	-	-	-	-	-	-	-	-	3	-
24CSE63.3	-	3	-	-	3	-	-	-	-	-	-	3	-
24CSE63.4	-	-	3	-	-	-	-	-	-	-	-	2	-
24CSE63.5	-	-	-	3	2	-	-	-	-	-	-	2	-
24CSE63.6	-	-	-	2	2	2	1	2	2	-	2	2	3

MODULE-1	**INTRODUCTION TO CYBERSECURITY**	**24CDS63.1**	**8 Hours**

Fundamentals of Cybersecurity, CIA Triad (Confidentiality, Integrity, Availability) , Security Goals and Principles, Cyber Threat Landscape, Types of Attackers and Threat Actors, Malware: Virus, Worm, Trojan, Ransomware, Spyware, Social Engineering and Phishing Attacks, Cyber Kill Chain Concept, Recent Cybersecurity Breaches (Case Studies)

Hands-on:

1. To understand and demonstrate the core principles of the CIA Triad (Confidentiality, Integrity, and Availability) by implementing encryption, file integrity verification using SHA-256 hashing, and basic network connectivity testing.
2. To identify and analyze social engineering and phishing attacks by detecting suspicious email characteristics, evaluating phishing indicators, and understanding preventive measures against cyber threats.

3. To analyze recent cybersecurity breaches by identifying the attack type, threat actor, attack vector, security principles violated, impact on the organization, and recommending appropriate preventive measures.			
Text Book	Text Book 1**:** 1.1, 1.2, 1.3, 1.4, 1.5,1.6, 2.1, 2.2 ,2.3, 21.1–21.5 Text Book 2**:** 1.1–1.3, 2.1–2.4, 2.5, 2.6, 3.1–3.4		
MODULE-2	**NETWORK SECURITY FUNDAMENTALS**	**24CDS63.2**	**8 Hours**
Computer Network Security Concepts, OSI and TCP/IP Security Issues, Network Attacks -DoS and DDoS, Spoofing, Sniffing, Session Hijacking, Firewalls and IDS/IPS, Virtual Private Networks (VPN), Wireless Network Security, Secure Communication Protocols -HTTPS, SSL/ TLS, SSH			
Hands-on: 1. To analyze network communication using Wireshark by capturing packets, mapping them to the OSI and TCP/IP models, and identifying potential security vulnerabilities in network protocols. 2. To understand the role of Firewalls, Intrusion Detection Systems (IDS), and Intrusion Prevention Systems (IPS) by configuring firewall rules and analyzing their effectiveness in protecting network resources. 3. To explore secure communication protocols by analyzing SSL/TLS certificates, comparing HTTP and HTTPS communication, and establishing secure remote access using SSH.			
Text Book	Text Book 1**:** 8.1–8.4, 17.1–17.5, 18.1–18.3, 20.1, 20.2, 20.3,20.4, 23.1–23.5, 24.1–24.4 Text Book 2**:** 5.1–5.4		
MODULE-3	**CRYPTOGRAPHY AND ACCESS CONTROL**	**24CDS63.3**	**8 Hours**
Introduction to Cryptography, Symmetric Encryption, Asymmetric Encryption, Hash Functions and Digital Signatures, Public Key Infrastructure (PKI) , Authentication Mechanisms, Multi-Factor Authentication (MFA), Access Control Models -DAC, MAC, RBAC, Password Security and Identity Management			
Hands-on: 1. Generate a pair of RSA public and private keys using Python or OpenSSL. Encrypt a message using the RSA public key and decrypt it using the corresponding private key. 2. Demonstrate Discretionary Access Control (DAC) by assigning file permissions to different users in Linux or Windows. 3. Develop a secure file protection system that performs: Password authentication, AES file encryption, SHA-256 integrity verification, Digital signature verification.			
Text Book	Text Book 1: 1.1–1.4, 2.1–2.5, 3.1–3.4, 9.1–9.4, 11.1–11.4, 13.1–13.3, 14.1–14.4; Text Book 2: 3.1–3.5, 4.1–4.5, 5.1–5.3		
MODULE-4	**INTRODUCTION TO TOOLS & SECURITY MANAGEMENT**	**24CDS63.4**	**8 Hours**
Introduction to security tools- Network Protocol Analyzer -Wireshark, Network Discovery and Security Auditing-Nmap, Cryptography tools-CrypTool2/CyberChef, Vulnerability Assessment & Ethical Hacking tools-OWASP ZAP, Cyber Forensics & Incident Response tool- Autopsy.			
Hands-on: 1. To perform network discovery and security auditing using Nmap by identifying active hosts, open ports, running services, and preparing a basic security assessment report. 2. To perform vulnerability assessment of a web application using OWASP ZAP by identifying security weaknesses, analyzing scan results, and recommending appropriate mitigation measures. 3. To investigate digital evidence using Autopsy by analyzing forensic images, recovering deleted files, examining user activity, and generating a forensic investigation report.			
Text Book	Text Book 1**:** 16.1–16.4, 18.1–18.3; Text Book 2**:** 4.1–4.7, 5.1–5.4, 10.1–10.5, 11.1–11.4, 12.1–12.5		

MODULE-5	EMERGING TRENDS, CYBER LAWS AND ETHICS	24CDS63.5, 24CDS63.6	8 Hours

Emerging cybersecurity challenges pertaining to IoT cloud & AI, Credit card Frauds in Mobile and Wireless Computing Era, Security Challenges Posed by Mobile Devices, Registry Settings for Mobile Devices, Authentication service Security Information Security Governance, Security Policies and Standards, Incident Response Lifecycle, Digital Forensics Fundamentals, Business Continuity Planning (BCP), Disaster Recovery Planning (DRP), Introduction to GDPR (General Data Protection Regulation)

Hands-on:

1. Examine the security settings of an Android or iOS device and identify enabled security features such as screen lock, encryption, biometric authentication, and app permissions.
2. Configure screen lock, biometric authentication, automatic updates, and backup settings on a mobile device and document the changes.
3. Analyze a sample organization's privacy policy and identify whether it addresses key GDPR principles such as consent, data minimization, and user rights.

Text Book	Text Book 1**:** 16.1–16.4, 18.1–18.3; Text Book 2**:** 4.1–4.7, 5.1–5.4, 10.1–10.5, 11.1–11.4, 12.1–12.5

CIE Assessment Pattern (50 Marks – Lab)

		Tests(s)	Certified Online Learning	Weekly Assessment
		25	15	10
L1	Remember	-	-	-
L2	Understand	5	5	-
L3	Apply	10	5	5
L4	Analyze	5	5	5
L5	Evaluate	5	-	-
L6	Create	-	-	-

SEE Assessment Pattern (50 Marks – Lab)

RBT Levels		Exam Marks Distribution (50)
L1	Remember	-
L2	Understand	5
L3	Apply	20
L4	Analyze	15
L5	Evaluate	10
L6	Create	-

Suggested Learning Resources:

Text Books:

1. "Computer Security: Principles and Practice", William Stallings and Lawrie Brown, 5th Edition, Pearson Education, 2024. ISBN: 978-0-13-809167-5
2. "Cybersecurity Essentials", Charles J. Brooks, Christopher Grow, Philip Craig, Donald Short,3rd Edition, John Wiley & Sons,2023. ISBN: 978-1-119-36239-5.

Reference Books:

1. "Principles of Information Security", Michael E. Whitman and Herbert J. Mattord, 7th Edition, Cengage Learning. 7th Edition, 2023. ISBN - 978-9-355-73890-5
2. "Cryptography and Network Security: Principles and Practice", William Stallings, 8th Edition, Pearson Education 2022/2024 Global Edition. ISBN: 978-1-292-43748-4
3. "Network Security Essentials: Applications and Standards" , William Stallings, 7th Edition, Pearson. 2018. ISBN: 978-9-352-86660-1

4. "Cyber Security and Cyber Laws", Nina Godbole and Sunit Belapure, Wiley India. 1st Edition, 2018. ISBN: 978-81-265-2179-1.
Web links and Video Lectures (e-Resources): • **https://www.youtube.com/watch?v=Yr0xPVFcf-U** • **https://pll.harvard.edu/course/cs50s-introduction-cybersecurity** • **https://www.youtube.com/watch?v=sW0Wiepofo4** • **https://www.netacad.com/courses/introduction-to-cybersecurity?courseLang=en-US** • **https://www.cdse.edu/Training/Security-Training-Videos/Cybersecurity/**
Activity-Based Learning (Suggested Activities in Class) ● Problem solving Approach ● Organizing Group wise discussions on related topics ● Class presentations

PREDICTIVE ANALYTICS

Course Code	**24CDS641**	**CIE Marks**	**50**
L:T:P:S	**3:0:0:0**	**SEE Marks**	**50**
Hrs / Week	**3**	**Total Marks**	**100**
Credits	**03**	**Exam Hours**	**03**

Course outcomes:
At the end of the course, the student will be able to:

24CDS641.1	Understand predictive modelling techniques like supervised, unsupervised learning, decision trees, and neural networks.
24CDS641.2	Analyze data preparation, including cleaning, handling missing values, and creating features.
24CDS641.3	Apply PCA and clustering algorithms for dimensionality reduction and pattern recognition.
24CDS641.4	Implement and assess predictive models, focusing on key metrics and interpretation.
24CDS641.5	Evaluate predictive models using percent correct classification and rank-ordered methods.
24CDS641.6	Analyse the challenges in predictive analytics, including data understanding and integrating BI and data mining.

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
24CDS641.1	2	2	1	-	-	-	-	-	-	-	3	3	3
24CDS641.2	2	3	2	-	-	-	-	-	-	-	3	3	3
24CDS641.3	3	2	2	-	-	-	-	-	-	-	3	3	3
24CDS641.4	-	2	3	-	-	-	-	-	-	-	3	3	3
24CDS641.5	-	2	3	-	-	-	-	-	-	-	3	3	3
24CDS641.6	-	2	3	-	-	-	-	-	-	-	3	3	3

MODULE-1	**OVERVIEW OF PREDICTIVE ANALYTICS**	**24CDS641.1**	**8 Hours**
Predictive Analytics: Supervised vs. Unsupervised Learning, Parametric vs. Non-Parametric Models; Business Intelligence, Predictive Analytics vs. Business Intelligence, Predictive Analytics vs. Statistics; Predictive Analytics vs. Data Mining; Challenges in Using Predictive Analytics, Data Understanding			
Self-study	Study key differences and applications of supervised vs. unsupervised learning, parametric vs. non-parametric models		
Text Book	Text Book 1: Ch1, Ch3		
MODULE-2	**DATA PREPARATION**	**24CDS641.2**	**8 Hours**
Data Preparation: Variable Cleaning, Incorrect Values, Consistency in Data Formats, Outliers, Multidimensional Outliers, Missing Values, Fixing Missing Data; Feature Creation: Simple Variable Transformations, Fixing Skew, Binning Continuous Variables, Numeric Variable Scaling, Nominal Variable Transformation, Ordinal Variable Transformations, Date and Time Variable Features, ZIP Code Features, Multidimensional Features, Sampling.			

Case Study	Detecting and managing outliers in sensor data collected from a network of environmental monitoring devices, ensuring data integrity and reliability for accurate analysis		
Text Book	Text Book 1: Ch 4		
MODULE-3	**DESCRIPTIVE MODELING**	**24CDS641.3, 24CDS641.4**	**8 Hours**
Descriptive Modeling; Data Preparation Issues with Descriptive Modeling; Applying PCA to New Data, PCA for Data Interpretation, Additional Considerations before Using PCA, The Effect of Variable Magnitude on PCA Models; Selecting the Number of Clusters, The Kohonen SOM Algorithm, Visualizing Kohonen Maps, Similarities with K-Means.			
Case Study	Apply Principal Component Analysis (PCA) to financial data for dimensionality reduction and understand market trends.		
Text Book	Text Book 1:Ch 3 14, Text Book 2: Ch 14		
MODULE-4	**PREDICTIVE MODELING**	**24CDS641.5**	**8 Hours**
Predictive Modeling; The Decision Tree Landscape, Building Decision Trees, Decision Tree Splitting Metrics, Decision Tree Knobs and Options, Reweighting Records: Priors, Reweighting Records: Misclassification Costs; Interpreting Logistic Regression Models; Neural Networks: Building Blocks- The Neuron, Neural Network Training, The Flexibility of Neural Networks, Neural Network Settings, Neural Network Pruning, Interpreting Neural Networks, Neural Network Decision Boundaries.			
Case Study	Case Study: Apply decision trees for customer segmentation in retail and logistic regression for predicting customer churn in telecommunications,		
Text Book	Text Book 1: Ch 6, 7, 8 , 10,11		
MODULE-5	**ASSESSING PREDICTIVE MODELS**	**24CDS641.6**	**8 Hours**
Assessing Predictive Models: Batch Approach to Model Assessment, Percent Correct Classification, Rank-Ordered Approach to Model Assessment; Assessing Regression Models; Model Ensembles: Motivation for Ensembles, Bagging, Boosting, Improvements to Bagging and Boosting.			
Case Study	Apply k-NN for movie recommendations and evaluate model performance in practical applications.		
Text Book	Text Book 1: Ch 4, 12, 15,. Textbook 2 : Ch. 9–12, 13		

CIE Assessment Pattern (50 Marks – Theory) –

RBT Levels		Mark Distribution		
		Test (s)	AAT1	AAT2
		25	15	10
L1	Remember	-	-	-
L2	Understand	5	-	-
L3	Apply	10	7.5	5
L4	Analyze	10	7.5	5
L5	Evaluate	-	-	-
L6	Create	-	-	-

SEE Assessment Pattern (50 Marks – Theory)

RBT Levels		Exam Marks Distribution (50)
L1	**Remember**	**-**
L2	**Understand**	**15**
L3	**Apply**	**15**
L4	**Analyze**	**10**
L5	**Evaluate**	**10**
L6	**Create**	**--**

Suggested Learning Resources:

Text Books:

1) Galit Shmueli, Peter C. Bruce, Kuber R. Deokar & Nitin R. Patel – Machine Learning for Business Analytics: Concepts, Techniques, and Applications with Analytic Solver Data Mining, 4th Ed., 2023, John Wiley & Sons Inc ISBN-13: 978-1119829836

2) U. Dinesh Kumar – Business Analytics: The Science of Data-Driven Decision Making , 2nd Ed., 2021, Wiley ISBN-13: 978-9354246197

Reference Books:

1) Foster Provost and Tom Fawcett , "Data Science for Business: What You Need to Know about Data Mining and Data Analytic Thinking" (2020). ISBN-13 978-1449361327.

