NEW HORIZON
COLLEGE OF ENGINEERING

Autonomous College Permanently Affiliated with VTU, Approved by AICTE & UGC
Accredited by NAAC with 'A' Grade, Accredited by NBA

Department of Computer Engineering

Scheme and Syllabus
7th & 8th Semester

BATCH: 2020-24 | CREDITS: 175 | (2018 Scheme)

Academic Year 2023-24

Scheme and Syllabus

BATCH: 2020-24

CREDITS: 175

(2018 Scheme)

CONTENTS

INSTITUTION

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 students with 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.

To develop value based socially responsible professionals for the betterment of the society

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
- ❖ Innovation
- ❖ Integrity
- ❖ Professionalism
- ❖ Inclusiveness
- ❖ Social Responsibility

DEPARTMENT OF COMPUTER ENGINEERING

Vision

To produce engineers, researchers and technologists with managerial skills of highest competence who would be able to solve the challenges of society.

Mission

To impart high quality professional training, practical experience and value education in the Computer Engineering.

To pursue creative research in Computer Engineering in order to serve the engineering community and society.

To prepare and encourage a student for Lifelong learning to meet career and ethical challenges through active participation in co-curricular and extracurricular activities.

Program Educational Objectives (PEOs)

PEO1:	To prepare globally competent graduates having strong fundamentals of Computer Engineering domain knowledge, updated with modern technology to provide effective solutions for engineering problems.
PEO2:	To acuminate graduates with ability to adapt and develop projects towards the latest technological era of the Computing and IT sector with a high degree of innovative ideas.
PEO3:	To produce committed and motivated graduates with research attitude, investigative approach, and multidisciplinary thinking for implementation of strategic tasks.
PEO 4:	To shape the graduates with strong managerial and communication skills to work and learn continuously and effectively as individuals as well as in teams.

PEO to Mission Statement Mapping

Mission Statements	PEO1	PEO2	PEO3	PEO4
To impart high quality professional training, practical experience and value education in the Computer Engineering.	3	2	2	2
To pursue creative research in Computer Engineering in order to serve the engineering community and society.	3	2	2	2
To prepare and encourage a student for Lifelong learning to meetcareer and ethical challenges through active participation in co- curricular and extracurricular activities.	2	2	3	3

Correlation: 3- High, 2-Medium, 1-Low

Program Outcomes (POs) with Graduate Attributes

PO1	**Engineering knowledge:** Apply the knowledge of mathematics, science, Engineering fundamentals, and an Engineering specialization to the solution of complex Engineering problems in Computer Engineering.
PO2	**Problem analysis:** Identify, formulate, review research literature, and analyze complex Engineering problems in Computer Engineering reaching substantiated conclusions using first principles of mathematics, natural sciences, and Engineering sciences.
PO3	**Design / Development of Solutions:** Design solutions for complex Engineering problems and design system components or processes of Computer Engineering that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and Environmental considerations.
PO4	**Conduct Investigations of Complex Problems:** Use research-based knowledge and research methods including design of experiments in Computer Engineering, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO5	**Modern Tool Usage:** Create, select, and apply appropriate techniques, resources, and modern Engineering and IT tools including prediction and modeling to complex Engineering activities in Computer Engineering with an understanding of the limitations.
PO6	**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 in Computer Engineering.
PO7	**Environment and Sustainability:** Understand the impact of the professional Engineering solutions of Computer Engineering in societal and Environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO8	**Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the Engineering practice.
PO9	**Individual and Team Work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO10	**Communication Skills:** 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.
PO11	**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.
PO12	**Life-long Learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Program Specific Outcomes (PSOs)

A graduate of the Computer Engineering Program will demonstrate

PSO1: The ability to apply the knowledge of core science, engineering mathematics and engineering fundamentals to design and develop the computing systems.

PSO2: The ability to provide effective and efficient real time solutions to problems in computer engineering using acquired knowledge in various domains.

Mapping of POs with PEOs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
PEO1	3	3	3	2	3	-	-	-	3	-	3	-
PEO2	3	3	3	2	3	-	-	-	3	-	3	-
PEO3	3	3	3	2	3	-	-	-	3	-	3	-
PEO4	3	3	3	2	3	-	-	-	3	-	3	-

Correlation: 3- High, 2-Medium, 1-Low

DEPARTMENT OF COMPUTER ENGINEERING

SEVENTH SEMESTER-SCHEME

S. No	Course Code	Course	BOS	L	T	P	S	Overall Credits	Contact Hours	CIE	SEE	TOTAL
				Credit Distribution						**Marks**		
1	20CEE71A	Internet of Things	CEE	3	0	0	0	3	3	50	50	100
2	20CEE72A	Software Testing	CEE	3	0	0	0	3	3	50	50	100
3	20CEE73XA	Professional Elective-V	CEE	3	0	0	0	3	3	50	50	100
4	20CEE74XA	Professional Elective-VI	CEE	3	0	0	0	3	3	50	50	100
5	20CEL75A	Internet of Things Lab	CEE	0	0	2	0	2	4	25	25	50
6	20CEL76A	Software Testing Lab	CEE	0	0	2	0	2	4	25	25	50
7	20CEE77A	Project Phase-1	CEE	0	0	3	0	3	-	50	50	100
8	20NHOPxx	Open Elective	CEE	3	0	0	0	3	3	50	50	100
Total								**22**	**23**	**350**	**350**	**700**

Professional Elective Courses-V		Professional Elective Course- VI	
20CEE731A	Distributed Computing	20CEE741A	Software Quality Assurance
20CEE732A	Cyber Security	20CEE742A	Penetration Testing
20CEE733A	Advanced Microprocessor	20CEE743A	Biometrics Systems
20CEE734A	Data Acquisition and Productization	20CEE744A	HDL-Based Digital Systems Design

DEPARTMENT OF COMPUTER ENGINEERING

EIGTH SEMESTER-SCHEME

Sl. No	Course Code	Course	BOS	Credit Distribution				Overall Credits	Contact Hours	Marks		
				L	T	P	S			CIE	SEE	Total
1	20CEE81A	Computer Vision	CEE	3	0	0	0	3	3	50	50	100
2	20CEE82A	Internship Viva	CEE	0	0	4	0	4	-	50	50	100
3	20CEE83A	Project Phase 2	CEE	0	0	12	0	12	-	100	100	200
Total								19	3	200	200	400

Open Elective

Course Code	Course	BOS
20NHOP701	Big Data Analytics using HP Vertica- 1	CSE
20NHOP702	VM Ware Virtualization Essentials-1	ISE
20NHOP704	Big Data Analytics using HP Vertica – 2	CSE
20NHOP707	SAP	ME
20NHOP708	Schneider - Industrial Automation	EEE
20NHOP709	CISCO - Routing & Switching - 1	ECE
20NHOP712	CISCO - Routing & Switching -2	ECE
20NHOP714	Blockchain	CSE
20NHOP715	Product Life Cycle Management	ME
20NHOP720A	Robotic Process Automation	CSE
20NH0P721A	Industry 4.0	ME
20NHOP722A	Programming of Industrial Robot	ECE
20NHOP723A	5G Communication	ECE
20NHOP725A	VLSI Physical Design-I	ECE
20NHOP726A	VLSI Physical Design-2	ECE
20NHOP727A	Juniper Network Operating System	ECE
20NHOP728A	Database Administration using DB2	AI&ML

SEMESTER VII

(SYLLABUS)

INTERNET OF THINGS					
Course Code	20CEE71A		**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:

20CEE71A.1	Understand IoT concepts, underlying technologies and migration of M2M to IoT.
20CEE71A.2	Understand the M2M fundamentals and data management
20CEE71A.3	Analyze the various features of IoT standard protocols and platforms
20CEE71A.4	Implement programs using Raspberry pi model
20CEE71A.5	Understand the interface concepts with networks
20CEE71A.6	Design and develop real world IoT application using system like Raspberry pi.

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

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
20CEE71A.1	3	3	2	2	3	2	1	1	2	1	2	2	2	2
20CEE71A.2	3	3	2	2	3	2	1	1	2	1	2	1	2	2
20CEE71A.3	3	3	2	2	3	2	1	1	2	1	2	2	2	2
20CEE71A.4	3	2	2	2	2	2	1	1	2	1	2	1	1	1
20CEE71A.5	2	3	2	2	3	2	1	1	2	1	2	2	2	2
20CEE71A.6	3	3	2	2	2	2	1	1	2	1	2	2	1	1

MODULE-1	**INTRODUCTION TO IoT**	**20CEE71A.1**	**9 Hours**

Evolution of Internet of Things - Enabling Technologies – IoT Architectures: oneM2M, IoT World Forum (IoTWF) and Alternative IoT models – Simplified IoT Architecture and Core IoT Functional Stack - Fog, Edge and Cloud in IoT, -IoT and Digitization – Convergence of IT and IoT – IoT Challenges

Self-study	IoT Architectures, Cloud in IoT, IoT Challenges
Text Book	Text Book 1: 1.2, 1.3, 1.4, 1.9

MODULE-2	**M2M AND IoT TECHNOLOGY FUNDAMENTALS**	**20CEE71A.2**	**9 Hours**

Devices and gateways, Actuators and its types, Data management, Connecting Smart Objects, Everything as a Service (XaaS), M2M and IoT Analytics, Knowledge Management

Text Book	Text Book 1: 2.2, 2.4, 2.6 to 2.9

MODULE-3	**IOT PROTOCOLS AND PLATFORMS**	**20CEE71A.3**	**9 Hours**

6LowPAN, Wi-fi, Bluetooth, COAP, MQTT, Zigbee Architecture, LoRaWAN, Platforms: Components of Microsoft Azure

Self-study	Components of Microsoft Azure using various open-source platforms.
Text Book	Text Book 2: 3.1, 3.3, 3.9

MODULE-4	**IOT PROGRAMMING**	**20CEE71A.4, 20CEE71A.5**	**9 Hours**

Introduction to Raspberry PI, Rasbian OS, interfacing analog and digital devices, enabling network connectivity, Connecting with web Server, API Connectivity: OpenWeathermap API

Applications	Intefacing of Raspberry PI models with various sensors
Text Book	Text Book 3: 4.1, 6.3, 6.5, 6.7, Text Book 2: 10.1, 10.3

MODULE-5	**APPLICATIONS OF IoT**	**20CEE71A.6**	**9 Hours**

Use of Big Data and Visualization in IoT - Industry 4.0 concepts , Web Enabled Constrained Devices, Role of Machine Learning, Monitoring ambient room temperature using DHT11 Sensor, Using an RPi to Control an RGB LED, Using a PIR Motion Sensor and detecting an object with Raspberry Pi

Self-study / Case Study / Applications	Real time implementation of Raspberry Pi / Arduino using Proteus or any open source software
Text Book	Text Book 2: 4.5 to 6.1

CIE Assessment Pattern (50 Marks – Theory) –

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

SEE Assessment Pattern (50 Marks – Theory)

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

Text Books:

1. Maciej Kranz,"Building the Internet of Things: Implement New Business Models, Disrupt Competitors, Transform Your Industry",1st Edition,Wiley,2021 ISBN-10 1119285666
2. David Hanes , Gonzalo Salgueiro , Patrick Grossetete, Robert Barton (Author), Jerome Henry,"IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things "1st Edition,Cisco Press,2021 ISBN-10 1587144565
3. Colin Dow, "Internet of Things Programming Projects: Build modern IoT solutions with the Raspberry Pi 3 and Python", 1st edition, Packt Publishing,2018 ISBN-10 1789134803

Reference Books:

1. Qinghao Tang (Author), Fan Du,"Internet of Things Security: Principles and Practice", 1st edition,Springer,2021 ISBN-13 978-9811599415
2. Chandrasekar Vuppalapati, "Building Enterprise IoT Applications", 1st Edition, Academic Press,2019 ISBN-10 0367173859
3. Peter Waher, "Mastering Internet of Things: Design and create your own IoT applications using Raspberry Pi 3", First Edition, Packt Publishing, 2018 ISBN-13 978-1788397483
4. Abdulrahman Yarali , "IoT: Platforms, Connectivity, Applications and Services ",Nova Science Publishers Inc ,April 2018 ISBN-10 1536134007

Web links and Video Lectures (e-Resources):

- **https://www.raspberrypi.org/**
- **https://projects.raspberrypi.org/en/projects/raspberry-pi-getting-started/3**
- **https://www.raspberrypi.com/software**

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

- Quizzes & Assignments
- Visit to any IoT device industries
- Demonstration of interfacing latest IoT devices
- Video demonstration of latest trends in IoT's
- Contents related activities (Activity-based discussions)
  - ➢ For active participation of students, instruct the students to prepare interfacing programs
  - ➢ Organizing Group wise discussions on issues
  - ➢ Seminars

SOFTWARE TESTING				
Course Code	20CEE72A	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:

20CEE72A.1	Describe the fundamentals of software testing.
20CEE72A.2	Illustrate the limitation of testing process
20CEE72A.3	Analyse the design of test cases for different testing techniques.
20CEE72A.4	Develop test strategies and plans, deign test case, prioritize and execute them.
20CEE72A.5	Solve the problem of process framework.
20CEE72A.6	Create appropriate document for the software artefact.

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

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
20CEE72A.1	3	-	-	-	-	-	-	-	-	-	-	-	-	-
20CEE72A.2	3	2	-	-	-	-	-	-	-	-	-	-	-	-
20CEE72A.3	3	2	2	2	-	-	-	-	-	-	-	-	2	3
20CEE72A.4	3	2	2	2	-	-	-	-	-	-	-	-	2	3
20CEE72A.5	3	2	2	2	-	-	-	-	-	-	-	-	2	3
20CEE72A.6	3	2	-	-	-	-	-	-	-	-	-	-	2	3

MODULE-1	BASICS OF SOFTWARE TESTING	20CEE72A.1	9 Hours

Basic definitions, Software Quality, Requirements, Behaviour and Correctness, Correctness versus Reliability, Testing and Debugging, Test cases, Insights from a Venn diagram, Identifying test cases, Test-generation Strategies, Test Metrics, Error and fault taxonomies, Levels of testing, Testing and Verification, Static Testing, the triangle problem, the NextDate function, the commission problem, the SATM (Simple Automatic Teller Machine) problem.

Self-study / Case Study / Applications	Investigate the Challenges faced by traditional methods.
Text Book	Text Book 1, Reference Book 1,2

MODULE-2	FUNCTIONAL TESTING	20CEE72A.2	9 Hours

Boundary value analysis, Robustness testing, Worst-case testing, Robust Worst testing for triangle problem, Nextdate problem and commission problem, Equivalence classes, Equivalence test cases for the triangle problem, NextDate function, and the commission problem, Guidelines and observations, Decision tables, Test cases for the triangle problem, NextDate function, and the commission problem, Guidelines and observations. Fault Based Testing: Overview, Assumptions in fault based testing, Mutation analysis, Fault-based adequacy criteria, Variations on mutation analysis.

Text Book	Text Book 1, Text Book 2

MODULE-3	STRUCTURAL TESTING	20CEE72A.2, 20CEE72A.3	9 Hours

Overview, Statement testing, Branch testing, Condition testing, Path testing: DD paths, Test coverage metrics, Basis path testing, guidelines and observations, Data –Flow testing: Definition-Use testing, Slice based testing, Guidelines and observations.

Text Book	Text Book 1, Text Book 2

MODULE-4	PROCESS FRAMEWORK	20CEE72A.4, 20CEE72A.5	9 Hours

Basic principles: Sensitivity, redundancy, restriction, partition, visibility, Feedback, the quality process, Planning and monitoring, Quality goals, Dependability properties, Analysis Testing, Improving the process, Organizational factors. Improving the process, the quality team Documenting Analysis and Test: Organizing documents, Test design specifications documents, Test and analysis reports.

Text Book	Text Book 1, Text Book 2

MODULE-5	Integration and Component-Based Software Testing	20CEE72A.6	9 Hours

Overview, Integration testing strategies, Testing components and assemblies. System, Acceptance and Regression Testing: Overview, System testing, Acceptance testing, Usability, Regression testing, Regression

test selection techniques, Test case prioritization and selective execution. Levels of Testing, Integration Testing: Traditional view of testing levels, Alternative life-cycle models, The SATM system, Separating integration and system testing, A closer look at the SATM system.

Self-study	Survey on sample test case studies of the same.
Text Book	Text Book 2, Text Book 3

CIE Assessment Pattern (50 Marks – Theory) –

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

SEE Assessment Pattern (50 Marks – Theory)

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

Text Books:
1. Paul C. Jorgensen: Software Testing, A Craftsman's Approach, 3rd Edition, Auerbach Publications, 2008, ISBN 0849374758, 9780849374753.
2. Mauro Pezze, Michal Young: Software Testing and Analysis – Process, Principles and Techniques, Wiley India, 2009, ISBN-13 978-0-471-45593-6.
3. Aditya P Mathur: Foundations of Software Testing, Pearson Education 2008, ISBN 8131707954, 9788131707951.

Reference Books:
4. Software testing Principles and Practices – Gopalaswamy Ramesh, Srinivasan Desikan, 2 nd Edition, Pearson, 2007, ISBN-13 978-8177581218
5. Software Testing – Ron Patton, 2nd edition, Pearson Education, 2004, 0672327988, 9780672327988.
6. The Craft of Software Testing – Brian Marrick, Pearson Education, 1994, ISBN-10 0131774115, ISBN-13 978-0131774117.
7. Anirban Basu, Software Quality Assurance, Testing and Metrics, June 2015, ISBN-10 8120350685, ISBN-13 978-8120350687.

Web links and Video Lectures (e-Resources):
- https://onlinecourses.nptel.ac.in/noc22_cs61/preview

Activity-Based Learning (Suggested Activities in Class)/ Practical Based learning
- Quizzes & Assignments
- Visit to any manufacturing/aero/auto industry or any power plant
- Video demonstration of latest trends in web design
- Contents related activities (Activity-based discussions)
  - For active participation of students, instruct the students to prepare Flowcharts and Handouts
  - Organizing Group wise discussions on issues
  - Seminars

DISTRIBUTED COMPUTING

Course Code	20CEE731A	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:

20CEE731A.1	Describe the computation and communication models of distributed systems.
20CEE731A.2	Illustrate the issues of synchronization and collection of information in distributed systems.
20CEE731A.3	Analyze distributed mutual exclusion and distributed deadlock detection techniques.
20CEE731A.4	Investigate and elucidate agreement protocols and fault tolerance mechanisms in distributed systems.
20CEE731A.5	Apply the cloud computing models and the underlying concepts.
20CEE731A.6	Develop self-learning and research skills to apply the concepts for the practical systems.

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

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
20CEE731A.1	2	2	3	3	1	-	-	-	2	1	3	3	1	1
20CEE731A.2	1	3	2	1	2	-	-	-	2	2	2	2	3	2
20CEE731A.3	2	2	1	3	3	-	-	-	3	2	1	1	2	1
20CEE731A.4	1	2	2	3	1	-	-	-	3	3	2	1	1	1
20CEE731A.5	3	3	1	2	3	-	-	-	3	3	3	1	2	3
20CEE731A.6	2	2	1	-	2	-	-	-	2	-	-	-	3	2

MODULE-1	**INTRODUCTION**	**20CEE731A.1**	**8 Hours**

Introduction: Definition-Relation to Computer System Components – Motivation – Message -Passing Systems versus Shared Memory Systems – Primitives for Distributed Communication – Synchronous versus Asynchronous Executions – Design Issues and Challenges; A Model of Distributed Computations: A Distributed Program – A Model of Distributed Executions – Models of Communication Networks – Global State of a Distributed System.

Case Studies	Distributed computer systems: Four case studies https://ieeexplore.ieee.org/document/1458051
Text Book	Text Book 1 – 1.1 .. 1.8, 2.1 ..2.4

MODULE-2	**LOGICAL TIME AND GLOBAL STATE**	**20CEE731A.1, 20CEE731A.2**	**10 Hours**

Logical Time: Physical Clock Synchronization: NTP – A Framework for a System of Logical Clocks Scalar Time – Vector Time; Message Ordering and Group Communication: Message Ordering Paradigms – Asynchronous Execution with Synchronous Communication – Synchronous Program Order on Asynchronous System – Group Communication – Causal Order – Total Order; Global State and Snapshot Recording Algorithms: Introduction – System Model and Definitions – Snapshot Algorithms for FIFO Channels.