2) Eric Siegel, "Predictive Analytics: The Power to Predict Who Will Click, Buy, Lie, or Die" (2020), ISBN-13, 978-1119145677.

3) Sandy Ryza, Uri Laserson, Sean Owen, Josh Wills , "Advanced Analytics with Spark: Patterns for Learning from Data at Scale" (2019), ISBN-13, 978-1491912768.

Web links and Video Lectures (e-Resources):

1. **https://www.coursera.org/learn/predictive-analytics**
2. **https:**// www.youtube.com/watch?v=PaFPbb66DxQ
3. **https://www.udemy.com/course/data-science-analytics-ai-for-business-the-real-world**
4. **https://onlinecourses.swayam2.ac.in/imb24_mg71/preview**

Activity-Based Learning (Suggested Activities in Class)/ Practical Based learning

- Problem Solving exercises
- Case Studies
- Discussions

OBJECT ORIENTED ANALYSIS & DESIGN

Course Code	**24CDS642**	**CIE Marks**	**50**
L:T:P:S	**3:0:0:0**	**SEE Marks**	**50**
Hrs. / Week	**3**	**Total Marks**	**100**
Credits	**03**	**Exam Hours**	**03**

Course outcomes:
At the end of the course, the student will be able to:

24CDS642.1	Understand Object Oriented Modelling techniques.
24CDS642.2	Apply class modelling by creating class diagrams based on the given problem requirements.
24CDS642.3	Analyze state modeling, use case, sequence and activity modeling techniques to represent functional requirements for a particular problem.
24CDS642.4	Analyze the relationships and behavior of system components using Deployment Diagrams to understand dynamic interactions.
24CDS642.5	Interpret Object Oriented Principles for System Conception and Fine tune the Model
24CDS642.6	Evaluate the concept of software design patterns by identifying various pattern categories and describing their structure and purpose.

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
24CDS642.1	2	2	2	-	-	-	-	-	-	-	2	2	2
24CDS642.2	3	2	2	-	-	-	-	-	-	-	2	2	2
24CDS642.3	2	3	2	-	-	-	-	-	-	-	2	2	2
24CDS642.4	2	3	2	-	-	-	-	-	-	-	2	2	2
24CDS642.5	-	2	2	3	-	-	-	-	-	-	2	2	2
24CDS642.6	-	2	2	3	-	-	-	-	-	-	2	2	2

MODULE-1	**INTRODUCTION, MODELING CONCEPTS AND CLASS MODELING**	**24CDS642.1, 24CDS642.2**	**8 Hours**

Object Orientation, OO development, OO themes; Modeling, Concepts -1: The three models, Class Modeling: Object and class concepts; Link and associations concepts: multiplicity; ordering, Association Class, Association ends, Association end name, Qualified Association, Generalization and inheritance; A sample class model, Example Scenario: ATM management system.

Text Book	Text Book 1: Chapters 1, 2, 3

MODULE-2	**ADVANCED CLASS MODELING & BEHAVIORAL MODELING**	**24CDS642.3**	**8 Hours**

Advanced Class Modeling: Advanced object and class concepts; Aggregation Vs Composition. State Modeling: Events, States, Transitions and Conditions; State diagrams; State diagram behavior, Problems with flat state Diagram, Advanced State Modeling: Nested state, Nested state diagrams; Concurrency; A sample state model. Sequence scenario, Sequence Diagrams; Procedural sequence models.

Text Book	Text Book 1: Ch 3

<table>
<tr><td>MODULE-3</td><td>BEHAVIORAL, FUNCTIONAL AND ARCHITECTURAL MODELING</td><td>24CDS642.3, 24CDS642.4</td><td>8 Hours</td></tr>
<tr><td colspan="4">Use case Scenario, use case Diagrams, Guidelines for use case Diagram, use case Relationships, Activity Diagram Notations, Activity Diagram, Guidelines for activity Diagram, Sending and Receiving Signals, Swim lanes. Data Flow Diagram (Level-0, Level-1 and Level-2); Component diagrams and Deployment diagrams; Reverse Engineering.</td></tr>
<tr><td>Text Book</td><td colspan="3">Text Book 1: Ch 6, 7 ,10</td></tr>
<tr><td>Case Study</td><td colspan="3">Identify the use cases and the relation ships between them for budling an ATM system that supports below functionalites.
Authenticate Customer
Withdraw Cash
Deposit Cash
Check Balance
Transfer Funds
Change PIN
Print Receipt
Every transaction requires authentication. A customer may optionally request a receipt after completing a transaction.</td></tr>
<tr><td>MODULE-4</td><td>IMPLEMENTATION MODELING</td><td>24CDS642.5</td><td>8 Hours</td></tr>
<tr><td colspan="4">Development Stages, Development life cycle, System Conception: Devising a System Concept, Elaborating a Concepts, Keeping right classes and removing bad classes, Preparing a Problem Statement. Overview of implementation; Fine-tuning classes; Fine-tuning generalizations; Realizing associations; Testing.</td></tr>
<tr><td>Text Book</td><td colspan="3">Text Book 1: Ch 7-9 Text Book 2 :15</td></tr>
<tr><td>MODULE-5</td><td>DESIGN PATTERNS</td><td>24CDS642.6</td><td>8 Hours</td></tr>
<tr><td colspan="4">Pattern, Pattern categories, Pattern Description, Singleton pattern, Prototype pattern, Builder pattern, Factory method pattern, Abstract factory pattern, Proxy Pattern, Facade Pattern.</td></tr>
<tr><td>Case Studies</td><td colspan="3">Design a configuration Manager component for a Java application using Singleton pattern to ensure the configuration can be instantiated only once per application.</td></tr>
<tr><td>Text Book</td><td colspan="3">Text Book 1: Ch 13-16</td></tr>
<tr><td colspan="4">CIE Assessment Pattern (50 Marks – Theory) –
<table>
<tr><th colspan="2" rowspan="2">RBT Levels</th><th colspan="3">Marks Distribution</th></tr>
<tr><th>Test (s)</th><th>AAT1</th><th>AAT2</th></tr>
<tr><th colspan="2"></th><th>25</th><th>15</th><th>10</th></tr>
<tr><td>L1</td><td>Remember</td><td></td><td>-</td><td>-</td></tr>
<tr><td>L2</td><td>Understand</td><td>10</td><td>5</td><td>5</td></tr>
<tr><td>L3</td><td>Apply</td><td>10</td><td>10</td><td>5</td></tr>
<tr><td>L4</td><td>Analyze</td><td>5</td><td></td><td></td></tr>
<tr><td>L5</td><td>Evaluate</td><td></td><td></td><td>-</td></tr>
<tr><td>L6</td><td>Create</td><td>-</td><td>-</td><td>-</td></tr>
</table></td></tr>
</table>

SEE Assessment Pattern (50 Marks – Theory)

RBT Levels		Exam Marks Distribution (50)
L1	**Remember**	
L2	**Understand**	**20**
L3	**Apply**	**20**
L4	**Analyze**	**10**
L5	**Evaluate**	**--**
L6	**Create**	**--**

Suggested Learning Resources:

Text Books:

1) **Brahma Dathan and Sarnath Ramnath**, Object-Oriented Analysis, Design and Implementation: An Integrated Approach, **3rd Edition**, Universities Press (India) Pvt. Ltd., 2024. ISBN-13 (Paperback): 978-9393330765.
2) "Systems Analysis and Design" by Kenneth E. Kendall & Julie E. Kendall,10th Edition, Pearson, volume 10,2021,ISBN: 9780137947805

Reference Books:

1. Object-Oriented Analysis and Design Through UML , Gandharba Swain, Laxmi Publications, 2022 (1st Edition).
2. K. Venugopal Reddy, Sampath Korra, "Object –Oriented Analysis and Design Using UML", BSP BOOKS, November 6, 2019.
3. Vaskaran Sarcar, "Java Design Patterns: A Hands-On Experience with Real-World Examples", Apress; 2nd ed. edition, December 7, 2018.

Web links and Video Lectures (e-Resources):

- Object-Oriented System Development using UML – NPTEL (Prof. Rajib Mall, IIT Kharagpur) http://onlinecourses.nptel.ac.in/noc23_cs46/preview.
- Pattern-Oriented Software Architecture – YouTube Playlist (Coursera/Deep Dive) http://www.youtube.com/playlist?list=PLZ9NgFYEMxp6CHE-QQ040tlDILNcBqJnc
- Systems Analysis and Design – NPTEL Course (IISc Bangalore) http://archive.nptel.ac.in/courses/106/108/106108103/

Activity-Based Learning (Suggested Activities in Class)/ Practical Based learning

- Quizzes and Assignments on Behavioral Modelling
- Contents related activities (Activity-based discussions)
    - For active participation of students, instruct the students to prepare UML Diagrams and Organizing Group wise discussions.

SCALABLE DATA SCIENCE

Course Code	**24CDS643**	**CIE Marks**	**50**
L:T:P:S	**3:0:0:0**	**SEE Marks**	**50**
Hrs. / Week	**3**	**Total Marks**	**100**
Credits	**03**	**Exam Hours**	**03**

Course outcomes:
At the end of the course, the student will be able to:

24CDS643.1	Understand the core concepts in data science such as probability, linear algebra, and optimization.
24CDS643.2	Apply basic principles of hash functions and sketches to approximate data operations effectively.
24CDS643.3	Analyze approximate near neighbours search techniques, including extensions and randomized numerical linear algebra methods, to efficiently process large datasets
24CDS643.4	Analyze map-reduce programming examples, such as page rank, k-means, and matrix multiplication, to process big data efficiently.
24CDS643.5	Evaluate the Hadoop ecosystem and related paradigms, including Map-reduce, Scala, and Spark, to design and optimize computational solutions for large-scale data processing tasks.
24CDS643.6	Implement basic functional programming concepts in parallel data processing tasks.

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
24CDS643.1	2	2	2	-	-	-	-	-	-	-	2	2	2
24CDS643.2	3	2	2	-	-	-	-	-	-	-	2	2	2
24CDS643.3	2	3	2	-	-	-	-	-	-	-	2	2	2
24CDS643.4	2	3	2	-	-	-	-	-	-	-	2	2	2
24CDS643.5	2	-	2	3	-	-	-	-	-	-	2	2	2
24CDS643.6	2	2	3	-	-	-	-	-	-	-	2	2	2

MODULE-1	**INTRODUCTION**	**24CDS643.1**	**8 Hours**

Introduction, Probability: Concentration inequalities, Linear algebra: PCA, SVD, Optimization: Basics, Convex, GD, Machine Learning: Supervised, generalization, feature learning, clustering.