Text Book	Text Book 1 – 3.1 .. 3.4, 6.1 .. 6.6, 4.1 ..4.3

MODULE-3	**VISUALIZATION**	**20CEE731A.3, 20CEE731A.4**	**10 Hours**

Distributed Mutual exclusion Algorithms: Introduction – Preliminaries – Lamport's algorithm – Ricart-Agrawala's Algorithm –– Token-Based Algorithms – Suzuki-Kasami's Broadcast Algorithm; Deadlock Detection in Distributed Systems: Introduction – System Model – Preliminaries – Models of Deadlocks – Chandy-Misra-Haas Algorithm for the AND model and OR Model.

Case Studies	The Case for Distributed Shared-Memory Databases with RDMA-Enabled Memory Disaggregation [Vision Paper] https://arxiv.org/pdf/2207.03027.pdf
Text Book	Text Book 1 – 9.1 .. 9.4, 9.10, 10.1 .. 10.4, 10.7,10.8

MODULE-4	**CONSENSUS AND RECOVERY**	**20CEE731A.4, 20CEE731A.5**	**10 Hours**

Text Book	Text Book 1 – 14.1 .. 14.4, 13.1 .. 13.7

MODULE-5	**CLOUD COMPUTING AND ITS SERVICES**	**20CEE731A.4, 20CEE731A.5, 20CEE731A.6**	**7 Hours**

Definition of Cloud Computing – Characteristics of Cloud – Cloud Deployment Models – Cloud Service Models – Driving Factors and Challenges of Cloud – Virtualization – Load Balancing – Scalability and Elasticity – Replication – Monitoring – Cloud Services and Platforms: Compute Services – Storage Services – Application

Services

Text Book	Reference Book 6

CIE Assessment Pattern (50 Marks – Theory) –

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

SEE Assessment Pattern (50 Marks – Theory)

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

Suggested Learning Resources:
Text Books:
1. Kshemkalyani Ajay D, Mukesh Singhal, "Distributed Computing: Principles, Algorithms and Systems", Cambridge Press, 2011. ISBN-10 0521189845
2. George Coulouris, Jean Dollimore, Time Kindberg, "Distributed Systems Concepts and Design", Fifth Edition, Pearson Education, 2012 ISBN 10: 0-13-214301-1

Reference Books:

1. Pradeep L Sinha, "Distributed Operating Systems: Concepts and Design", Prentice Hall of India, 2007 ISBN-10 0780311191
2. Tanenbaum A S, Van Steen M, "Distributed Systems: Principles and Paradigms", Pearson Education, 2007, ISBN-10 153028175X
3. Arshdeep Bahga, Vijay Madisetti, "Cloud Computing: A Hands-On Approach", Universities Press, 2014 ISBN-10 0996025502

Web links and Video Lectures (e-Resources):
- **https://onlinecourses.nptel.ac.in/noc22_cs80/preview**
- **https://onlinecourses.nptel.ac.in/noc23_cs72/preview**
- **https://ocw.mit.edu/courses/6-824-distributed-computer-systems-engineering-spring-2006/**

Activity-Based Learning (Suggested Activities in Class)/ Practical Based learning
- Quizzes & Assignments
- Visit to any manufacturing/ ITindustry where the deployment of distributed systems is done
- Video demonstration of latest trends in distributed systems
- Contents related activities (Activity-based discussions)
  - For active participation of students, instruct the students to prepare Flowcharts and Handouts
  - Organizing Group wise discussions on issues
  - Seminars

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<table>
<tr><td colspan="6" align="center">**CYBER SECURITY**</td></tr>
<tr><td>**Course Code**</td><td>**20CEE732A**</td><td></td><td>**CIE Marks**</td><td>**50**</td></tr>
<tr><td>**L:T:P:S**</td><td>**3:0:0:0**</td><td></td><td>**SEE Marks**</td><td>**50**</td></tr>
<tr><td>**Hrs / Week**</td><td>**3**</td><td></td><td>**Total Marks**</td><td>**100**</td></tr>
<tr><td>**Credits**</td><td>**03**</td><td></td><td>**Exam Hours**</td><td>**03**</td></tr>
</table>

Course outcomes:

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

20CEE732A.1	Describe the basics of cyber security, cyber-crime and cyber law
20CEE732A.2	Classify various types of attacks and learn the tools to launch the attacks.
20CEE732A.3	Analyze and Apply various tools to perform information gathering.
20CEE732A.4	Apply intrusion techniques to detect intrusion
20CEE732A.5	Apply intrusion prevention techniques to prevent intrusion
20CEE732A.6	Develop self-learning and research skills to apply the concepts for the cyber world.

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

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
20CEE732A.1	1	1	1	1	-	1	-	-	-	-	1	-	2	2
20CEE732A.2	1	3	1	3	2	1	-	-	-	-	-	-	2	1
20CEE732A.3	2	1	1	1	-	1	-	-	-	-	1	-	2	2
20CEE732A.4	3	3	2	2	2	1	-	-	-	-	-	-	2	3
20CEE732A.5	3	2	1	1	1	1	-	1	-	-	1	-	2	2
20CEE732A.6	2	2	1	-	2	-	-	-	2		-	-	3	2

MODULE-1	**INTRODUCTION**		**20CEE732A.1**	**9 Hours**

Cyber Security – History of Internet – Impact of Internet – CIA Triad; Reason for Cyber Crime – Need for Cyber Security – History of Cyber Crime; Cybercriminals – Classification of Cybercrimes – A Global Perspective on Cyber Crimes; Cyber Laws – The Indian IT Act – Cybercrime and Punishment.

Self-study / Case Study/ Applications	*Understanding the impact of Cybercrimes and Laws in society.* https://www.cyberralegalservices.com/detail-casestudies.php
Text Book	Text Book 1 – chapter 1 & 2, Text Book 2 – chapter 1

MODULE-2	**ATTACKS AND COUNTERMEASURES**	**20CEE732A.1, 20CEE732A.2**	**9 Hours**

 Malicious Attack Threats and Vulnerabilities: Scope of Cyber-Attacks – Security Breach – Types of Malicious Attacks – Malicious Software – Common Attack Vectors – Social engineering Attack – Wireless Network Attack – Web Application Attack – Attack Tools – Countermeasures.

Self-study / Case Study/ Applications	*Understanding the OWASP Open Worldwide Application Security Project – Explore the world of Cyber Security*
Text Book	Reference Book 1 - Chapter 3

MODULE-3	**RECONNAISSANCE**	**20CEE732A.3, 20CEE732A.4**	**10 Hours**

Harvester – Whois – Netcraft – Host – Extracting Information from DNS – Extracting Information from E-mail Servers – Social Engineering Reconnaissance; Scanning – Port Scanning – Network Scanning and Vulnerability Scanning – Scanning Methodology – Ping Sweer Techniques – Nmap Command Switches – SYN – Stealth – XMAS – NULL – IDLE – FIN Scans – Banner Grabbing and OS Finger printing Techniques.

Text Book	Reference Book – 2 – Chapter 2 and 3, Reference Book 3 – Chapter 3

MODULE-4	**INTRUSION DETECTION**	**20CEE732A.4, 20CEE732A.5**	**10 Hours**

Host -Based Intrusion Detection – Network -Based Intrusion Detection – Distributed or Hybrid Intrusion Detection – Intrusion Detection Exchange Format – Honeypots – Example System Snort.

Text Book	Reference Book – 5

MODULE-5	**INTRUSION PREVENTION**	**20CEE732A.4, 20CEE732A.5, 20CEE732A.6**	**7 Hours**

Firewalls and Intrusion Prevention Systems: Need for Firewalls – Firewall Characteristics and Access Policy – Types of Firewalls – Firewall Basing – Firewall Location and Configurations – Intrusion Prevention Systems – Example Unified Threat Management Products.

Text Book	Reference Book 4 – Chapter 9

CIE Assessment Pattern (50 Marks – Theory) –

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

SEE Assessment Pattern (50 Marks – Theory)

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

Suggested Learning Resources:
Text Books:
1. Anand Shinde, "Introduction to Cyber Security Guide to the World of Cyber Security", Notion Press, 2021 ISBN-10 1637816421
2. Nina Godbole, Sunit Belapure, "Cyber Security: Understanding Cyber Crimes, Computer Forensics and Legal Perspectives", Wiley Publishers, 201 ISBN-10: 9788126521791
3.https://owasp.org/www-project-top-ten/

Reference Books:
1. David Kim, Michael G. Solomon, "Fundamentals of Information Systems Security", Jones & Bartlett Learning Publishers, 2013 (Unit 2) ISBN-10 1284031624
2. Patrick Engebretson, "The Basics of Hacking and Penetration Testing: Ethical Hacking and Penetration Testing Made easy", Elsevier, 2011 ISBN-10 9780124116443
3. Kimberly Graves, "CEH Official Certified Ethical hacker Review Guide", Wiley Publishers, 2007 ISBN-10 8126511966
4. William Stallings, Lawrie Brown, "Computer Security Principles and Practice", Third Edition, Pearson Education, 2015 ISBN 978-0-13-377392-7

Web links and Video Lectures (e-Resources):
- **https://www.youtube.com/watch?v=EKdZutMkmTE**
- **https://www.youtube.com/watch?v=D4fYyu305jg**

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

- Quizzes & Assignments
- Visit to any manufacturing/ IT industry where the practice of Cyber Security is done
- Video demonstration of latest trends in distributed systems
- Contents related activities (Activity-based discussions)
  - For active participation of students, instruct the students to prepare Flowcharts and Handouts
  - Organizing Group wise discussions on issues
  - Seminars

ADVANCED MICROPROCESSOR

Course Code	20CEE733A	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:

20CEE733A.1	Explain the architecture and programming of advanced Intel family microprocessors and microcontrollers.
20CEE733A.2	Explain the concepts in internal programming model of Intel family of microprocessors.
20CEE733A.3	Analyze the data conversion and different ways of accessing the files in disk
20CEE733A.4	Develop the program to use the arithmetic coprocessor
20CEE733A.5	Analyze the basic architecture of Pentium family of processors.
20CEE733A.6	Apply the architecture programming and interfacing of advanced microprocessors.

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

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
20CEE733A.1	2	-	-	-	-	-	-	-	-	-	-	-	2	-
20CEE733A.2	2	3	-	-	-	-	-	-	-	-	-	-	2	-
20CEE733A.3	-	3	-	-	-	-	-	-	-	-	-	-	2	-
20CEE733A.4	-	-	3	-	3	-	-	3	3	3	-	3	2	-
20CEE733A.5	-	3	-	-	-	-	-	-	-	-	-	-	2	-
20CEE733A.6	3	-	-	-	-	-	-	-	-	-	-	-	2	-

MODULE-1	ADVANCED MICROPROCESSOR ARCHITECTURE	20CEE733A.1 20CEE733A.2	9 Hours
	Internal Microprocessor Architecture - Real mode memory addressing – Protected Mode Memory addressing – Memory paging - Data addressing modes – Program memory addressing modes – Stack memory addressing modes.		
Self-study / Case Study / Applications	Investigate the different addressing modes in various microcontroller and microprocessor		
Text Book	Text Book 1: 2.1 , 2.2 , 2.3 , 2.4 , 3.1 , 3.2 , 3.3		
MODULE-2	MODULAR PROGRAMMING AND ITS CONCEPTS	20CEE733A.1 20CEE733A.2 20CEE733A.3	9 Hours
	Modular programming –Using keyboard and Video display –Data Conversions- Disk files- Interrupt hooks- using assembly languages with C/ C++		
Self-study / Case Study / Applications	Investigate on advantages, disadvantages and applications of modular programming. Justify how is it suitable for assembly language.		
Text Book	Text Book 1: 8.1 , 8.2 , 8.3 , 8.4 , 8.5		
MODULE-3	ARITHMETIC COPROCESSORS	20CEE733A.1 20CEE733A.2 20CEE733A.4	9 Hours
	Data format, 80X87 architecture, Instruction set 541, Programming, MMX technology, SSE Technology.		
Case Study / Applications	Investigate the statement "New applications written for the Pentium 4 should contain SSE instructions in place of MMX instructions"		
Text Book	Text Book 1: 14.1 , 14.2 , 14.3 , 14.4 , 14.5 , 14.6		
MODULE-4	MICROPROCESSOR	20CEE733A.1 20CEE733A.2 20CEE733A.6	9 Hours
	80186 / 80188 architecture, Programming the 80186 / 80188, Real Time Operating System, Introduction to 80286 and 80386, 80386 registers and memory, Virtual 8086 mode, Memory paging mechanism, 80486 microprocessor.		
Text Book	Text Book 1: Chapter 16, Chapter 17		
MODULE-5	PENTIUM PROCESSORS	20CEE733A.1 20CEE733A.2 20CEE733A.5	9 Hours
	Introduction to Pentium Microprocessor – Special Pentium registers- Pentium memory management –		

New Pentium Instructions –Pentium Processor –Special Pentium pro features – Pentium 4 processor

Self-study	Review the various features of Pentium Microprocessor present today.
Text Book	Text Book 1: 18.1 , 18.2 , 18.3 , 18.4 , 18.5 , 18.6 , 19.4

CIE Assessment Pattern (50 Marks – Theory) –

		Marks Distribution		
RBT Levels		**Test (s)**	**Qualitative Assessment (s)**	**MCQ's**
		25	**15**	**10**
L1	Remember	5	-	-
L2	Understand	5	3	-
L3	Apply	10	5	5
L4	Analyze	5	7	5
L5	Evaluate	-	-	-
L6	Create	-	-	-

SEE Assessment Pattern (50 Marks – Theory)

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

Suggested Learning Resources:
  Text Books:
   1. Barry B.Brey, The Intel Microprocessors 8086/8088, 80, 86, 80286, 80386 80486, Pentium, Pentium Pro Processor, Pentium II, Pentium III, Pentium 4, Architecture, Programming and interfacing, Prentice Hall of India Private Limited, New Delhi, 2003. ISBN-10 8131726223
   2. John Peatman, Design with Microcontroller McGraw Hill Publishing Co Ltd, New Delhi ISBN-10 0070492387

  Reference Books:
   1.Alan Clements, "The principles of computer Hardware", Oxford University Press, 3rd Edition, 2003 ISBN: 0-19-566901-0.
   2.Rajkamal, The concepts and feature of micro controllers 68HC11, 8051 and 8096; S Chand Publishers, New Delhi ISBN-10 8121924758

Web links and Video Lectures (e-Resources):
   - **https://www.scribd.com/document/224808412/8096#**
   - **https://userpages.umbc.edu/~squire/intel_book.pdf**
   - **https://www.scribd.com/doc/224701168/8096or8097-microcontroller-pdf**
   - **https://nptel.ac.in/courses/117104072**

Activity-Based Learning (Suggested Activities in Class)

   - Quizzes & Assignments .

   - Contents related activities (Activity-based discussions)

     ➢ For active participation of students, instruct the students to prepare Flowcharts and Handouts

     ➢ Organizing Group wise discussions on issues
     ➢ Seminars

DATA ACQUISITION AND PRODUCTIZATION				
Course Code	20CEE734A	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:

20CEE734A.1	Describe data acquisition system.
20CEE734A.2	Illustrate a sensor type to measure a specific environmental change.
20CEE734A.3	Analyze what type of amplifier is needed for a specific sensor output.
20CEE734A.4	Investigate data pre-processing, extraction, cleaning, annotation, integration on data.
20CEE734A.5	Apply the suitable visualization techniques to output analytical results.
20CEE734A.6	Create appropriate applications using Internet of things.

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

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
20CEE734A.1	3	-	-	-	-	-	-	-	-	-	-	-	3	2
20CEE734A.2	-	2	-	-	-	-	-	-	-	-	-	-	3	2
20CEE734A.3	3	2	-	-	-	-	-	-	-	-	-	-	3	2
20CEE734A.4	3	2	-	-	-	-	-	-	-	-	-	-	3	2
20CEE734A.5	-	2	-	-	-	-	-	-	-	-	-	-	3	2
20CEE734A.6	3	2	-	-	-	-	-	-	-	-	-	-	3	2

MODULE-1	INTRODUCTION TO DATA WAREHOUSE	20CEE734A.1	9 Hours

OLTP and OLAP concepts, Introduction to Data Mining, Data Objects and Attribute Types, Basic Statistical Descriptions of Data, Exploratory Data analysis, Measuring Data Similarity and Dissimilarity, Graphical representation of data.

Text Book	Text Book 1
Self-study / Case Study / Applications	Investigate the Challenges faced by Huge Data.

MODULE-2	INTRODUCTION TO DATA ACQUISITION	20CEE734A.1, 20CEE734A.2	9 Hours

Applications, Process, Data Extraction, Data Cleaning and Annotation, Data Integration, Data Reduction, Data Transformation, Data Discretization and Concept Hierarchy Generation.

Text Book	Text Book 1, Text Book 2

MODULE-3	VISUALIZATION	20CEE734A.3, 20CEE734A.4	9 Hours

Introduction, Terminology, Basic Charts and Plots, Multivariate Data Visualization, Data Visualization Techniques, Pixel-Oriented Visualization Techniques, Geometric Projection Visualization Techniques, Icon-Based Visualization Techniques, Hierarchical Visualization Techniques, Visualizing Complex Data and Relations, Data Visualization Tools, Rank Analysis Tools, Trend Analysis Tools, Multivariate Analysis Tools, Distribution Analysis Tools, Correlation Analysis Tools, Geographical Analysis Tools

Text Book	Text Book 1, Text Book 2

MODULE-4	IoT OVERVIEW	20CEE734A.4, 20CEE734A.5	9 Hours

IoT Design methodology, Semantic Web Infrastructure, Intelligence Applications, Programming Framework for IoT, Distributed Data Analysis for IoT, Security and Privacy in IoT, Applied IoT, Cloud Based Smart Facilities Management.

Text Book	Text Book 3
Self-study / Case Study / Applications	GSM based Smart Energy Meter uses Arduino Uno and GSM to monitor the daily load and sends the text messages to mobile number.

MODULE-5	VIRTUALIZATION ON EMBEDDED BOARDS IOT	20CEE734A.4, 20CEE734A.5, 20CEE734A.6	9 Hours

Stream Processing in IoT, Internet of Vehicles and Applications, Case study on Data Acquisition using Dashboards, Android, and iOS apps

Text Book	Text Book 3

CIE Assessment Pattern (50 Marks – Theory) –

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

SEE Assessment Pattern (50 Marks – Theory)

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

Suggested Learning Resources:

Text Books:
1. Han, Jiawei, Jian Pei, and Micheline Kamber, "Data mining: concepts and techniques", 3rd Edition, Elsevier, 2011 ISBN 978-0-12-381479-1
2. Margaret H. Dunham, "Data Mining: Introductory and Advanced Topics", Pearson Education, 2012 ISBN-10 0130888923
3. Arshdeep Bahga, Vijay Madisetti, "Internet of Things -A hands-on approach", Universities Press, 2015 ISBN-10 0130888923

Reference Books:
1. Manoel Carlos Ramon, "Intel Galileo and Intel Galileo Gen 2: API Features and Arduino Projects for Linux Programmers", Apress, 2014 ISBN978-1-4302-6839-0
2. Karl Pover, "Learning Qlikview Data Visualization", Packt, 2013 ISBN-10 1782179895
3. Rajkumar Buyya, Amir Vahid Dastjerdi, "Internet of Things: Principles and Paradigms", Elsevier, 2016 ISBN-10 012805395X

Web links and Video Lectures (e-Resources):
- **https://www.youtube.com/watch?v=1TU-Yubamu4**
- **https://www.youtube.com/watch?v=bgjGrSW-goY**

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

- Quizzes & Assignments
- Visit to any manufacturing/aero/auto industry or any power plant
- Video demonstration of latest trends in web design
- Contents related activities (Activity-based discussions)
  - For active participation of students, instruct the students to prepare Flowcharts and Handouts
  - Organizing Group wise discussions on issues
  - Seminars

SOFTWARE QUALITY ASSURANCE				
Course Code	**20CEE741A**		**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:

20CEE741A.1	To understand the basic view of software quality and quality factors.
20CEE741A.2	To understand the Software Quality Assurance (SQA) architecture and the details of its components.
20CEE741A.3	To understand of how the SQA components can be integrated into the project life cycle.
20CEE741A.4	To be familiar with the software quality infrastructure.
20CEE741A.5	Assess the quality of software product
20CEE741A.6	Apply the concepts in preparing the quality plan & documents.