Self Study	Provide an example of how concentration inequalities can be applied in analyzing algorithms or data.
Text Book	Text Book 1: Chapter 1, 4, 7

MODULE-2	**MEMORY-EFFICIENT DATA STRUCTURES**	**24CDS643.2**	**8 Hours**

Hash functions, universal / perfect hash families, Bloom filters, Sketches for distinct count. Count Sketch, Count-Min Sketch , Approximate nearest neighbours search: Introduction, kd-trees, LSH families, MinHash for Jaccard, SimHash for L2

Text Book	Text Book 4: Chapter 2 ,2.1-2.6

Self Study	Prepare a report on the way hash functions and sketching techniques contribute to efficient data processing and storage in computer science.		
MODULE-3	**APPROXIMATE NEAR NEIGHBORS SEARCH**	**24CDS643.3**	**8 Hours**
Extensions e.g. multi-probe, b-bit hashing, Data dependent variants Randomized Numerical Linear Algebra Random projection, Randomized Numerical Linear Algebra CUR Decomposition, Sparse RP, Subspace RP, Kitchen Sink			
Text Book	Text Book 3: Chapter 3, 4, 7		
MODULE-4	**MAP-REDUCE AND RELATED PARADIGMS**	**24CDS643.4, 24CDS643.5**	**8 Hours**
Map-reduce and related paradigms Map reduce - Programming examples - (page rank, k-means, and matrix multiplication) Big data: computation goes to data, Hadoop ecosystem, Map-reduce and related paradigms, Scala, Spark.			
Text Book	Text Book 4: Chapter 7		
MODULE-5	**INTRODUCTION TO PARALLEL DATA PROCESSING**	**24CDS643.6**	**8 Hours**
Parallel data processing strategies, Programming language options, Functional programming basics, Resilient Distributed Dataset and Data Frames on Apache SparkSQL.			
Text Book	Text Book 2: Chapter 1, 5, 12, 14		

CIE Assessment Pattern (50 Marks – Theory)

RBT Levels		Marks Distribution		
		Test (s)	AAT1	AAT2
		25	15	10
L1	Remember	-	-	-
L2	Understand	10	-	-
L3	Apply	5	5	5
L4	Analyze	5	10	5
L5	Evaluate	5	-	-
L6	Create	-	-	-

SEE Assessment Pattern (50 Marks – Theory)

RBT Levels		Exam Marks Distribution (50)
L1	Remember	-
L2	Understand	15
L3	Apply	15
L4	Analyze	10
L5	Evaluate	10
L6	Create	-

Suggested Learning Resources:

Text Books:

1) Charu C.Aggarwal, Linear Algebra and Optimization for Machine Learning, 2nd Edition.2026, ISBN 978-3-031-98618-5.
2) Sreeram Nudurupati, Essential Pyspark for Scalable Data Analytics: A beginner's guide to harnessing the power and ease of Pyspark3, 1st Edition,2021, ISBN-13: 9781800568877.
3) High dimensional probability, An introduction with applications in Data Sciences, 2nd Edition, Cambridge University Press, 2026, ISBN: 9781009490672.

4) Woodruff, David P. ""Sketching as a tool for numerical linear algebra."" Foundations and Trends® in Theoretical Computer Science 10.1–2 (2014): 1-157., ISBN-13- 978-1680830040.

Reference Books:

1) Essential PySpark for Scalable Data Analytics Paperback – Import, 29 October 2021, ISBN-13, 978-180056887.
2) Mahoney, Michael W. "Randomized algorithms for matrices and data." Foundations and Trends® in Machine Learning 3.2 ,2011,ISBN: 978-1-60198-506-4.

Web links and Video Lectures (e-Resources):

- https://www.classcentral.com/course/swayam-scalable-data-science-14279.
- https://www.ibm.com/training/badge/fundamentals-of-scalable-data-science

Activity-Based Learning (Suggested Activities in Class)/ Practical Based learning

- Contents related activities (Activity-based discussions) on Parallel processing
- Organizing Group wise discussions on issues
- Seminars

AUTOMATA THEORY AND COMPUTABILITY			
Course Code	**24CDS644**	**CIE Marks**	**50**
L:T:P:S	**3:0:0:0**	**SEE Marks**	**50**
Hrs. / Week	**3**	**Total Marks**	**100**
Credits	**03**	**Exam Hours**	**03**

Course outcomes:
At the end of the course, the student will be able to:

24CDS644.1	Apply finite automata and formal language concepts for language recognition and finite state system modeling.
24CDS644.2	Analyze regular sets and grammars using regular expressions, finite automata, and pumping lemma techniques.
24CDS644.3	Design context-free grammars for language recognition and parsing.
24CDS644.4	Analyze pushdown automata and their relationship with context-free languages, including parsing techniques.
24CDS644.5	Implement Turing Machines to recognize languages and relationship with Linear Bounded Automata and Type-0 Grammars.
24CDS644.6	Explore the analysis and construction of computable functions to understand their computational properties

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
24CDS644.1	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	3	3	3
24CDS644.2	**2**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	3	3	3
24CDS644.3	**2**	**2**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	3	3	3
24CDS644.4	**2**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	3	3	3
24CDS644.5	**2**	**2**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	3	3	3
24CDS644.6	**2**	**2**	**-**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	3	3	3

MODULE-1	**AUTOMATA AND FORMAL LANGUAGES**	**24CDS644.1**	**8 Hours**

THEORY OF AUTOMATA: Definition, Description of a Finite Automaton; Transition Systems; Properties of Transition Functions; Acceptability of a String by a Finite Automaton; Nondeterministic Finite State Machines; The Equivalence of DFA and NDFA; Mealy and Moore Models; Minimization of Finite Automata.
FORMAL LANGUAGES: Definitions and Examples; Chomsky Classification of Languages; Languages and Their Relation; Recursive and Recursively Enumerable Sets; Operations on Languages; Languages and Automata.

Self-study:	Study academic papers or research articles on minimization techniques for finite automata.
Text Book	Textbook 1: Chapter - 02,03,04

MODULE-2	**REGULAR SETS AND GRAMMARS**	**24CDS644.2**	**8 Hours**

REGULAR SETS AND REGULAR GRAMMARS: Regular Expressions; Finite Automata and Regular Expressions: Transition System Containing A-moves, NDFAs with A-moves and Regular Expressions, Conversion of Nondeterministic Systems to Deterministic Systems, Algebraic Method Using Arden's Theorem, Construction of

Finite Automata Equivalent to a Regular Expression, Equivalence of Two Finite Automata, Equivalence of Two Regular Expressions; Pumping Lemma for Regular Sets; Application of Pumping Lemma; Closure Properties of Regular Sets.			
Case Study	Analyze the implementation of regular expression engines in programming languages or search engines to understand how they efficiently match patterns in text data.		
Text Book	Textbook 1: Chapter - 05,06		
MODULE-3	**CONTEXT-FREE LANGUAGES & PUSHDOWN AUTOMATA**	**24CDS644.3 24CDS644.4**	**8 Hours**
CONTEXT·FREE LANGUAGES(CFL): CFL and Derivation Trees; Ambiguity in Context-free Grammars, Simplification of Context-free Grammars, Normal Forms for Context-free Grammars. PUSHDOWN AUTOMATA(PDA): Basic Definitions, Acceptance by PDA, Pushdown Automata and Context-free Languages, Parsing and Pushdown Automata.			
Case Study:	Explore applications of pushdown automata in syntax analysis stages of compilers and interpreters, where they are used to recognize and parse context-free grammars.		
Text Book	Textbook 1: Chapter - 07,08,09		
MODULE-4	**TURING MACHINES & LINEAR BOUNDED AUTOMATA**	**24CDS644.5**	**8 Hours**
TURING MACHINES AND LINEAR BOUNDED AUTOMATA**:** Turing Machine Model; Representation of Turing Machines; Language Acceptability by Turing Machines; Design of Turing Machines; Description of Turing Machines; Techniques for TM Construction; Variants of Turing Machines; The Model of Linear Bounded Automaton; Turing Machines and Type 0 Grammars; Linear Bounded Automata and Languages.			
Case Study	Solve practice problems and exercises to reinforce concepts such as designing Turing machines and their relationship with type 0 grammars.		
Text Book	Textbook 1: Chapter - 10,11,12		
MODULE-5	**ASSESSING PREDICTIVE MODELS**	**24CDS644.6**	**8 Hours**
COMPUTABILITY**:** Introduction and Basic Concepts; Primitive Recursive Functions; Recursive Functions; Partial Recursive Functions and Turing Machines: Computability, A Turing Model for Computation, Turing-computable Functions, Construction of the Turing Machine that Can Compute the Zero Function Z, Construction of the Turing Machine for Computing the Successor Function, Construction of the Turing Machine for Computing the Projection U_i^m, Construction of the Turing Machine that Can Perform Composition, Recursion, Minimization.			
Case Study	Investigate real-world examples of computable functions used in algorithmic decision-making or problem-solving tasks, and analyze their efficiency and limitations.		
Text Book	Textbook 1: Chapter - 10,13		

CIE Assessment Pattern (50 Marks – Theory) –

RBT Levels		Marks Distribution		
		Test (s)	AAT1	AAT2
		25	15	10
L1	Remember	-	-	-
L2	Understand	10	-	-
L3	Apply	5	7.5	5
L4	Analyze	5	7.5	5
L5	Evaluate	5	-	-
L6	Create	-	-	-

SEE Assessment Pattern (50 Marks – Theory)

RBT Levels		Exam Marks Distribution (50)
L1	**Remember**	**-**
L2	**Understand**	**10**
L3	**Apply**	**10**
L4	**Analyze**	**10**
L5	**Evaluate**	**10**
L6	**Create**	**--**

Suggested Learning Resources:

Text Books:

1. K. R. Chowdhary, Theory of Computation: Automata, Formal Languages, Computation and Complexity, Springer, 2025, ISBN:978-981-97-6233-0

Reference Books:

1. Michael Sipser : Introduction to the Theory of Computation, 3rd edition, Cengage learning,2013, ISBN-13, 978-8131525296.
2. Elaine Rich, Automata, Computability and Complexity, 1st Edition, Pearson Education,2012, ISBN-13, 978-8131788226.
3. John C Martin, Introduction to Languages and The Theory of Computation, 3rd Edition, Tata McGraw –Hill Publishing Company Limited, 2013, ISBN-13, 978-0072322002.

Web links and Video Lectures (e-Resources):

1. https://www.geeksforgeeks.org/theory-of-computation-automata-tutorials/
2. https://brilliant.org/courses/computer
3. https://www.youtube.com/playlist?list=PLEbnTDJUr_IcPtUXFy2b1sGRPsLFMghhS
4. https://www.youtube.com/playlist?list=PLF7D3B75EDA17FE4D

Activity-Based Learning (Suggested Activities in Class)/ Practical Based learning

- Use k-means clustering on a dataset and visualize the clusters, then compare with Kohonen SOM.
- Implement PCA on a dataset to reduce dimensionality and visualize the principal components.
- Implement a decision tree classifier on a dataset, adjusting various parameters and observing the effects.
- Implement k-NN and Naïve Bayes classifiers on a dataset and evaluate their performance.

ETHICAL AI			
Course Code	**24CDS645**	**CIE Marks**	**50**
L:T:P:S	**3:0:0:0**	**SEE Marks**	**50**
Hrs. / Week	**3**	**Total Marks**	**100**
Credits	**03**	**Exam Hours**	**03**

Course outcomes:
At the end of the course, the student will be able to:

24CDS645.1	Apply legal and ethical frameworks to evaluate the governance of AI systems.
24CDS645.2	Apply human rights centred design principles and normative frameworks to address ethical dilemmas and stakeholder conflicts in AI.
24CDS645.3	Analyse justice-based moral frameworks to assess accountability and responsibility in AI systems.
24CDS645.4	Evaluate ethical risks, societal impacts, and responsibilities of AI applications across health, legal, public, and scientific domains
24CDS645.5	Design ethical frameworks to address the societal impact of AI across diverse populations and contexts
24CDS645.6	Propose comprehensive ethical approaches for AI design, deployment, and governance.

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
24CDS645.1	3	-	-	-	-	-	-	-	-	-	3	3	3
24CDS645.2	3	-	-	-	2	-	-	-	-	-	3	3	3
24CDS645.3	-	3	-	-	2	-	-	-	-	-	3	3	3
24CDS645.4	-	2	-	3	-	-	-	3	-	-	3	3	3
24CDS645.5	-	-	3	2	-	-	-	3	-	-	3	3	3
24CDS645.6	2	2	2	2	-	-	-	3	-	-	3	3	3

MODULE-1	**INTRODUCTION TO AI AND ETHICAL IMPLICATIONS**	**24CDS645.1**	**8 Hours**

Overview of AI, generative AI vs predictive AI, Introduction & Overview for Law and Regulation ethical concerns in AI development, societal impacts of AI, and ethical decision-making frameworks in AI systems. Ethical theories (deontology, utilitarianism, virtue ethics) and definitions of "ethics" vs. "morality" in AI.