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

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
20CEE741A.1	3	3	3	3	-	-	-	-	-	-	3	3	3	3
20CEE741A.2	3	3	3	3	-	1	-	-	-	-	3	3	3	3
20CEE741A.3	3	3	3	3	3	-	3	-	-	3	3	3	2	2
20CEE741A.4	3	3	3	3	3	-	3	-	-	3	3	3	2	2
20CEE741A.5	3	3	3	3	-	-	-	-	-	-	3	3	2	2
20CEE741A.6	3	3	3	3	-	-	-	-	-	-	3	3	2	2

MODULE-1	**INTRODUCTION TO SOFTWARE QUALITY AND ASSURANCE**	**20CEE741A.1**	**9 Hours**

The software quality challenge, Software quality, Software quality factors, The components of the software quality assurance system – overview, Management and its role in software quality assurance.

Case Studies	*Neal Coulter*
Text Book	Text Book 1: Chapter 3, Chapter 4

MODULE-2	**SQA COMPONENTS IN THE PROJECT LIFE CYCLE**	**20CEE741A.2**	**9 Hours**

SQA Components in the Project Life Cycle -Integrating quality activities in the project life cycle, Reviews, Software testing – strategies Quality and Management Standards

Text Book	Text Book 1: Chapter 4, Chapter 9

MODULE-3	**SOFTWARE QUALITY IMPLEMENTATION**	**20CEE741A.3**	**9 Hours**

Software Quality Implementation, Assuring the quality of software maintenance components, Assuring the quality of external participants' contributions, CASE tools and their effect on software quality

Text Book	Text Book 1 : Chapter 11, 12, 13
Case Studies	[Top 20 Automation Testing Case Studies in 2023 (aimultiple.com)](#) https://research.aimultiple.com/automation-testing-case-study/#examples-of-test-automation-case-studies

MODULE-4	**SOFTWARE QUALITY INFRASTRUCTURE COMPONENTS**	**20CEE741A.4**	**9 Hours**

Procedures and work instructions, Staff training and certification, Corrective and preventive actions, Documentation control

Text Book	Text Book 1: Chapter 14, 16,17

MODULE-5	**SOFTWARE QUALITY METRICS**	**20CEE7341A.5** **20CEE7341A.6**	**9 Hours**

Software Quality metrics, Cost of Quality, Pre-project Software Quality Components Contract review, Development and quality plans

Case Study	[Quality Metrics for Hybrid Software Development Organizations – A Case Study	IEEE Conference Publication	IEEE Xplore](#) *https://ieeexplore.ieee.org/document/8859415*
Text Book	Text Book 1: Chapter 21, 22

CIE Assessment Pattern (50 Marks – Theory) –

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

SEE Assessment Pattern (50 Marks – Theory)

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

Suggested Learning Resources:
Text Books:
1.   Daniel Galin, "Software Quality Assurance", Pearson Publication, 2009 ISBN-10 0201709457
Reference Books:
1.   Kshirsagar Naik and Priyadarshi Tripathy, Software Testing & Quality Assurance Theory and Practice, Wiley Student edition ISBN 978-0-471-78911-6
2.   William E. Perry, Effective Methods for Software Testing, WILLEY, 3rd Edition. ISBN-10 8126508930
3.   Alan C. Gillies, "Software Quality: Theory and Management", International Thomson Computer Press, 1997 ISBN 0 412 4513 0 250

Web links and Video Lectures (e-Resources):
- **https://www.youtube.com/watch?v=XftNtpWjvzA&list=PLZFw7Zsba5RNK4_lyLCW2nlllMaUpdsMZ**
- **https://www.youtube.com/watch?v=xtQpNdGK6WI**
- **https://www.youtube.com/watch?v=LNSG-yssisA**
- **https://builtin.com/software-engineering-perspectives/software-quality-assurance**

PENETRATION TESTING

Course Code	20CEE742A		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:

20CEE742A.1	Describe Plan and scope of a web security.
20CEE742A.2	Understand legal and compliance requirements for attacks.
20CEE742A.3	Perform vulnerability scanning and penetration testing using appropriate tools and techniques
20CEE742A.4	Analyze the penetration testing results.
20CEE742A.5	Write proposals outlining clear recommendations to implement effective remediation techniques to address system vulnerabilities.
20CEE742A.6	Explore on applications Session Hijacking.

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

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
20CEE742A.1	3	-	-	-	-	-	-	-	-	-	-	-	3	2
20CEE742A.2	3	2	-	-	-	-	-	-	-	-	-	-	3	2
20CEE742A.3	3	2	-	-	-	-	-	-	-	-	-	-	3	2
20CEE742A.4	3	2	-	-	-	-	-	-	-	-	-	-	3	2
20CEE742A.5	3	-	-	-	-	-	-	-	-	-	-	-	3	2
20CEE742A.6	3	2	-	-	-	-	-	-	-	-	-	-	3	2

MODULE-1	INTRODUCTION TO WEB APPLICATIONS	20CEE742A.1	9 Hours

security, threats and OWASP principles, introduction to secure design, web server: introduction a secure setup of apache, firewalling a server Browser: general concepts, functionalities, browsers war, configuration (HTTP-cookies, contents, scripting etc. attack to browsers, and users tracking/profiling (third party cookies, super cookies, XSS, CSFR, Command Injection), browser security (add-ons, plugins, same-origin policy etc.) & secure browsing.

Text Book	Text Book 1		
MODULE-2	ATTACKS TO PRIVACY	20CEE742A.1, 20CEE742A.2	9 Hours

(HTTP cookies, third party cookies, browser fingerprinting, CSP) Advanced browser configuration, anonymity and onion routing (Tor). Internet E-mail: Architecture and infrastructure, functions, agents and standards, MIME & PGP, phishing, spamming & spoofing, DKIM, SPF, introduction to email forensics.

Self-study / Case Study / Applications	Investigate the Challenges faced, as hackers become more sophisticated with their attacks, it becomes easier for them to breach a company.

Text Book	Text Book 1		
MODULE-3	VULNERABILITY RESEARCH	20CEE742A.3, 20CEE742A.4	9 Hours

Five stages of Hacking-Vulnerability Research-Legal implication of hacking Impact of hacking. Foot printing & Social engineering

Text Book	Text Book 1		
MODULE-4	COMPETITIVE INTELLIGENCE	20CEE742A.3, 20CEE742A.4, 20CEE742A.5	9 Hours

DNS Enumerations- Social Engineering attacks. Scanning & Enumeration Port Scanning-Network Scanning-Vulnerability Scanning- NMAP scanning tool- OS Finger Printing Enumeration. System Hacking Password.

Text Book	Text Book 1		
MODULE-5	ARP POISONING	20CEE742A.5, 20CEE742A.6	9 Hours

Session Hijacking- DNS Spoofing- Conduct SQL Injection attack – Counter measures. Cracking techniques-Key loggers- Escalating privileges- Hiding Files-Steganography technologies- Countermeasures

Text Book	Text Book 1

CIE Assessment Pattern (50 Marks – Theory) –

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

SEE Assessment Pattern (50 Marks – Theory)

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

Suggested Learning Resources:
 Text Books:
  1. Penetration testing, A hands on introduction to Hacking, by Georgia Weidman San Francisco
     ISBN-10: 1-59327-564-1 ISBN-13: 978-1-59327-564-8
 Reference Books:
  1. Attacking Network Protocols: A Hacker's Guide to Capture, Analysis, and Exploitation
     ISBN-10 9781593277505
  2. Peter Kim, "The Hacker Playbook 3: Practical Guide to Penetration Testing", Zaccheus Entertainment, 2018, ISBN-10: 1980901759
  3. Mac OS and iOS Internals, Volume III: Security & Insecurity, 2016, ISBN-10 0991055535

Web links and Video Lectures (e-Resources):
- **https://onlinecourses.nptel.ac.in/noc19_cs68/preview**
- **https://www.youtube.com/watch?v=IV7Sb9ZwpPk**
- **https://www.youtube.com/watch?v=duLjQsKfstM**

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

- Quizzes & Assignments
- Visit to any manufacturing/aero/auto industry or any power plant
- Video demonstration of latest trends in web design
- Contents related activities (Activity-based discussions)
  - For active participation of students, instruct the students to prepare Flowcharts and Handouts
  - Organizing Group wise discussions on issues
  - Seminars

<table>
<tr><td colspan="6" align="center">**BIOMETRICS SYSTEMS**</td></tr>
<tr><td>**Course Code**</td><td>**20CEE743A**</td><td></td><td>**CIE Marks**</td><td colspan="2">**50**</td></tr>
<tr><td>**L:T:P:S**</td><td>**3:0:0:0**</td><td></td><td>**SEE Marks**</td><td colspan="2">**50**</td></tr>
<tr><td>**Hrs / Week**</td><td>**3**</td><td></td><td>**Total Marks**</td><td colspan="2">**100**</td></tr>
<tr><td>**Credits**</td><td>**03**</td><td></td><td>**Exam Hours**</td><td colspan="2">**03**</td></tr>
</table>

Course outcomes:

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

20CEE743A.1	Describe the technologies of fingerprint, iris, face and speech recognition
20CEE743A.2	Understand the general principles of design of biometric systems and the underlying trade-offs.
20CEE743A.3	Recognize personal privacy and security implications of biometrics-based identification technology.
20CEE743A.4	Analyze and identify issues in the realistic evaluation of biometrics-based systems.
20CEE743A.5	Analyze design basic biometric system applications.
20CEE743A.6	Explore on applications in the field of Biometric Systems.

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

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
20CEE743A.1	3	-	-	-	-	-	-	-	-	-	-	-	3	2
20CEE743A.2	3	2	-	-	-	-	-	-	-	-	-	-	3	2
20CEE743A.3	3	2	-	-	-	-	-	-	-	-	-	-	3	2
20CEE743A.4	3	2	-	-	-	-	-	-	-	-	-	-	3	2
20CEE743A.5	3	-	-	-	-	-	-	-	-	-	-	-	3	2
20CEE743A.6	3	2	-	-	-	-	-	-	-	-	-	-	3	2

MODULE-1	**INTRODUCTION TO BIOMETRICS**	**20CEE743A.1**	**9 Hours**

Introduction and back ground – biometric technologies – passive biometrics – active biometrics - Biometrics Vs traditional techniques – Benefits of biometrics - Operation of a biometric system– Key biometric processes: verification, identification and biometric matching – Performance measures in biometric systems: FAR, FRR, FTE rate, FTA rate and rate- Need for strong authentication – Protecting privacy and biometrics and policy – Biometric applications.

Text Book	Text Book 1		

MODULE-2	**FINGERPRINT IDENTIFICATION TECHNOLOGY**	**20CEE743A.1, 20CEE743A.2**	**9 Hours**

Fingerprint Patterns, Fingerprint Features, Fingerprint Image, width between two ridges - Fingerprint Image Processing - Minutiae Determination - Fingerprint Matching: Fingerprint Classification, Matching policies.

Text Book	Text Book 1		

MODULE-3	**III FACE RECOGNITION**	**20CEE743A.3, 20CEE743A.4**	**9 Hours**

Introduction, components, Facial Scan Technologies, Face Detection, Face Recognition, Representation and Classification, Kernel- based Methods and 3D Models, Learning the Face Spare, Facial Scan Strengths and Weaknesses, Methods for assessing progress in Face Recognition.

Text Book	Text Book 1		

MODULE-4	**VOICE SCAN**	**20CEE743A.3, 20CEE743A.4, 20CEE743A.5**	**9 Hours**

Introduction, Components, Features and Models, Addition Method for managing Variability, Measuring Performance, Alternative Approaches, Voice Scan Strengths and Weaknesses, NISTSpeaker Recognition Evaluation Program, Biometric System Integration.

Text Book	Text Book 1		

MODULE-5	**FUSION IN BIOMETRICS**	**20CEE743A.5, 20CEE743A.6**	**9 Hours**

Introduction to Multibiometric - Information Fusion in Biometrics - Issues in Designing a Multibiometric System - Sources of Multiple Evidence - Levels of Fusion in Biometrics – Sensor level, Feature level, Rank level, Decision level fusion - Score level Fusion. Examples – biopotential and gait based biometric systems.

Text Book	Text Book 1		

CIE Assessment Pattern (50 Marks – Theory) –

		Marks Distribution		
RBT Levels		**Test (s)**	**Qualitative Assessment (s)**	**MCQ's**
		25	**15**	**10**
L1	Remember	5	-	-
L2	Understand	5	7.5	5
L3	Apply	10	7.5	5
L4	Analyze	5	-	-
L5	Evaluate	-	-	-
L6	Create	-	-	-

SEE Assessment Pattern (50 Marks – Theory)

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

Suggested Learning Resources:

Text Books:
1. James Wayman, Anil Jain, Davide Maltoni, Dario Maio, "Biometric Systems, Technology Design and Performance Evaluation", Springer, 2005 ISBN978-1-85233-596-0
2. David D. Zhang, "Automated Biometrics: Technologies and Systems", Kluwer Academic Publishers, New Delhi, 2000 ISBN-10 0792378563
3. Arun A. Ross , Karthik Nandakumar, A.K.Jain, "Handbook of Multibiometrics", Springer, New Delhi, 2011, ISBN: 0387773258,9780387773254

References:
1. Paul Reid, "Biometrics for Network Security", Pearson Education, 2004, ISBN: 9780131015494

2. Nalini K Ratha, Ruud Bolle, "Automatic fingerprint Recognition System", Springer, 2003, ISBN: 0-387-95593-3
3. L C Jain, I Hayashi, S B Lee, U Halici, "Intelligent Biometric Techniques in Fingerprint and Face Recognition" CRC Press, 1999, ISBN 9780849320552

Web links and Video Lectures (e-Resources):
- **https://archive.nptel.ac.in/courses/106/104/106104119/**
- **https://www.youtube.com/watch?v=1nKE7sbQKtU**
- **https://www.youtube.com/watch?v=hv31ZESxoTQ**

Activity-Based Learning (Suggested Activities in Class)/ Practical Based learning
- Quizzes & Assignments
- Visit to any manufacturing/bio medical related industry for exploring the concept of Biometrics
- Video demonstration of latest trends and research requirements in biometrics systems
- Contents related activities (Activity-based discussions)
  - For active participation of students, instruct the students to prepare Flowcharts and Handouts
  - Organizing Group wise discussions on issues
  - Seminars

<div align="center">

HDL BASED DIGITAL SYSTEM DESIGN

</div>

Course Code	20CEE744A	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:

20CEE744A.1	Demonstrate the knowledge on language constructs and programming fundamentals HDL design flow of Verilog HDL.
20CEE744A.2	Choose the suitable abstraction level for a particular digital design.
20CEE744A.3	Construct Combinational and sequential circuits in different modelling styles using Verilog HDL.
20CEE744A.4	Design and develop the combinational and sequential circuits using behavioural modelling.
20CEE744A.5	Analyze the process of switch level modelling , system task, function and compiler directives.
20CEE744A.6	Analyze and Verify the functionality of digital circuits/systems using test benches.

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

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
20CEE744A.1	2	-	-	-	-	-	-	-	-	-	-	-	3	-
20CEE744A.2	3	-	-	-	-	-	-	-	-	-	-	-	3	-
20CEE744A.3	-	-	3	-	3	-	-	-	2	-	-	-	3	-
20CEE744A.4	-	-	3	-	-	-	-	-	2	-	-	-	3	-
20CEE744A.5	-	3	-	-	-	-	-	-	-	-	-	-	3	-
20CEE744A.6	3	2	-	-	-	-	-	-	-	-	-	-	3	-

MODULE-1	INTRODUCTION TO VERILOG	20CEE744A.1	9 Hours

Verilog as HDL, Levels of design Description, Concurrency, Simulation and Synthesis, Functional Verification, System Tasks, Programming Language Interface (PLI), Module, Simulation and Synthesis Tools, Keywords, Identifiers, White Space Characters, Comments, Numbers, Strings, Logic Values, Strengths, Data Types, Scalars and Vectors, Parameters, Operators.

Text Book	Text Book 1: Chapter 1 , Chapter 2 , Chapter 3

MODULE-2	GATE LEVEL MODELING & MODELING AT DATA FLOW LEVEL	20CEE744A.1 20CEE744A.2 20CEE744A.3	9 Hours

Introduction, AND Gate Primitive, Module Structure, Other Gate Primitives, Illustrative Examples, Tri-State Gates, Array of Instances of Primitives, Design of Flip – Flops with gate primitives, Delays, Strengths and Contention Resolution, Net Types, Design of Basic Circuits.
Introduction, Continuous Assignment Structures, Delays and Continuous Assignments, Assignment to Vectors, Operators.

Self-study / Case Study / Applications	Demonstrate the function of given logic circuits using Verilog gate level modelling and data flow modelling.
Text Book	Text Book 1: Chapter 4 , Chapter 5 , Chapter 6

MODULE-3	BEHAVIORAL MODELING	20CEE744A.1 20CEE744A.2 20CEE744A.3 20CEE744A.4	9 Hours

Introduction, Operations and Assignments, Functional Bifurcation, 'Initial' Construct, 'Always' Construct, Examples, Assignments with Delays, 'Wait' Construct, Multiple Always Blocks, Designs at Behavioral Level, Blocking and Non-Blocking Assignments, The case statement, Simulation Flow, 'if' and 'if-else' constructs, 'assign – de-assign' construct, 'repeat' construct, 'for' loop, the 'disable' construct, 'while' loop, 'forever' loop, parallel blocks, 'force-release' construct, Event.

Self-study / Case Study / Applications	Demonstrate the function of given logic circuits using Verilog behavioral modelling.
Text Book	Text Book 1: Chapter 10 , Chapter 11

MODULE-4	SWITCH LEVEL MODELLING & SYSTEM TASKS, FUNCTIONS, AND COMPILER DIRECTIVES	20CEE744A.1 20CEE744A.2 20CEE744A.5	9 Hours

Basic Transistor Switches, CMOS Switch, Bi – directional Gates, Time Delays with Switch Primitives, Instantiations with Strengths and Delays, Strength Contention with Trireg Nets. Parameters, Path Delays, Module Parameters, System Tasks and Functions, File – Based Tasks and Functions, Compiler Directives, Hierarchical Directives, Hierarchical Access, User-defined Primitives			
Self-study	Survey on various enhancement in HDL to meet the current requirement.		
Text Book	Text Book 1: Chapter 9, Chapter 10 , Chapter 11		
MODULE-5	**SEQUENTIAL CIRCUIT DESCRIPTION & COMPONENT TEST AND VERIFICATION**	**20CEE744A.1 20CEE744A.6**	**9 Hours**
Sequential Models – Feedback Model, Capacitive Model, Implicit Model, Basic Memory Components, Functional Register, Static Machine Coding, Sequential Synthesis. Test Bench – Combinational Circuit Testing, Sequential Circuit Testing, Test Bench Techniques, Design Verification, Assertion Verification.			
Self-study	Survey on different optimization techniques in the design of digital circuits.		
Text Book	Text Book 2: Chapter 5 , Chapter 6		

CIE Assessment Pattern (50 Marks – Theory)

RBT Levels		Marks Distribution		
		Test (s)	Qualitative Assessment (s)	MCQ's
		25	**15**	**10**
L1	Remember	5	-	-
L2	Understand	5	-	-
L3	Apply	10	3	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	10
L2	Understand	10
L3	Apply	20
L4	Analyze	10
L5	Evaluate	--
L6	Create	--

Suggested Learning Resources:
 Text Books:
   1. T. R. Padmanabhan, B. Bala Tripura Sundari, "Design through Verilog HDL, Wiley, 2016, ISBN: 978-0-471-72300-4
   2. Z Navabi - Verilog Digital System Design, 2nd Edition, McGraw Hill, 2006, ISBN-10 0071445641
 Reference Books:
   1. Fundamentals of Logic design with Verilog – Stephen Brown and ZvonkoVranesic, TMH, 2nd Edition, 2017, ISBN-10 9780070667242
   2. Advanced Digital Logic Design using Verilog, State Machine & Synthesis for FPGA – Sunggu Lee, Cengage Learning, 2012, ISBN-10 9788131518489
   3. Verilog HDL – Samir Palnitkar, 2nd Edition, Pearson Education, 2009, ISBN: 0-13-044911-3
   4. Advanced Digital Design with Verilog HDL – Michael D. Ciletti, PHI, 2001, ISBN-10 0136019285

Web links and Video Lectures (e-Resources):
   • **https://archive.nptel.ac.in/courses/117/108/117108040/**
   • **https://www.cadence.com/en_US/home/training/all-courses/82143.html**
   • **https://www.coursera.org/learn/digital-systems**

Activity-Based Learning (Suggested Activities in Class)/ Practical Based learning
   • Quizzes & Assignments
   • Write and Demonstrate the given digital concept by writing a Verilog code.
   • Contents related activities (Activity-based discussions)
     ➢ For active participation of students, instruct the students to prepare Flowcharts and Handouts

INTERNET OF THINGS LABORATORY

Course Code	20CEL75A		CIE Marks	25
L:T:P:S	0:0:2:0		SEE Marks	25
Hrs / Week	3		Total Marks	50
Credits	02		Exam Hours	03

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

20CEL75A.1	Understandfunctionalitiesofvarioussingleboardembeddedplatformsfundamentals
20CEL75A.2	Understanding interfacing IoT devices with RaspberryPI/Arduino
20CEL75A.3	Apply Raspberry PI/Arduino interfacing to creates imple application
20CEL75A.4	Implement interfacing of various sensors with RaspberryPi/Arduino.