Case Study	Examine the Cambridge Analytica data misuse scandal as a case study to understand privacy and governance failures, and analyze the autonomous vehicle trolley dilemma for applying ethical theories in real contexts. Explore bias in predictive policing tools, ethical concerns of facial recognition in public surveillance, and the implications of generative AI in creative industries,
Text Book	Text Book 1: Ch 1, 2, 3, 6, 8

MODULE-2	**FRAMEWORK AND MODES**	**24CDS645.2**	**8 Hours**

AI Governance by Human Rights- Centered Design, Deliberation and Oversight: End to Ethics Washing,

The Incompatible Incentives of Private-Sector AI. Normative Modes: Codes and standards. The Role of Professional Norms in the Governance of Artificial Intelligence.			
Case Study	Students can examine the EU AI Act as a case of rights-based governance and contrast it with industry ethics codes to see gaps between regulation and self-regulation. They may also study examples of ethics washing in big tech and explore how professional bodies like IEEE/ACM set norms for responsible AI.		
Text Book	Text Book 1: Ch 3, 4, 5, 6		
MODULE-3	**CONCEPTS AND ISSUES**	**24CDS645.3**	**8 Hours**
Moral Framework of Justice in AI: on the Limits, Failing and Ethics of Fairness, Accountability in Computer Systems-Responsibility and AI, The concept of Handoff as a Model for Ethical Analysis and Design			
Case Study:	Students can study the COMPAS algorithm bias case in criminal justice as an example of fairness failures, and review accountability issues in self-driving car accidents. For self-study, they may explore responsibility gaps in AI decision-making and the idea of shared human–AI accountability		
Text Book	Text Book 1: Ch 6, 8, 9, 10. Text Book 3: Chapter 6,7		
MODULE-4	**Predictive AI Model's implications and Ethics of Data**	**24CDS645.4**	**8 Hours**
Introduction to supervised learning, predictive analytics, algorithmic bias, fairness in predictive modelling, and consequences of biased predictions in decision-making, Privacy issues, data ownership, consent in data usage, differential privacy, transparency in data collection, ethical data handling.			
Case Study	Students can examine the Cambridge Analytica case to understand data misuse and consent issues, and the Amazon hiring algorithm bias as an example of unfair predictive modelling. For self-study, they may explore differential privacy in healthcare data and the trade-off between transparency and data protection.		
Text Book	Text Book 2: Ch 7,15. Text Book 3: 6,8,		
MODULE-5	**Cases and Application**	**24CDS645.5 24CDS645.6**	**8 Hours**
Ethics of AI in Transport - Ethics of AI in Biomedical Research, Ethics of AI in Law: Basics Questions, Beyond Bias:" Ethical AI" in Criminal Law. In-depth study of specific ethical issues (e.g., AI in military applications, surveillance technologies, AI in creative industries), regulatory challenges, and developing ethical guidelines.			
Case Study	Students can review self-driving car accident cases to discuss transport ethics and AI in predictive policing for law and justice concerns. For self-study, they may explore ethical issues in military drones, AI in creative industries, and global regulatory challenges.		
Text Book	Text Book 2: 15, Text Book 1: Ch 8, 9, 10, 11		

CIE Assessment Pattern (50 Marks – Theory)

RBT Levels		Marks Distribution		
		Test (s)	AAT1	AAT2
		25	15	10
L1	Remember	-	-	-
L2	Understand	5	-	5
L3	Apply	10	5	5
L4	Analyze	5	5	-
L5	Evaluate	5	5	-
L6	Create	-	-	-

SEE Assessment Pattern (50 Marks – Theory)

RBT Levels		Exam Marks Distribution (50)
L1	Remember	-
L2	Understand	15
L3	Apply	15
L4	Analyze	10
L5	Evaluate	10
L6	Create	--

Suggested Learning Resources:

Text Books:

1) Paula Boddington, AI Ethics: A Textbook, 1st Edition, Springer Nature Singapore, 2023, ISBN: 978-981-19-9382-4.
2) Nathalie A. Smuha (Ed.), The Cambridge Handbook of the Law, Ethics and Policy of Artificial Intelligence, Cambridge University Press, 2025, ISBN: 9781009367783
3) Animesh Mukherjee, Juhi Kulshrestha, Abhijnan Chakraborty, and Srijan Kumar (Eds.), Ethics in Artificial Intelligence: Bias, Fairness and Beyond, Springer Singapore, 2024, ISBN: 978-981-99-7184-8. https://link.springer.com/book/10.1007/978-981-99-7184-8

Reference Books:

1) Luciano Floridi, The Ethics of Artificial Intelligence: Principles, Challenges, and Opportunities OUP Oxford, 2023, ISBN-13: 978-0198883111
2) Melanie Mitchell, Artificial Intelligence: A Guide for Thinking Humans, Dimensions ,2019. ISBN: 9780374715236, 0374715238

Web links and Video Lectures (e-Resources):

- https://ocw.mit.edu/courses/res-ec-001-exploring-fairness-in-machine-learning-for-international-development-spring-2020/pages/module-one-introduction/
- https://swayam-plus.swayam2.ac.in/courses/course-details?id=P_INTEL_02

Activity-Based Learning (Suggested Activities in Class)/ Practical Based learning

- Group discussion on real-world problems.
- Contents-related activities (Activity-based discussions)
- Organizing Group discussions on real-world problems
- Seminars

ADVANCED JAVA			
Course Code	**24CDS651**	**CIE Marks**	**50**
L:T:P:S	**0:0:1:0**	**SEE Marks**	**50**
Hrs./ Week	**2**	**Total Marks**	**100**
Credits	**01**	**Exam Hours**	**03**

Course outcomes:
At the end of the course, the student will be able to:

24CDS651.1	Apply event handling mechanism in Java based GUI programming.
24CDS651.2	Analyze database access and details for managing information using the JDBC API
24CDS651.3	Build web applications using Servlets and JSP
24CDS651.4	Explore the usage of frameworks Spring in J2EE based application development

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
24CDS651.1	3	2	3	-	1	-	-	-	-	-	-	3	3
24CDS651.2	-	3	3	-	1	-	-	-	-	-	-	3	3
24CDS651.3	2	2	3	-	1	-	-	-	-	-	-	3	3
24CDS651.4	2	2	2	3	1	-	-	-	-	-	-	3	3

Pgm. No.	List of Programs	Hours	COs
	Prerequisite		
	• Basic Java Programming. Collection Framework.	2	NA
	PART-A		
1	Design and create a swing based simple calculator program to perform basic arithmetic operations.	2	24CDS651.1
2	Design and demonstrate loading of file in a Swing Component.	2	24CDS651.1
3	Design and develop a swing-based application to count the number of times a specific button is clicked by the user, apply event handling mechanism.		24CDS651.2
4	Design, Develop and Implement a JDBC program using statement object to display the Employee information to the console. Assume suitable columns and rows for the Employee table and JDBC drivers.	2	24CDS651.2
5	Design, Develop and Implement a JDBC based program using Prepared statement object to perform update operation and display the updated Product data. Assume suitable columns for the Product table and JDBC drivers.	2	24CDS651.2
6	Design, Develop and Implement a JDBC based program using callable	2	24CDS651.2

	statement to execute a stored SQL procedure to display the details of a student matching the USN provided, from student table. Assume suitable columns and rows for the student table and JDBC drivers.		
PART-B			
7	Develop a library home page with option to search all books written by a particular author. Use servlet to make DB connectivity and JSP to display the list of books in tabular fashion to the client. In case of error, JSP page must display error message to client. Assume suitable Data Base and drivers. Table can have columns author name and book title.	2	24CDS651.3
8	Design and develop a user login page and authenticate the user in a JSP page using database. Assume user name and password to be the column of the USER database. Establish connectivity using JDBC drivers.	2	24CDS651.3
9	Create a HTML Page, which asks the user to enter a number in a textbox. On clicking the submit button, it places the request to a Servlet. The Servlet generates all Prime numbers which are less than the given number and adds them to an ArrayList and forwards the control to a JSP page. The JSP page iterates through the ArrayList and prints them in a tabular format. Apply RequestDispatcher methods to achieve the same.	2	24CDS651.3
10	Design a Seminar registration form with Candidate Name, Email id, Favourite Courses enrolled. Apply usebean tag in JSP to receive and send the data to Candidate Java Bean and reply with successful registration and display the registered data.	2	24CDS651.3
11	Create a Spring based examination conduction application to demonstrate the concept of dependency injection. Bean USER has the properties id, name, email id. Bean ANSWER has attributes id, answer, postedDate. Bean QUESTION has id, name, answer.	2	24CDS651.4
12	Design and develop a user login-based web application based on Spring Model view Controller (MVC) components.	2	24CDS651.4
PART-C **Beyond Syllabus Virtual Lab Content** **(To be done during Lab but not to be included for CIE or SEE)**			
1) Design and develop a Student Feedback Portal using JSP and JavaBeans to collect and display course feedback. 2) Develop a Spring Core application to demonstrate Dependency Injection (DI) using XML or Annotation-based configuration.			

CIE Assessment Pattern (50 Marks – Lab)

RBT Levels		Test (s)	Weekly Assessment
		20	30
L1	Remember	-	-
L2	Understand	-	-
L3	Apply	10	10
L4	Analyze	5	10
L5	Evaluate	5	10
L6	Create	-	-

SEE Assessment Pattern (50 Marks – Lab)

RBT Levels		Exam Marks Distribution (50)
L1	Remember	-
L2	Understand	-
L3	Apply	20
L4	Analyze	20
L5	Evaluate	10
L6	Create	

REFERENCE BOOKS:

1. Herbert Schildt and Danny Coward, "JAVA: the Complete Reference", 13th Edition, Tata McGraw Hill, 2023(print), ISBN: 9781265062705
2. Dr. Nirali Dabhi, Dr. Dharmendra Patel and Dr. Atul Patel, "Web Development Toolkit for Java Developers", BPB Publications, 2023 (Print), ISBN: 9789355510341.
3. Laurentiu Spilca, "Spring Start Here: Learn What You Need and Learn It Well", Manning Publications, 2021 (Print), ISBN: 9781617298691.
4. Stephanie Bodoff et al, "The J2EE Tutorial", 3rd Edition, Pearson Education,2015 (Reprint).

WEB RESOURCES

- https://spring.io/

SOFTWARE TESTING			
Course Code	**24CDS652**	**CIE Marks**	**50**
L:T:P:S	**0:0:1:0**	**SEE Marks**	**50**
Hrs./ Week	**2**	**Total Marks**	**100**
Credits	**01**	**Exam Hours**	**03**

Course outcomes:
At the end of the course, the student will be able to:

24CDS652.1	Apply various approaches such as decision table, equivalence class testing and voundary value analysis method to derive test cases.
24CDS652.2	Design test cases for web applications user interface
24CDS652.3	Analyze selenium automation framework for automated testing of web applications
24CDS652.4	Evaluate APPIUM for mobile app testing using

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
24CDS652.1	3	-	-	-	-	-	-	-	-	-	-	3	3
24CDS652.2	2	2	3	2	1	-	-	-	-	-	-	3	3
24CDS652.3	2	3	-	2	1	-	-	-	-	-	-	3	3
24CDS652.4	2	2	2	3	1	-	-	-	-	-	-	3	3

Pgm. No.	List of Programs	Hours	COs
	Prerequisite		
	• Familiarity with basic software development lifecycle	2	NA
	PART-A		
1	Design and develop a program in a language of your choice to solve the triangle problem defined as follows: Accept three integers which are supposed to be the three sides of a triangle and determine if the three values represent an equilateral triangle, isosceles triangle, scalene triangle, or they do not form a triangle at all. Assume that the upper limit for the size of any side is 10. Derive test cases for your program based on decision table approach, execute the test cases and discuss the results	2	24CDS652.1
2	Design, develop, code and run the program in any suitable language to solve the commission problem. Analyze it from the perspective of boundary value testing, derive different test cases, execute these test cases and discuss the test results.	2	24CDS652.1
3	Design, develop, code and run the program in any suitable Language to implement the NextDate function. Analyze it from the perspective of		24CDS652.1

	equivalence class value testing, derive different testcases, execute these test cases and discuss the test results.		
4	Design front-end for any web application and derive the test cases as applicable. Validate the UI elements using JavaScript.	2	24CDS652.2
5	Write a program for matrix multiplication. "Introspect the causes for its failure and write down the possible reasons". Analyze the Positive test cases and Negative Test cases.	2	24CDS652.1
6	Implement test script in Selenium IDE using recording, playing back/executing and saving processes. Use Selenium IDE Commands Assertions and Actions to directly interact with page elements.	2	24CDS652.3
PART-B			
7	Using Selenium IDE, create a test suite containing minimum 4test cases (for any two web sites).	2	24CDS652.3
8	Demonstrate selenium server installation using JAVA	2	24CDS652.3
9	Illustrate automated testing using selenium to perform tests on login web page.	2	24CDS652.3
10	Use selenium to test a program that updates 10 student records into a table from Excel file.	2	24CDS652.3
11	Write and test a program to provide total number of objects present on a web page using selenium.	2	24CDS652.3
12	Demonstrate mobile app testing using APPIUM.	2	24CDS652.4

PART-C
Beyond Syllabus Virtual Lab Content
(To be done during Lab but not to be included for CIE or SEE)

1) Web Form Automation using Selenium.
   - Open a sample login page.
   - Enter username and password automatically.
   - Click the login button.
   - Verify the page title.
2) Launch an Android application using Appium and perform basic UI interaction

CIE Assessment Pattern (50 Marks – Lab)

RBT Levels		Test (s)	Weekly Assessment
		20	**30**
L1	**Remember**	**-**	**-**
L2	**Understand**	**-**	**-**
L3	**Apply**	**10**	10
L4	**Analyze**	**5**	10
L5	**Evaluate**	**5**	10
L6	**Create**	**-**	**-**

SEE Assessment Pattern (50 Marks – Lab)

RBT Levels		Exam Marks Distribution (50)
L1	**Remember**	**-**
L2	**Understand**	**-**
L3	**Apply**	**20**
L4	**Analyze**	**20**
L5	**Evaluate**	**10**
L6	**Create**	

Reference Books:

1. Paul C. Jorgensen: Software Testing, A Craftsman's Approach, 5th Edition, Auerbach Publications, 2021, ISBN-13: 978-0367358495.
2. Boni Garcia, Hands-On Selenium WebDriver with Java :A Deep Dive into the Development of End-to-End Tests,O'REILLY,2022, ISBN:9781098110000
3. Edward Kit, "Software Testing in the Real World - Improving the Process", Pearson Education, 2004, ISBN:978-8177585728.

WEB RESOURCES:

1. Automation Testing Tutorial: https://artoftesting.com/automation-testing
2. Complete Guide on Appium Testing Automation: https://testgrid.io/blog/appium-testing-tutorial/

FUNDAMENTALS OF MOBILE APPLICATION DEVELOPMENT			
Course Code	**24CDS653**	**CIE Marks**	**50**
L:T:P:S	**0:0:1:0**	**SEE Marks**	**50**
Hrs. / Week	**2**	**Total Marks**	**100**
Credits	**01**	**Exam Hours**	**03**

Course outcomes:
At the end of the course, the student will be able to:

24CDS653.1	Develop single screen mobile applications by setting up Android development environment
24CDS653.2	Analyze Intents & Services concepts in developing mobile applications.
24CDS653.3	Implement mobile applications using files.
24CDS653.4	Evaluate methods of storing and retrieving data using Database

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
24CDS653.1	2	2	3	-	3	-	-	-	-	-	-	**3**	**3**
24CDS653.2	2	3	-	-	3	-	-	-	-	-	-	**3**	**3**
24CDS653.3	-	2	3	-	3	-	-	-	-	-	-	**3**	**3**
24CDS653.4	2	2	-	3	-	-	-	-	-	-	-	**3**	**3**

Pgm. No.	List of Programs	Hours	COs
	Prerequisite		
	• Basics of programing	2	NA
	PART-A		
1	Develop an Android application using Button, TextView and EditText for designing a Calculator having basic functionality like Addition, Subtraction, Multiplication and Division.	2	24CDS653.1
2	Develop an Android application that displays information about a small business. Your design must include: • Business name • Photo of business • Contact information and • Description of Business	2	24CDS653.1
3	Develop an Android application to design a Visiting card. The visiting card should have a company logo at the top right corner. The company name should be displayed in capital letters, aligned to the center. Information like Name of the employee, Designation, Phone number, Address, Email, and the Website address is to be displayed.	2	24CDS653.1

4	Develop an Android application The Easy Unit Converter using Radio Buttons	2	24CDS653.1
5	Develop an Android application Currency Converter using Spinners	2	24CDS653.1
6	Develop an Android application using Explicit intent to display the login page. On giving the wrong credentials, it should display the toast message and if credentials are correct, it should display Welcome and the username	2	24CDS653.1
PART-B			
7	Develop an Android application using Implicit intent to display the Gallery and Call buttons. On clicking these buttons, it should go to the respective pages	2	24CDS653.2
8	Develop an Android application Tourist spot with three activities : Welcome page, Display attractions of tourist spot and Webpage of the tourist spot	2	24CDS653.2
9	Develop an Android application to play music in background	2	24CDS653.2
10	Develop an Android application Hospital Database App using Android. The app should store Hospital ID, Hospital name and location of hospital in a file	2	24CDS653.3
11	Develop an Android application The Expense Manager using Android. The application should store all the expenses in a file	2	24CDS653.3
12	Develop an Android application Student Database App using Android. The app should store USN, Student name and Semester of student in SQLite database	2	24CDS653.4

PART-C
Beyond Syllabus Virtual Lab Content
(To be done during Lab but not to be included for CIE or SEE)

1) Develop an Android application Health Monitoring App using Android. The app should store Name, Age, blood pressure, blood group and glucose level of patient in SQLite database
2) Develop an Android application to display Map of your college locality
3) Develop an Android application to alert SMS to one given phone number

CIE Assessment Pattern (50 Marks – Lab)

RBT Levels		Test (s)	Weekly Assessment
		20	30
L1	Remember	-	-
L2	Understand	-	-
L3	Apply	10	10
L4	Analyze	5	10
L5	Evaluate	5	10
L6	Create	-	-

SEE Assessment Pattern (50 Marks – Lab)

RBT Levels		Exam Marks Distribution (50)
L1	**Remember**	**-**
L2	**Understand**	**-**
L3	**Apply**	**20**
L4	**Analyze**	**20**
L5	**Evaluate**	**10**
L6	**Create**	**-**

Suggested Learning Resources:

Reference Books:

1. Reto Meier; Professional Android 4 Application Development; Wiley India Pvt. ltd; 1st Edition; 2012; ISBN-13: 9788126525898.
2. Phillips, Stewart, Hardy and Marsicano; Android Programming, 2nd edition - Big Nerd Ranch Guide; 2015; ISBN-13 978-0134171494.
3. Mark Murphy; Beginning Android 3; Apress Springer India Pvt Ltd. ;1st Edition; 2011;ISBN-13: 978-1- 4302-3297-1
4. Eric Hellman; Android Programming – Pushing the limits by Hellman; Wiley; 2013; ISBN 13: 978-1118717370

WEB RESOURCES:

1. https://developer.android.com/

ADVANCED PYTHON PROGRAMMING			
Course Code	**24CDS654**	**CIE Marks**	**50**
L:T:P:S	**0:0:1:0**	**SEE Marks**	**50**
Hrs. / Week	**2**	**Total Marks**	**100**
Credits	**01**	**Exam Hours**	**03**

Course outcomes:
At the end of the course, the student will be able to:

24CDS654.1	Apply advanced python language constructs to use data structures and OOPS concepts
24CDS654.2	Analyze the language constructs for graphical operations
24CDS654.3	Evaluate various techniques for interconnection to network and databases
24CDS654.4	Implement queries using advanced packages for python computing

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
24CDS654.1	3	2	2	-	-	-	-	-	-	-	-	**3**	**3**
24CDS654.2	1	3	2	-	1	-	-	-	-	-	-	**3**	**3**
24CDS654.3	2	1	2	3	3	-	-	-	-	-	-	**3**	**3**
24CDS654.4	1	1	3	2	3	-	-	-	-	-	-	**3**	**3**

Pgm. No.	List of Programs	Hours	COs
	Prerequisite		
	• Basics python programing • Basics of Visualization	2	NA
	PART-A		
1	Write a Python program that performs the following tasks: • Manipulate a string to reverse its characters and count the occurrence of a specific substring. • Create a list of integers and perform sorting and slicing operations. • Define a tuple of mixed data types and unpack its elements into variables. • Implement a set to remove duplicates from a list of integers and perform set operations (union, intersection). • Use a dictionary to store student grades and calculate the average grade.	2	24CDS654.1
2	Write a Python program that demonstrates the following: • Use control flow statements (if-else, loops) to iterate through a list and perform conditional operations. • Implement list comprehensions to generate a list of squared numbers from 1 to 10. • Define a basic function to calculate factorial and use recursion.	2	24CDS654.1

	Create a lambda function to compute the square of a number.		
3	Write a Python program that performs file handling and exceptions handling: • Read data from a text file, count the number of lines, and print each line. • Write data to a new text file and handle exceptions for file opening and writing operations. • Use try-except blocks to handle specific exceptions (e.g., FileNotFoundError, IOError). • Implement file operations (open, read, write, close) using context managers (with statement).	2	24CDS654.1 24CDS654.2
4	Write a Python program that demonstrates OOP concepts: • Define a class representing a Car with attributes (make, model, year) and methods (accelerate, brake). • Create instances of the Car class and invoke its methods to simulate driving actions. • Implement inheritance by creating a subclass (ElectricCar) that inherits from the Car class and has additional methods (charge_battery). • Use encapsulation to restrict access to certain attributes and methods of the Car class.	2	24CDS654.1 24CDS654.2
5	Write a Python program to draw the traffic signal using Turtle Graphics. • Draw the signal box. • Draw three filled circles (Red, Yellow, and Green). • Use appropriate fill colors	2	24CDS654.1 24CDS654.2
6	Develop a simple game using the Pygame library where the player controls a rectangular box using the keyboard to collect a ball. Display the score and end the game when the objective is achieved or a collision occurs.	2	24CDS654.1 24CDS654.2
	PART-B		
7	Develop a multiple-client chat application using Python's socket and threading modules. The server should accept connections from multiple clients simultaneously and broadcast messages received from one client to all other connected clients.	2	24CDS654.3 24CDS654.4
8	Develop a Python web service using the Flask framework that provides RESTful API endpoints to manage student information. The service should support retrieving, adding, updating, and deleting student records using appropriate HTTP methods. Implement the following API endpoints: • GET – Retrieve the list of all students. • GET – Retrieve the details of a specific student by ID • POST – Add a new student • PUT – Update an existing student's information. • DELETE – Remove a student record.	2	24CDS654.3 24CDS654.4
9	Develop a Python program to connect to a relational database (SQLite/MySQL), create a table, and perform CRUD (Create, Read, Update, and Delete) operations on employee records.	2	24CDS654.3 24CDS654.4

10	Develop a Python web application using the Flask framework to create a Student Registration Form. The application should accept student details through a web form and display the submitted information on a new webpage.	2	24CDS654.3 24CDS654.4
11	Develop a Python program that uses the threading module to create multiple threads. Each thread should perform a different task simultaneously, such as displaying numbers and alphabets with a time delay, demonstrating concurrent execution.	2	24CDS654.3 24CDS654.4
12	Write a Python program that uses the threading module to process multiple images concurrently. Each thread should apply a different image processing operation, such as resizing, converting an image to grayscale, or rotating an image, and save the processed images.	2	24CDS654.3 24CDS654.4

PART-C

Beyond Syllabus Virtual Lab Content

(To be done during Lab but not to be included for CIE or SEE)

1) https://python-iitk.vlabs.ac.in/
2) https://codingjr.online/home/virtual_labs

CIE Assessment Pattern (50 Marks – Lab)

RBT Levels		Test (s)	Weekly Assessment
		20	30
L1	Remember	-	-
L2	Understand	-	-
L3	Apply	10	10
L4	Analyze	5	10
L5	Evaluate	5	10
L6	Create	-	-

SEE Assessment Pattern (50 Marks – Lab)

RBT Levels		Exam Marks Distribution (50)
L1	Remember	-
L2	Understand	-
L3	Apply	20
L4	Analyze	20
L5	Evaluate	10
L6	Create	

Suggested Learning Resources:

Reference Books:

1. Hunt, John. Advanced Guide to Python 3 Programming. Germany: Springer International Publishing, 2023, ISSN 2197-1781.
2. Lanaro, Gabriele., Nguyen, Quan., Kasampalis, Sakis. Advanced Python Programming: Build High Performance, Concurrent, and Multi-threaded Apps with Python Using Proven Design Patterns. India: Packt Publishing, 2019, ISBN-13:978-1838551216
3. Nguyen, Quan. Advanced Python Programming: Accelerate Your Python Programs Using Proven Techniques and Design Patterns. Germany: Packt Publishing, ISBN-13,978-1801814010

Web Resources:

- NETACAD: Advance Your Python Skills with Python Essentials 2: https://www.netacad.com/articles/news/s-advance-your-python-skills-with-python-essentials-2?courseLang=en-US

SCALA PROGRAMMING			
Course Code	**24CDS655**	**CIE Marks**	**50**
L:T:P:S	**0:0:1:0**	**SEE Marks**	**50**
Hrs. / Week	**2**	**Total Marks**	**100**
Credits	**01**	**Exam Hours**	**03**

Course outcomes:
At the end of the course, the student will be able to:

24CDS655.1	Understand the basic syntax, data types, conditional statements and Arrays
24CDS655.2	Analyze primary operations such as filtering, grouping, aggregation, and joining to extract meaningful insights from data.
24CDS655.3	Apply Libraries to visualize and interpret data distributions, trends, and patterns.
24CDS655.4	Implement Machine learning algorithms such as Linear Regression and Clustering using Spark MLlib.