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

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
20CEL75A.1	2	3	3	2	1	2	1	1	2	-	-	2	2	3
20CEL75A.2	3	2	3	2	1	2	1	1	2	-	-	2	3	2
20CEL75A.3	2	3	2	2	1	2	1	1	2	-	-	1	2	3
20CEL75A.4	3	3	3	2	1	2	1	1	2	-	-	2	3	3

Exp. No. / Pgm. No.	List of Experiments / Programs	Hours	COs
Prerequisite Experiments / Programs / Demo		
General	• Demonstration in Proteus software • Interfacing of Raspberry Pi / Arduino	2	NA
PART-A		
1	To interface LED with Arduino/Raspberry Pi and write a program to turn ON LED for 1 sec after every 2 seconds.	3	20CEL75A.1
2	To interface Buzzer with Arduino/Raspberry Pi and write a program to turn off and on periodically	3	20CEL75A.1
3	To interface DHT11 sensor with Arduino/Raspberry Pi and write a program to print temperature and humidity readings.	3	20CEL75A.2
4	To interface smoke sensor with Arduino/Raspberry Pi and write a program to turn on alarm when smoke is detected.	3	20CEL75A.2
PART-B		
5	Demonstrate the connectivity of Arduino/RaspberryPi with PIR motion sensor with an application to detect obstacle and notify user using LED/LCD.	3	20CEL75A.2
6	To interface ultrasonic sensor with Arduino/Raspberry Pi and write a program to display the distance of the obstacle.	3	20CEL75A.2
7	To interface float sensor to detect water level in over head tanks and warn the overflow using Arduino/Raspberry PI with an LED	3	20CEL75A.3
8	To interface ADXL335 accelerometer with Arduino/RaspberryPi to detect the various orientation and display it on serial monitor.	3	20CEL75A.3
9	Create an application that has three LEDs (Red, Green and white). The LEDs should follow the cycle (All Off, Red On ,Green On ,White On)for each hand movement (use Ultrasonic sensor).	3	20CEL75A.4
10	To interface soil moisture sensor to display the quality of soil moisture values using Arduino.	3	20CEL75A.4

CIE Assessment Pattern (25 Marks – Lab)

RBT Levels		Test (s)	Weekly Assessment
		15	**10**
L1	Remember	**-**	**-**
L2	Understand	-	-
L3	Apply	5	-
L4	Analyze	-	-
L5	Evaluate	5	5
L6	Create	5	5

SEE Assessment Pattern (25 Marks – Lab)

RBT Levels		Exam Marks Distribution (25)
L1	Remember	-
L2	Understand	-
L3	Apply	05
L4	Analyze	
L5	Evaluate	15
L6	Create	05

Suggested Learning Resources:
Reference Books:
1) Arduino Cookbook, 2nd Edition, by Michael Margolis. ISBN: 978-1785286582

2) Getting Started with Arduino: The Open-Source Electronics Prototyping Platform (Make) 3rd Edition. ISBN: 978-1774854891

3) Arduino: The complete guide to Arduino for beginners, including projects, tips, tricks, and programming, ISBN: 978-1761032806

SOFTWARE TESING LABORATORY

Course Code	20CEL76A			CIE Marks	25	
L:T:P:S	0:0:2:0			SEE Marks	25	
Hrs / Week	3			Total Marks	50	
Credits	02			Exam Hours	03	

Course outcomes:

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

20CEL76A.1	Analyze the requirements for the given problem statement.
20CEL76A.2	Design and implement various solutions for the given problem.
20CEL76A.3	Employ various design strategies for problem solving.
20CEL76A.4	Construct control flow graphs for the solution that is implemented.

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

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
20CEL76A.1	2	2	-	-	-	-	-	-	-	-	-	2	3	2
20CEL76A.2	2	-	-	-	3	-	-	-	-	-	-	2	3	2
20CEL76A.3	2	-	-	-	3	-	-	-	-	-	-	2	3	2
20CEL76A.4	2	-	-	-	-	-	-	-	-	-	-	2	3	2

Pgm. No.	List of Experiments / Programs	Hours	COs
	Prerequisite Experiments / Programs / Demo		
	SQL – Data Base	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. Derive test cases for your program based on decision-table approach, execute the test cases and discuss the results.	3	20CEL76A.1
2	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 boundary-value analysis, execute the test cases and discuss 3the results.	3	20CEL76A.2
3	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 equivalence class partitioning, execute the test cases and discuss the results.	3	20CEL76A.2
4	Design, develop, code and run the program in any suitable language to solve the commission problem. Analyze it from the perspective of dataflow testing, derive different test cases,	3	20CEL76A.3

	execute these test cases and discuss the test results.		
5	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.	3	20CEL76A.3
6	Design, develop, code and run the program in any suitable language to solve the commission problem. Analyze it from the perspective of equivalence class testing, derive different test cases, execute these test cases and discuss the test results.	3	20CEL76A.4
PART-B			
7	Design, develop, code and run the program in any suitable language to solve the commission problem. Analyze it from the perspective of decision table-based testing, derive different test cases, execute these test cases and discuss the test results	3	20CEL76A.4
8	Design, develop, code and run the program in any suitable language to implement the binary search algorithm. Determine the basis path sand using them derive different test cases, execute these test cases and discuss the test results	3	20CEL76A.4
9	Design, develop, code and run the program in any suitable language to implement the quicksort algorithm. Determine the basis paths and using them derive different test cases, execute these test cases and discuss the test results.	3	20CEL76A.4
10	Design, develop, code and run the program in any suitable language to implement an absolute letter grading procedure, making suitable assumptions. Determine the basis paths and using them derive different test cases, execute these test cases and discuss the test results.	3	20CEL76A.4

<div align="center">**PART-C**</div>

1. Identifying the Requirements from Problem Statements
2. Consider an automated banking application. The user can dial the bank from a personal computer, provide a six-digit password, and follow with a series of keyword commands that activate the banking function.

CIE Assessment Pattern (50 Marks – Lab)

RBT Levels		Test (s)	Weekly Assessment
		25	**25**
L1	Remember	-	-
L2	Understand	-	5
L3	Apply	-	10
L4	Analyze	-	5
L5	Evaluate	25	5
L6	Create	-	-

SEE Assessment Pattern (50 Marks – Lab)

RBT Levels		Exam Marks Distribution (50)
L1	Remember	-
L2	Understand	05
L3	Apply	15
L4	Analyze	05
L5	Evaluate	-
L6	Create	-

Suggested Learning Resources:
  1. **Reference Books:** The Art of Software Testing (Book): 3rd edition, ISBN: 978-1118031964

Course Code	20CEE77A			CIE Marks	50
L:T:P:S	0:0:3:0			SEE Marks	50
Hrs / Week	-			Total Marks	100
Credits	03			Exam Hours	03

Course outcomes:

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

20CEE77A.1	Prepare the students to solve/work on the real world/ Practical/Theoretical problems involving issues in computer science and Engineering.
20CEE77A.2	Able to summarize their work by proper Software Engineering Documents after evaluating the testing plans.
20CEE77A.3	Practice presentations, Communications, and teamwork skills.
20CEE77A.4	Able to learn and develop new concepts in the multidisciplinary area.
20CEE77A.5	Use different Programming languages/software tools/ Hardware technologies.
20CEE77A.6	Apply algorithmic strategies while solving problems.

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

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
20CEE77A.1	3	3	2	3	-	-	-	-	-	-	-	2	3	2
20CEE77A.2	2	3	-	-	-	-	-	-	-	3	-	2	3	2
20CEE77A.3	-	-	-	-	-	-	-	3	3	3	-	2	-	-
20CEE77A.4	2	2	-	-	-	-	-	-	-	-	-	2	3	2
20CEE77A.5	2	-	-	-	3	-	-	-	-	-	-	2	3	2
20CEE77A.6	2	2	-	2	-	-	-	-	-	-	-	2	3	2

		RUBRICS			
	Excellent(S) (100%)	**Very Good (A)** (80%)	**Good (B)** (60%)	**Fair(C)** (40%)	**Unsatisfactory(D)** (0)
Problem Statement (Synopsis)	Domain specific problem statement that focuses on latest technology in computer science with exact outcomes specified and aligned to societal issues. Project has critical thinking to solve problems	Domain specific problem statement that focuses on latest technology in computer science. There are very few or too many outcomes specified and have little impact on societal issues. Project has critical thinking	Domain specific problem statement that focuses on latest technology in computer science. There are very few or too many outcomes specified and have little impact on societal issues. Project has critical thinking involved.	Domain specific problem statement that focuses on existing technology in computer science. There are very few outcomes specified and have very less impact on societal issues. Solve problems and think critically, but not in depth or in a sustained way	Irrelevant Problem statement and has no outcomes defined and no critical thinking involved