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
24CDS655.1	1	1	1	1	-	-	-	-	-	-	-	3	3
24CDS655.2	2	3	2	2	2	-	-	-	-	-	-	3	3
24CDS655.3	3	2	2	2	2	-	-	-	-	-	-	3	3
24CDS655.4	2	2	3	2	2	-	-	-	-	-	-	3	3

Pgm. No.	List of Programs	Hours	COs
	Prerequisite		
	• Programming knowledge (C/C++/JAVA/PYTHON)	2	NA
	PART-A		
1	Write a Scala program to declare variables of different data types (integer, double, string, boolean) and print their values.	2	24CDS655.1
2	Write a Scala program that checks if a given number is positive, negative, or zero, and prints an appropriate message.	2	24CDS655.1
3	Write a Scala program to create an array and aE list of integers, then print all elements in both collections.	2	24CDS655.1
4	Write a Scala program that defines two functions, one to add two integers and another to multiply two integers. Use these functions to print the sum and product of two given numbers.	2	24CDS655.2
5	Write a Scala program to load a CSV file containing retail sales data into a DataFrame using Apache Spark. Perform the following operations: • Show the first 10 rows of the DataFrame.	2	24CDS655.2

	• Filter the records where sales are greater than $1000. • Group the data by the 'Category' column and calculate the total sales for each category. • Join this DataFrame with another DataFrame containing product details on a common column and display the result.		
6	Write a Scala program to visualize data using Breeze and Vegas libraries. Perform the following tasks: • Create a list of integers representing some data points. • Plot a histogram of these data points using Breeze. • Use Vegas to create a bar plot showing the distribution of these data points.	2	24CDS655.3
PART-B			
7	Write a Scala program to calculate descriptive statistics for a dataset containing temperature readings , Visualize using appropriate libraries. Your program should: • Compute the mean, median, variance, and standard deviation of the temperature readings. • Print out the computed values.	2	24CDS655.3
8	Write a Scala program to train a linear regression model using Spark MLlib to predict house prices based on various features (e.g., size, location). Your program should: • Load the dataset from a file. • Split the data into training and test sets. • Train a linear regression model on the training data. • Evaluate the model on the test data and print out the coefficients and intercept of the model.	2	24CDS655.4
9	Write a Scala program to perform K-Means clustering on a dataset of customer attributes using Spark MLlib. Your program should: • Load the dataset from a file. • Train a K-Means model with a specified number of clusters. • Print out the coordinates of the cluster centers. • Assign each data point to a cluster and display the results.	2	24CDS655.4
10	Write a Scala program to classify movie reviews as positive or negative using Spark MLlib. Your program should: • Load a dataset of movie reviews and their corresponding labels. • Tokenize the text data and transform it into feature vectors. • Train a logistic regression model on the training data. • Evaluate the model and display the prediction results.	2	24CDS655.4
11	Write a Scala program to perform time series forecasting on stock price data using the Prophet library. Your program should: • Load and prepare the stock price data. • Fit a Prophet model to the data. • Make future predictions for the next 12 months. • Print out the forecasted stock prices.	2	24CDS655.4
12	Write a Scala program to clean a dataset of customer information using Apache Spark. Your program should: • Load the dataset from a file. • Handle missing values by filling them with specified default	2	24CDS655.4

	values. • Filter out records with outlier values in the 'age' column. • Perform a transformation to create a new column 'income_scaled' where the income is divided by 1000. • Display the cleaned and transformed DataFrame.		

PART-C
Beyond Syllabus Virtual Lab Content
(To be done during Lab but not to be included for CIE or SEE)

1) https://allaboutscala.com/tutorials/scala-exercises-solutions/
2) Demonstrate Functional Programming with Monads.
3) Demonstrate Actor Model with Akka.

CIE Assessment Pattern (50 Marks – Lab)

RBT Levels		Test (s)	Weekly Assessment
		20	30
L1	Remember	-	-
L2	Understand	-	-
L3	Apply	10	10
L4	Analyze	5	10
L5	Evaluate	5	10
L6	Create	-	-

SEE Assessment Pattern (50 Marks – Lab)

RBT Levels		Exam Marks Distribution (50)
L1	Remember	-
L2	Understand	-
L3	Apply	20
L4	Analyze	20
L5	Evaluate	10
L6	Create	

Suggested Learning Resources:

Reference Books:

1. Martin Odersky, Lex Spoon, Bill Venners, Programming in Scala, 5th Edition, Artima Pres, 2021, ISBN-13,978-0981531687.
2. Akash Tandon, Sandy Ryza, Uri Laserson, Sean Owen, Josh Wills, Advanced Analytics with PySpark: Patterns for Learning from Data at Scale Using Python and Spark, O'Reilly Media, 2022, ISBN-13: 978-9355422804.
3. Pascal Bugnion, Scala for Data Science, Packt Publishing, 1st Edition (October 2016), ISBN-13:9781785281372

ADVANCED PROBLEM SOLVING METHODOLOGIES

Course Code	**24SDK66**	**CIE Marks**	**50**
L:T:P:S	**0:0:0:0**	**SEE Marks**	**-**
Hrs / Week	**2**	**Total Marks**	**50**
Credits	**0**	**Exam Hours**	**02**

Course outcomes:
Upon successful completion of this course, the student will be able to:

24SDK66.1	Infer the complex problems using the concepts of data structures and C programming
24SDK66.2	Apply object-oriented programming concepts in C++and Java to solve real time problem statements.
24SDK66.3	Solve real-world problem using python and C#
24SDK66.4	Develop the skills of handling data base queries and procedures

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
24SDK66.1	3	3	-	-	2	-	-	-	-	-	-
24SDK66.2	2	3	3	-	3	-	-	-	-	-	-
24SDK66.3	2	2	3	2	3	-	-	-	-	-	-
24SDK66.4	2	3	3	-	3	-	-	-	-	-	-

MODULE-1	**Problem Solving On Data Structures and C**	**24SDK66.1**	**6 Hours**

Data Structures using C: Stack and queues, list, graph, tree, sorting and searching, Hash functions
Advanced C programming: Pointers, Recursion, Functions, Structure, Union, C Preprocessor

MODULE-2	**Problem Solving on Object Oriented Programming Using CPP**	**24SDK66.2**	**6 Hours**

Object Oriented Programming: Inheritance, Polymorphism, Exception handling, File Handling, Predefined function, Void function, Name spaces, Input and output streams.

MODULE-3	**Problem Solving on JAVA And XML**	**24SDK66.2**	**6 Hours**

Object oriented programming using Java: Inheritance, Polymorphism, Abstract class and Interface, Collections, Exception handling, Streams, Functional Interface.
XML: DTD, Schema, Server Path, DOM, XSLT, Name Space, AJAX.

MODULE-4	**Problem Solving Using C # And Python**	**24SDK66.3**	**6 Hours**

Python: Functions, iterators, Object oriented Programming, Exception Handling, Packages, Frame works- Django, Collections.
C#: Object oriented Programming, Delegate, Collections and generic, Name space.

MODULE-5	**Scenario Based Problems On DBMS**	**24SDK66.4**	**6 Hours**

ER Model, SQL- DDL, DML, TCL, DCL, Joins, subquery, PL/SQL-Index, Sequence, procedures and functions, normalization, B tree, B+ tree, Forms.

Note:

1. **Students shall solve the programming exercises and scenario-based problems available on the designated portal as part of the prescribed boot camp.**
2. **The CIE assessment and evaluation will be as per the guidelines framed by CDC.**

CIE Assessment Pattern (50 Marks – Theory)

RBT Levels		Marks Distribution
		Tests
		50
L1	Remember	5
L2	Understand	10
L3	Apply	20
L4	Analyze	15
L5	Evaluate	-
L6	Create	-

Suggested Learning Resources:

Reference Books:

1. Martin C Brown, "Python-The Complete Reference", Mc Graw Hill, 4th edition, 2020
2. Reema Tharega, "Data Structures using C", Oxford University Press, 2020
3. Ullakirch-Prinz, "A complete guide to program in C++", Jonas and Bartlett Learning, 2022
4. Kathy Sierra, "Headfirst Java", O'reilly Media, 2021
5. Andrew Stellman, "Headfirst C#", O'reilly Media, 2021

Web links and Video Lectures (e-Resources):

1. **https://www.learncpp.com/**
2. **https://www.programiz.com/dsa**
3. **https://code.visualstudio.com/Docs/languages/csharp**
4. **https://www.udemy.com/course/the-complete-java-course-from-basics-to-advanced/?couponCode=ST16MT70224**
5. **https://www.codecademy.com/learn/paths/c**

Activity-Based Learning (Suggested Activities in Class)/ Practical Based learning

- Analysis of industry relevant use cases
- Problem solving on scenario-based questions
- Placement portal practice sessions

CAPSTONE PROJECT			
Course Code	**24CDS67**	**CIE Marks**	**50**
L:T:P:S	**0:0:2:0**	**SEE Marks**	**50**
Hrs / Week	**04**	**Total Marks**	**100**
Credits	**02**	**Exam Hours**	**03**

Course outcomes:
At the end of the course, the student will be able to:

24CDS67.1	Identify societal problems under sustainable development goals and classify them under different domains of computer science and engineering and interdisciplinary perspective.
24CDS67.2	Demonstrate the ability to conduct comprehensive literature reviews using appropriate research databases, search strategies, and citation management tools to identify relevant sources of information.
24CDS67.3	Analyze existing literature and formulate the problem statement.
24CDS67.4	Formulate an idea and share the idea in a suitable platform
24CDS67.5	Organize the article logically, following a structured format with well-defined sections such as introduction, background, methodology, Analysis discussion, and conclusion.
24CDS67.6	Demonstrate their communication skill effectively with the technical presentation.

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
24CDS67.1	3	3	2	-	-	3	2	3	3	3	2	-	2
24CDS67.2	3	3	3	2	-	3	2	3	3	3	2	-	2
24CDS67.3	3	3	3	2	1	3	-	3	3	3	2	2	2
24CDS67.4	3	3	3	2	2	-	-	3	3	3	2	2	2
24CDS67.5	3	3	3	2	2	-	1	3	3	3	2	2	2
24CDS67.6	3	-	-	-	2	-	-	3	3	3	2	2	2

Capstone Project: Roadmap, activities, and deliverables

Goal Selection and Project Planning:
- Identification of suitable topic based on Sustainable Development Goals.
- Forming project teams based on common interests and skill sets.
- Teams' involvement in developing project proposals outlining objectives, strategies, and expected outcomes.

Research and Needs Assessment:
- Survey conduction by thorough research on the chosen SDGs, including global and local context, challenges, and opportunities.
- Conduct needs assessments to identify specific issues or gaps that student projects can address

Interdisciplinary approaches:
- Applying interdisciplinary approaches and innovative solutions to tackle sustainability challenges.

Knowledge Sharing and Communication:
- students to share their project experiences and insights through presentations, reports, and social media.
- Foster peer-to-peer learning and collaboration by creating platforms for knowledge exchange and networking.

CIE Assessment Pattern (50 Marks – Demo and Viva)

RBT Levels		Periodical Reviews & Evaluation
		50
L1	Remember	5
L2	Understand	5
L3	Apply	10
L4	Analyze	10
L5	Evaluate	10
L6	Create	10

SEE Assessment Pattern (50 Marks – Demo and Viva)

RBT Levels		Exam Marks Distribution (50)
L1	Remember	-
L2	Understand	-
L3	Apply	20
L4	Analyze	10
L5	Evaluate	10
L6	Create	10

Suggested Learning

Resources:

1. Johnson, L. M., & Brown, A. S. (2021), Modern Software Project Management: Strategies and Best Practices. Tech Knowledge Publishers.
2. Sustainable Development Goals: An Indian Perspective (Sustainable Development Goals Series) 1st ed. 2020 Edition, Somnath Hazra , Springer
3. McConnell, S. (2021), Software Project Survival Guide (2nd ed.). Microsoft Press. Schwalbe, K. (2022), Information Technology Project Management (9th ed.). Cengage Learning.

Web links and Video Lectures (e-Resources):

- https://www.project-everyone.org/
- https://www.instructables.com/Engineering-1/
- https://www.hackster.io/
- https://owl.purdue.edu/ (For writing effective articles)
- https://github.com/

NATIONAL SERVICE SCHEME

Course Code	**24NSS60**	**CIE Marks (each Semester)**	**50**
L:T:P:S	**0:0:0:0**	**SEE Marks**	**--**
Hrs / Week	**2**	**Total Marks**	**50 x 4 = 200**
Credits	**00**	**Exam Hours**	**02**

Course outcomes:

At the end of the course, the student will be able to:

24NSS60.1	Understand the importance of his / her responsibilities towards society.
24NSS60.2	Analyse the environmental and societal problems/issues and will be able to design solutions for the same.
24NSS60.3	Evaluate the existing system and to propose practical solutions for the same for sustainable development. Implement government or self-driven projects effectively in the field.
24NSS60.4	Develop capacity to meet emergencies and natural disasters & practice national integration and social harmony in general.

Mapping of Course Outcomes to Program Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
24NSS60.1	-	-	-	-	-	3	3	2	-	-	1
24NSS60.2	-	-	-	-	-	3	3	2	-	-	1
24NSS60.3	-	-	-	-	-	3	3	2	-	-	1
24NSS60.4	-	-	-	-	-	3	3	2	-	-	1

Semester/ Course Code	CONTENT	COs	HOURS
3RD 24NSS30	1. Organic farming, Indian Agriculture (Past, Present and Future) Connectivity for marketing 2. Waste management–Public, Private and Govt organization, 5R's. 3. Setting of the information imparting club for women leading to contribution in social and economic issues.	24NSS30.1, 24NSS30.2, 24NSS30.3, 24NSS30.4	30 HRS
4TH 24NSS40	4. Water conservation techniques – Role of different stakeholders– Implementation. 5. Preparing an actionable business proposal for enhancing the village income and approach for implementation. 6. Helping local schools to achieve good results and enhance their enrolment in Higher/ technical/ vocational education.	24NSS40.1, 24NSS40.2, 24NSS40.3, 24NSS40.4	30 HRS
5TH 24NSS50	7. Developing Sustainable Water management system for rural areas and implementationapproaches. 8. Contribution to any national level initiative of Government of India. Foreg. Digital India, Skill India, Swachh Bharat, Atmanirbhar Bharath, Make in India, Mudra scheme, Skill developmentprograms etc. 9. Spreading public awareness under rural outreach programs. (minimum 5 programs).	24NSS50.1, 24NSS50.2, 24NSS50.3, 24NSS50.4	30 HRS
6TH 24NSS60	10. Organize National integration and social harmony events / workshops / seminars. (Minimum TWO programs). 11. Govt. school Rejuvenation and helping them to achieve good infrastructure.	24NSS60.1, 24NSS60.2, 24NSS60.3, 24NSS60.4	30 HRS

CIE Assessment Pattern (50 Marks – Activity based) –

CIE component for every semester	Marks
Presentation - 1 Selection of topic, PHASE - 1	10
Commencement of activity and its progress -	10

PHASE - 2	
Case study-based Assessment Individual performance	10
Sector wise study and its consolidation	10
Video based seminar for 10 minutes by each student at the end of semester with Report.	10
Total marks for the course in each semester	**50**

- Implementation strategies of the project (NSS work).
- The last report should be signed by NSS Officer, the HOD and principal.
- At last report should be evaluated by the NSS officer of the institute.
- Finally, the consolidated marks sheet should be sent to the university and also to be made available at LIC visit.

Suggested Learning Resources:

Reference Books:

1. NSS Course Manual, Published by NSS Cell, VTU Belagavi.
2. Government of Karnataka, NSS cell, activities reports and its manual.
3. Government of India, NSS cell, Activities reports and its manual.

Pre-requisites to take this Course:

1. Students should have a service-oriented mindset and social concern.
2. Students should have dedication to work at any remote place, anytime with available resources and proper time management for the other works.
3. Students should be ready to sacrifice some of the time and wishes to achieve service-oriented targets on time.

Pedagogy:

- In every semester from 3rd semester to 6th semester, each student should do activities according to the scheme and syllabus.
- At the end of every semester student performance has to be evaluated by the NSS officer for the assigned activity progress and its completion.
- At last, in 6th semester consolidated report of all activities from 3rd to 6th semester, compiled report should be submitted as per the instructions.
- State the need for NSS activities and its present relevance in the society and provide real-life examples.
- Support and guide the students for self-planned activities.
- NSS coordinator will also be responsible for assigning homework, grading assignments and quizzes, and documenting students' progress in real activities in the field.
- Encourage the students for group work to improve their creative and analytical skills.

Plan of Action:

- Student/s in individual or in a group Should select any one activity in the beginning of each semester till end of that respective semester for successful completion as per the instructions of NSS officer with the consent of HOD of the department.
- At the end of every semester, activity report should be submitted for evaluation.
- Practice Session Description:
    - Lecture session by NSS Officer
    - Students Presentation on Topics
    - Presentation - 1, Selection of topic, PHASE – 1
    - Commencement of activity and its progress - PHASE – 2
    - Execution of Activity
    - Case study-based Assessment, Individual performance
    - Sector/ Team wise study and its consolidation
    - Video based seminar for 10 minutes by each student at the end of semester with Report.

Sl No	Topic	Groupsize	Location	Activity execution	Reporting	Evaluation of the Topic
1.	Organic farming, IndianAgriculture (Past, Present and Future) Connectivity for marketing.	May be individual or team	Farmers land/Villages/ roadside / Community area / College campus	Site selection /proper consultation/ Continuous monitoring/ Information board	Report should be submitted byindividual to the concerned evaluation authority	Evaluation as per the rubrics of scheme and syllabus by NSS officer
2.	Waste management– Public, Private and Govtorganization, 5 R's.	May be individual or team	Villages/ City Areas / Grama panchayat/ public associations/ Government Schemes officers/ campus	Site selection /proper consultation/Co ntinuous monitoring/ Information board	Report should be submitted byindividual to the concerned evaluation authority	Evaluation as per the rubrics of scheme and syllabus by NSS officer
3.	Setting of the information imparting club for women leading to contributionin social and economic issues.	May be individual or team	Women empowerment groups/ Consulting NGOs & Govt Teams / College campus	Group selection/pro per consultation/ Continuous monitoring/ Information board	Report should be submitted byindividual to the concerned evaluation authority	Evaluation as per the rubrics of scheme and syllabus by NSS officer
4.	Water conservation techniques – Role of different stakeholders– Implementation.	May be individual or team	Villages/ City Areas / Grama panchayat/ public associations/ Government Schemes officers/ campus	site selection / proper consultation/ Continuous monitoring/ Information board	Report should be submitted byindividual to the concerned evaluation authority	Evaluation as per the rubrics of scheme and syllabus by NSS officer
5.	Preparing an actionable business proposal for enhancing the village income and approach for implementation.	May be individual or team	Villages/ City Areas / Grama panchayat/ public associations/ Government Schemes officers/ campus	Group selection/pro per consultation/ Continuous monitoring/ Information board	Report should be submitted byindividual to the concerned evaluation authority	Evaluation as per the rubrics of scheme and syllabus by NSS officer

6.	Helping local schools toachieve good results and enhance their enrolment in Higher/ technical/ vocational education.	May be individual or team	Local government / private/ aided schools/Government Schemes officers	School selection/proper consultation/ Continuous monitoring/ Information board	Report should be submitted byindividual to the concerned evaluation authority	Evaluation as per the rubrics of scheme and syllabus by NSS officer
7.	Developing SustainableWater management system for rural areas and implementation approaches.	May be individual or team	Villages/ City Areas / Grama panchayat/ public associations/ Government Schemes officers/ campus	site selection/properconsultation/ Continuous monitoring/ Information board	Report should be submitted byindividual to the concerned evaluation authority	Evaluation as per the rubrics of scheme and syllabus by NSS officer
8.	Contribution to any national level initiative of Government of India.For eg. Digital India, Skill India, Swachh Bharat, Atmanirbhar Bharath, Make in India, Mudra scheme,Skill development programs etc.	May be individual or team	Villages/ City Areas / Grama panchayat/ public associations/ Government Schemes officers/ campus	Group selection/proper consultation/ Continuous monitoring / Information board	Report should be submitted byindividual to the concerned evaluation authority	Evaluation as per the rubrics of scheme and syllabus by NSS officer
9.	Spreading public awareness under ruraloutreach programs. (minimum5 programs)	May be individual or team	Villages/ City Areas / Grama panchayat/ public associations/ Government Schemes officers/ campus	Group selection/proper consultation/ Continuous monitoring / Information board	Report should be submitted byindividual to the concerned evaluation authority	Evaluation as per the rubrics of scheme and syllabus by NSS officer
10.	Organize National integration and socialharmony events / workshops / seminars. (Minimum 02 programs).	May be individual or team	Villages/ City Areas / Grama panchayat/ public associations/ Government Schemes officers/ campus	Place selection/proper consultation/ Continuous monitoring / Information board	Report should be submitted byindividual to the concerned evaluation authority	Evaluation as per the rubrics of scheme and syllabus by NSS officer

11.	Govt. school Rejuvenation and helping them to achieve good infrastructure.	May be individual or team	Villages/ City Areas / Grama panchayat/ public associations/ Government Schemes officers/ campus	Place selection/proper consultation/ Continuous monitoring / Information board	Report should be submitted byindividual to the concerned evaluation authority	Evaluation as per the rubrics of scheme and syllabus by NSS officer

PHYSICAL EDUCATION AND SPORTS

Course Code	**24PED60**	**CIE Marks (each semester)**	**50**
L:T:P:S	**0:0:0:0**	**SEE Marks**	**--**
Hrs / Week	**2**	**Total Marks**	**50 x 4= 200**
Credits	**00**	**Exam Hours**	**02**

Course outcomes:
At the end of the course, the student will be able to:

24PED60.1	Understand the fundamental concepts and skills of Physical Education, Health, Nutrition and Fitness
24PED60.2	Create consciousness among the students on Health, Fitness and Wellness in developing and maintaining a healthy lifestyle
24PED60.3	Perform in the selected sports or athletics of student's choice and participate in the competition at regional/state / national / international levels.
24PED60.4	Understand the roles and responsibilities of organization and administration of sports and games

Mapping of Course Outcomes to Program Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
24PED60.1	-	-	-	-	-	2	-	3	3	-	-	2
24PED60.2	-	-	-	-	-	2	-	3	3	-	-	2
24PED60.3	-	-	-	-	-	2	-	3	3	-	-	2
24PED60.4	-	-	-	-	-	2	-	3	3	-	-	2

Semester	CONTENT	COs	HOURS
3RD 24PED30	**Module 1: Orientation** F. Lifestyle, G. Fitness H. Food & Nutrition I. Health & Wellness J. Pre-Fitness test.	24PED30.1, 24PED30.2	5 HRS
	Module 2: General Fitness & Components of Fitness G. Warming up (Free Hand exercises) H. Strength – Push-up / Pull-ups I. Speed – 30 Mtr Dash J. Agility – Shuttle Run K. Flexibility – Sit and Reach L. Cardiovascular Endurance – Harvard step Test	24PED30.2, 24PED30.3	15 HRS
	Module 3: Recreational Activities E. Postural deformities. F. Stress management. G. Aerobics. H. Traditional Games.	24PED30.3, 24PED30.4	10 HRS
4TH 24PED40	**Module 1: Ethics and Moral Values** C. Ethics in Sports D. Moral Values in Sports and Games	24PED40.1, 24PED40.2	5 HRS

	Module 2: Specific Games (Anyone to be selected by the student) G. Volleyball – Attack, Block, Service, Upper Hand Pass and Lower hand Pass. H. Throwball – Service, Receive, Spin attack, Net Drop & Jump throw. I. Kabaddi – Hand touch, Toe Touch, Thigh Hold, Ankle hold and Bonus. J. Kho-Kho – Giving Kho, Single Chain, Pole dive, Pole turning, 3-6 Up. K. Table Tennis – Service (Fore Hand & Back Hand), Receive (Fore Hand & Back Hand), Smash. L. Athletics (Track / Field Events) – Any event as per availability of Ground.	24PED40.3	20 HRS
	Module 3: Role of Organization and administration	24PED40.4	5 HRS
5TH 24PED50	**Fitness Components:** Meaning and Importance, Fit India Movement, Definition of fitness, Components of fitness, Benefits of fitness, Types of fitness and Fitness tips. **Practical Components:** Speed, Strength, Endurance, Flexibility, and Agility **Athletics**: 4. Track -Sprints: • Starting Techniques: Standing start and Crouch start (its variations) use of Starting Block. • Acceleration with proper running techniques. • Finishing technique: Run Through, Forward Lunging and Shoulder Shrug. 5. Jumps- Long Jump: Approach Run, Take-off, Flight in the air (Hang Style/Hitch Kick)and Landing 6. Throws- Shot Put: Holding the Shot, Placement, Initial Stance, Glide, Delivery Stance and Recovery (Perry O'Brien Technique) **Handball OR Ball Badminton** **Handball:** B. Fundamental Skills 7. Catching, Throwing and Ball control, 8. Goal Throws: Jumpshot, Centershot, Diveshot, Reverseshot. 9. Dribbling: High and low. 10. Attack and counter attack, simple counter attack, counter attack from two wings and center. 11. Blocking, Goal Keeping and Defensive skills. 12. Game practice with application of Rules and Regulations. C. Rules and their interpretations and duties of officials **Ball badminton:** B. Fundamental Skills 5. Basic Knowledge: Various parts of the Racket and Grip. 6. Service: Short service, Long service, Long-high service. 7. Shots: Overhead shot, Defensive clearshot, Attacking clearshot, Dropshot, Netshot, Smash. 8. Game practice with application of Rules and Regulations. B. Rules and their interpretation and duties of officials.	24PED50.1, 24PED50.2, 24PED50.3, 24PED50.4	Total 30 Hrs/ Semester 2 Hrs/week
6TH 24PED60	**Athletics**: 4. Track -110 Mtrs and 400Mtrs:	24PED60.1, 24PED60.2,	Total 30 Hrs/ Semester

	• Hurdling Technique: Lead leg Technique, Trail leg Technique, Side Hurdling, Over the Hurdles • Crouch start (its variations) use of Starting Block. • Approach to First Hurdles, In Between Hurdles, Last Hurdles to Finishing. 5. Jumps- High jump: Approach Run, Take-off, Bar Clearance (Straddle) and Landing. 6. Throws- Discus Throw: Holding the Discus, Initial Stance Primary Swing, Turn, Release and Recovery (Rotation in the circle). **Football OR Hockey** **Football:** A. Fundamental Skills 1. Kicking: Kicking the ball with inside of the foot, Kicking the ball with Full Instep of the foot, Kicking the ball with Inner Instep of the foot, Kicking the ball with Outer Instep of the foot and Lofted Kick. 10. Trapping: Trapping- the Rolling ball, and the Bouncing ball with sole of the foot. 11. Dribbling: Dribbling the ball with Instep of the foot, Dribbling the ball with Inner and Outer Instep of the foot. 12. Heading: In standing, running and jumping condition. 13. Throw-in: Standing throw-in and Running throw-in. 14. Feinting: With the lower limb and upper part of the body. 15. Tackling: Simple Tackling, Slide Tackling. 16. Goal Keeping: Collection of Ball, Ball clearance-kicking, throwing and deflecting. 17. Game practice with application of Rules and Regulations. B. Rules and their interpretation and duties of officials. **Hockey:** A. Fundamental Skills 1. Passing: Short pass, Longpass, pushpass, hit 2. Trapping. 3. Dribbling and Dozing 9. Penalty stroke practice. 10. Penalty corner practice. 11. Tackling: Simple Tackling, Slide Tackling. 12. Goal Keeping, Ball clearance- kicking, and deflecting. 13. Game practice with application of Rules and Regulations. B. Rules and their interpretation and duties of officials	24PED60.3, 24PED60.4	2 Hrs/week

CIE Assessment Pattern (50 Marks – Practical) –

CIE to be evaluated every semester end based on practical demonstration of Sports and Athletics activities learnt in the semester.

CIE	Marks
Participation of student in all the modules	10
Quizzes – 2, each of 7.5 marks	15
Final presentation / exhibition / Participation in competitions/ practical on specific tasks assigned to the students	25
Total	**50**

Suggested Learning Resources:

Reference Books:

1. Saha, A.K. Sarir Siksher Ritiniti, Rana Publishing House, Kalyani.
2. Bandopadhyay, K. Sarir Siksha Parichay, Classic Publishers, Kolkata.
3. Petipus, et.al., Athlete's Guide to Career Planning, Human Kinetics.
4. Dharma, P.N. Fundamentals of Track and Field, Khel Sahitya Kendra, New Delhi.
5. Jain, R. Play and Learn Cricket, Khel Sahitya Kendra, New Delhi.
6. Vivek Thani, Coaching Cricket, Khel Sahitya Kendra, New Delhi.
7. Saha, A.K. Sarir Siksher Ritiniti, Rana Publishing House, Kalyani.
8. Bandopadhyay, K. Sarir Siksha Parichay, Classic Publishers, Kolkata
9. Naveen Jain, Play and Learn Basketball, Khel Sahitya Kendra, New Delhi.
10. Dubey H.C., Basketball, Discovery Publishing House, New Delhi.
11. Rachana Jain, Teach Yourself Basketball, Sports Publication.
15. Jack Nagle, Power Pattern Offences for Winning basketball, Parker Publishing Co., New York.
16. Renu Jain, Play and Learn Basketball, Khel Sahitya Kendra, New Delhi.
17. SallyKus, Coaching Volleyball Successfully, Human Kinetics.

YOGA			
Course Code	**24YOG60**	**CIE Marks**	**50**
L:T:P:S	**0:0:0:0**	**SEE Marks**	**--**
Hrs / Week	**2**	**Total Marks**	**50 x 4 = 200**
Credits	**00**	**Exam Hours**	**02**

Course outcomes:
At the end of the course, the student will be able to:

24YOG60.1	Understanding the origin, history, aim and objectives of Yoga
24YOG60.2	Become familiar with an authentic foundation of Yogic practices
24YOG60.3	Practice different Yogic methods such as Suryanamaskara, Pranayama and some of the Shat
24YOG60.4	Use the teachings of Patanjali in daily life.

Mapping of Course Outcomes to Program Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
24YOG60.1	-	-	-	-	-	3	-	-	-	-	1
24YOG60.2	-	-	-	-	-	3	-	-	-	-	1
24YOG60.3	-	-	-	-	-	3	-	-	-	-	1
24YOG60.4	-	-	-	-	-	3	-	-	-	-	1

Semester / Course Code	CONTENT	COs	HOURS
3rd 24YOG30	**Introduction of Yoga:** Aim and Objectives of yoga, Prayer: Yoga, its origin, history and development. Yoga, its meaning, definitions. Different schools of yoga, importance of prayer **Brief introduction of yogic practices for common man:** Yogic practices for common man to promote positive health **Rules and regulations:** Rules to be followed during yogic practices by practitioner **Misconceptions of yoga:** Yoga its misconceptions, Difference between yogic and non-yogic practices. **Suryanamaskara:** 3. Suryanamaskar prayer and its meaning, Need, importance and b of Suryanamaskar. 4. Suryanamaskar 12 count,2rounds **Different types of Asanas**: 5. Sitting: Padmasana, Vajrasana, Sukhasana 6. Standing: Vrikshana, Trikonasana, Ardhakati Chakrasana 7. Prone line: Bhujangasana, Shalabhasana 8. Supineline: Utthitadvipadasana, Ardhahalasana, Halasana	24YOG30.1, 24YOG30.2, 24YOG30.3, 24YOG30.4	Total 32 Hrs/ Semester 2 Hrs/week
4TH 24YOG40	**Suryanamaskara:** Suryanamaskar 12 count,4rounds **Brief introduction and importance of:** **Kapalabhati:** Revision of Kapalabhati -40strokes/min3rounds **Different types of Asanas**: 5. Sitting: Paschimottanasana, Ardha Ushtrasana, Vakrasana, Aakarna Dhanurasana 6. Standing: Parshva Chakrasana, Urdhva Hastothanasana, Hastapadasana 7. Prone line: Dhanurasana 8. Supine line: Karna Peedasana, Sarvangasana, Chakraasana **Patanjali's Ashtanga Yoga**: Asana, Pranayama **Pranayama:** Chandra Bhedana, Nadishodhana, Surya Bhedana	24YOG40.1, 24YOG40.2, 24YOG40.3, 24YOG40.4	Total 32 Hrs/ Semester 2 Hrs/week

5TH 24YOG50	**Kapalabhati:** Revision of Kapalabhati - 60strokes/min3rounds **Brief introduction and importance of:** **Different types of Asanas**: 5. Sitting: Yogamudra in Padmasana, Vibhakta Paschimottanasana, Yogamudra in Vajrasana 6. Standing: Parivritta Trikonasana, Utkatasana, Parshvakonasana 7. Prone line: Padangushtha Dhanurasana, Poorna Bhujangasana / Rajakapotasana 8. Supine line: Navasana/Noukasana, Pavanamuktasana, Sarvanga **Patanjali's Ashtanga Yoga**: Pratyahara, Dharana **Pranayama:** Ujjayi, Sheetali, Sheektari	24YOG50.1, 24YOG50.2, 24YOG50.3, 24YOG50.4	Total 32 Hrs/ Semester 2 Hrs/week
6TH 24YOG60	**Kapalabhati:** Revision of Kapalabhati – 80 strokes/min3rounds **Brief introduction and importance of:** **Different types of Asanas**: 5. Sitting: Bakasana, Hanumanasana, Ekapada Rajakapotasana 6. Standing: Parivritta Trikonasana, Utkatasana, Parshvakonasana 7. Supine line: Setubandhasana, Shavasanaa (Relaxation posture) 8. Balancing: Sheershasana **Patanjali's AshtangaYoga**: Dhyana (Meditation), Samadhi **Pranayama:** Bhastrika, Bhramari, Ujjai **Shat Kriyas:** Jalaneti and sutraneti, Sheetkarma Kapalabhati	24YOG60.1, 24YOG60.2, 24YOG60.3, 24YOG60.4	Total 32 Hrs/ Semester 2 Hrs/week

CIE Assessment Pattern (50 Marks – Practical)

CIE to be evaluated every semester based on practical demonstration of Yogasana learnt in the semester and internal tests (objective type)

CIE	Marks
Avg of Test 1 and Test 2	25
Demonstration of Yogasana	25
Total	**50**

Suggested Learning Resources:

Reference Books:

4. Swami Kuvulyananda: Asma (Kavalyadhama, Lonavala)
5. Tiwari, O P: Asana Why and How
6. Ajitkumar: Yoga Pravesha (Kannada)
7. Swami Satyananda Saraswati: Asana Pranayama, Mudra, Bandha (Bihar School of yoga, Munger)
8. Swami Satyananda Saraswati: Surya Namaskar (Bihar School of yoga, Munger)
9. Nagendra H R: The art and science of Pranayama
10. Tiruka: Shatkriyegalu (Kannada)
11. Iyengar B K S: Yoga Pradipika (Kannada)
12. Iyengar B K S: Light on Yoga (English)

Web links and Video Lectures (e-Resources):

- **https://youtu.be/KB-TYlgd1wE**
- **https://youtu.be/aa-TG0Wg1Ls**

APPENDIX A

List of Alternate Assessment Techniques

SLNO	Assessments
1	Open Book Test
2	Problem Solving Assessments
3	Mini Projects/ Projects
4	Group Discussions
5	Case studies
6	Practical Activities/Problem Solving Exercises
7	Practical Orientation on design thinking, Creative & Innovation
8	Participatory & Industry-Integrated Activities
9	Class Presentations

APPENDIX B

Outcome Based Education

Outcome-based education (OBE) is an educational theory that bases each part of an educational system around goals (outcomes). By the end of the educational experience each student should have achieved the goal. There is no specified style of teaching or assessment in OBE; instead classes, opportunities, and assessments should all help students achieve the specified outcomes.

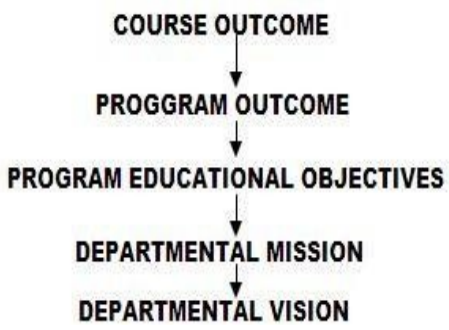
There are three educational Outcomes as defined by the National Board of Accreditation:

Program Educational Objectives: The Educational objectives of an engineering degree program are the statements that describe the expected achievements of graduate in their career and also in particular what the graduates are expected to perform and achieve during the first few years after graduation. [nbaindia.org]

Program Outcomes: What the student would demonstrate upon graduation. Graduate attributes are separately listed in Appendix C

Course Outcome: The specific outcome/s of each course/subject that is a part of the program curriculum. Each subject/course is expected to have a set of Course Outcomes

Mapping of Outcomes



APPENDIX C

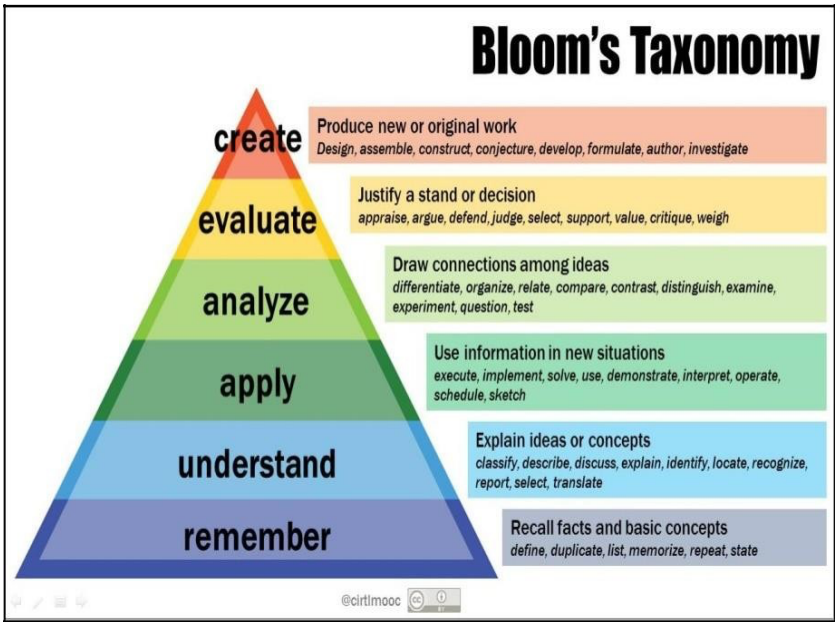
The Graduate Attributes of NBA

Engineering knowledge	Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
Problem analysis	Identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
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.
Conduct investigations of complex problems	The problems that cannot be solved by straight forward application of knowledge, theories and techniques applicable to the engineering discipline that may not have a unique solution. For example, a design problem can be solved in many ways and lead to multiple possible solutions that require consideration of appropriate constraints/requirements not explicitly given in the problem statement (like: cost, power requirement, durability, product life, etc.) which need to be defined (modeled) within appropriate mathematical framework that often require use of modern computational concepts and tools.
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.
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.
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.
Ethics	Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
Individual and team work	Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
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.
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.
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.

APPENDIX D

BLOOM'S TAXONOMY

Bloom's taxonomy is a classification system used to define and distinguish different levels of human cognition—i.e., thinking, learning, and understanding. Educators have typically used Bloom's taxonomy to inform or guide the development of assessments (tests and other evaluations of student learning), curriculum (units, lessons, projects, and other learning activities), and instructional methods such as questioning strategies.



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