Literature Survey					
Coverage of Content	The appropriate content is covered in depth without being redundant. Sources are cited when specific statements are made. Significance to purpose is unquestionable.	All major sections of the content are included, but not covered in as much depth, or as explicit, as expected. Significance to purpose is evident.	Most sections of the content are included, but not covered in as much depth, or as explicit, as expected. Significance to purpose is clear.	Few sections of pertinent content have been omitted. The topic is of little significance to the purpose.	Major sections of pertinent content have been omitted or greatly run-on. The topic is of little significance to the purpose.
A synthesis of ideas and hypothesis	Insights into the problem are appropriate. Conclusions and the research questions are strongly supported in the survey	Insights into the problem are appropriate. Conclusions supported the problem statement.	Provides concluding remarks that show an analysis and synthesis of ideas occurred. Few of conclusions were not supportive	Provides concluding remarks that show an analysis and synthesis of ideas occurred. Some of the conclusions were not supported in the survey.	There is no indication to synthesize the information or draw a conclusion.
Citations / References	All needed citations were included in the report. References matched the citations, and all were encoded in IEEE format.	All needed citations were included in the report. References matched the citations	Citations within the body of the report and a corresponding reference list were presented. Formatting had very few problems	Citations within the body of the report and a corresponding reference list were presented. Some formatting problems exist, or components were missing.	Citations for statements included in the report were not present, or references which were included were not found in the text.
High level design	All required modules designed with data flow diagram meeting all the objectives that have impact on real world concerns	All required modules designed with data flow diagram meeting most of the objectives	All required modules designed with data flow diagram meeting few of the objectives	Few modules designed with data flow diagram meeting few of the objectives	Project looks like traditional schoolwork with No authentic features designed and have no impact on real world concerns.
Document ation (Report Submissio n)	Clearly and effectively documented including descriptions of all the concepts +	Clearly and effectively documented including descriptions of all the concepts + Plagiarism Check Report	Clearly and effectively documented including descriptions of all the concepts +	Clearly and effectively documented including descriptions of all the concepts	No documentation included

	Plagiarism Check Report (Less than 10%)	(11%-15%)	Plagiarism Check Report (16%-20%)	+ Plagiarism Check Report (21%-25%)	
Individual Contribution to the project	Distribution of workload among the team members is clearly defined, the goal of the project is fully achieved and the student contributed his/her 100% to achieve the goal of the project.	Distribution of workload among the team members is clearly defined, the project is fully completed and the student contributed partially to finish the work allocated to him/her.	Distribution of workload among the team members is not clearly defined, the goal of the project is partially achieved and student does not contribute to achieve the allocated work.	Distribution of workload among the team members is clearly defined, the goal of the project is not achieved and student does not contribute to achieve the allocated work.	Distribution of workload among the team members is not clearly defined, the goal of the project is not achieved and student does not contribute to achieve the allocated work.

CIE Assessment Pattern (50 Marks – Lab)

RBT Levels		Synopsis Presentation- Review-0	Review-1	Final Review	Report Submission with plagiarism certificate
		5	**15**	**20**	**10**
L1	Remember	-	-	-	
L2	Understand	-	-	-	10
L3	Apply	5	5	5	-
L4	Analyze	-	5	5	-
L5	Evaluate	-	5	-	-
L6	Create	-	-	10	-

SEE Assessment Pattern (50 Marks – Lab)

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

SEMESTER VII

(SYLLABUS)

COMPUTER VISION			
Course Code	20CEE81A	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:

20CEE81A.1	Explain basic knowledge, theories and methods in image processing and computer vision.
20CEE81A.2	Implement basic and some advanced image processing techniques.
20CEE81A.3	Apply 2D a feature-based based image alignment, segmentation, and motion estimations.
20CEE81A.4	Analyze 3D image reconstruction techniques
20CEE81A.5	Design and develop innovative image processing and computer vision applications.
20CEE81A.6	Explain image-based rendering and recognition

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

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
20CEE81A.1	2	-	-	-	-	-	-	-	-	-	-	-	2	-
20CEE81A.2	2	-	3	-	-	-	-	-	-	-	-	-	2	-
20CEE81A.3	3	-	-	-	-	-	-	-	-	-	-	-	2	-
20CEE81A.4	-	3	-	-	-	-	-	-	-	-	-	-	2	-
20CEE81A.5	-	-	3	-	3	-	-	3	3	3	-	3	2	-
20CEE81A.6	3	2	-	-	-	-	-	-	-	-	-	-	2	-

MODULE-1	INTRODUCTION TO IMAGE FORMATION AND PROCESSING	20CEE81A.1 20CEE81A.2 20CEE81A.5	9 Hours

Computer Vision - Geometric primitives and transformations - Photometric image formation - The digital camera - Point operators - Linear filtering - More neighborhood operators - Fourier transforms - Pyramids and wavelets - Geometric transformations - Global optimization.

Self-study	Investigate the Challenges of different image processing techniques.
Text Book	Text Book 1: Chapter 1 , Chapter 2 , Chapter 3

MODULE-2	FEATURE DETECTION, MATCHING AND SEGMENTATION	20CEE81A.1 20CEE81A.2 20CEE81A.3 20CEE81A.5	9 Hours

Points and patches - Edges and Contours – Contour Tracking - Segmentation – Application, Clustering pixels, Graphs, Mean Shift and Normalized cuts.

Self-study	Investigate the different segmentation techniques and its applications.
Text Book	Text Book 1: Chapter 7. Text Book 2: Chapter 9

MODULE-3	FEATURE-BASED ALIGNMENT & MOTION ESTIMATION	20CEE81A.1 20CEE81A.2 20CEE81A.3 20CEE81A.5	9 Hours

Pairwise alignment – Image Stitching – Global alignment – Compositing. Geometric intrinsic calibration – Pose Estimation - Triangulation - Two-frame structure from motion – Multi frame structure from motion - Factorization - Bundle adjustment - Constrained structure and motion. Translational alignment - Parametric motion - Optical flow - Layered motion.

Self-study / Case Study / Applications	Explore the various modern motion estimation techniques used in different application.
Text Book	Text Book 1: Chapter 8 , Chapter 9 , Chapter 11

MODULE-4	3D RECONSTRUCTION	20CEE81A.1 20CEE81A.2 20CEE81A.4 20CEE81A.5	9 Hours

Shape from X – 3D scanning - Surface representations - Point-based representations- Volumetric representations - Model-based reconstruction - Recovering texture maps and albedosos.

Self-study	Identify the different application that uses the 3D reconstruction technique and analyse it.
Text Book	Text Book 1: Chapter 13

MODULE-5	RECOGNITION AND IMAGE-BASED RENDERING	20CEE81A.1 20CEE81A.2 20CEE81A.5 20CEE81A.6	9 Hours

View interpolation Layered depth images - Light fields and Lumigraphs - Environment mattes - Video-based rendering. Instance recognition - Image Classification - Object detection - Semantic Segmentation – Video Understanding.

Self-study / Case Study / Applications	Survey on modern recognition and rendering techniques and compare it.
Text Book	Text Book 1: Chapter 6 , Chapter 14

CIE Assessment Pattern (50 Marks – Theory)

		Marks Distribution		
RBT Levels		**Test (s)**	**Qualitative Assessment (s)**	**MCQ's**
		25	**15**	**10**
L1	Remember	5	-	-
L2	Understand	5	5	-
L3	Apply	10	3	5
L4	Analyze	5	7	5
L5	Evaluate	-	-	-
L6	Create	-	-	-

SEE Assessment Pattern (50 Marks – Theory)

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

Suggested Learning Resources:

Text Books:

1. Richard Szeliski, "Computer Vision: Algorithms and Applications", Springer- Texts in Computer Science, Second Edition, 2022, ISBN-10 1848829345
2. Computer Vision: A Modern Approach, D. A. Forsyth, J. Ponce, Pearson Education, Second Edition, 2015. ISBN-10 9332550115

Reference Books:

1. Richard Hartley and Andrew Zisserman, Multiple View Geometry in Computer Vision, Second Edition, Cambridge University Press, March 2004 ISBN-10 0521540518
2. Christopher M. Bishop; Pattern Recognition and Machine Learning, Springer, 2016, ISBN-10 : 0241973376
3. E. R. Davies, Computer and Machine Vision, Fourth Edition, Academic Press, 2012, ISBN-10 9780123869081

Web links and Video Lectures (e-Resources):

- **https://archive.nptel.ac.in/courses/106/105/106105216/**
- **https://archive.nptel.ac.in/courses/108/103/108103174/**
- **https://www.coursera.org/learn/introduction-computer-vision-watson-opencv**

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

- Quizzes & Assignments .
- Demonstration of given concept through program.
- Contents related activities (Activity-based discussions)
  - For active participation of students, instruct the students to prepare Flowcharts and Handouts
  - Seminars

<table>
<tr><td colspan="6" align="center">**PROJECT PHASE II**</td></tr>
<tr><td>**Course Code**</td><td colspan="2">**20CEE83A**</td><td>**CIE Marks**</td><td colspan="2">150</td></tr>
<tr><td>**L:T:P:S**</td><td colspan="2">0:0:12:0</td><td>**SEE Marks**</td><td colspan="2">150</td></tr>
<tr><td>**Hrs / Week**</td><td colspan="2">-</td><td>**Total Marks**</td><td colspan="2">300</td></tr>
<tr><td>**Credits**</td><td colspan="2">12</td><td>**Exam Hours**</td><td colspan="2">03</td></tr>
</table>

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

20CEE83A.1	Demonstrate the proposed work in module wise with proper time allocation and finance management.
20CEE83A.2	Assess the post analysis implementation and identify its future scope, issues and impact.
20CEE83A.3	Communicate technical and general information by means of oral as well as written presentation skills with professionalism.
20CEE83A.4	distribute the work and commit to professional ethics and responsibilities as a member in a team and individual.

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

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
20CEE83A.1	-	-	3	-	3	-	-	-	-	-	3	-	3	3
20CEE83A.2	-	3	-	3	-	3	3	-	-	-	-	3	3	3
20CEE83A.3	-	-	-	-	-	-	-	3	-	3	-	-	3	3
20CEE83A.4	3	-	-	-	-	-	-	3	3	-	-	-	3	3

RUBRICS

	Excellent(S) (100%)	Very Good (A) (80%)	Good (B) (60%)	Fair(C) (40%)	Unsatisfactory(D) (0)
Design and Implementation	All required concepts implemented are meeting the objectives with excellent GUI. Project has well defined authentic features implemented with all real impact on the real world issues. Usage of latest tools	Most of the required concepts implemented are meeting the objectives with appropriate GUI. Project has most of the authentic features implemented with some impact on societal issues. Usage of latest tools	Some of the required concepts implemented are meeting the objectives with GUI. Project has authentic functionality implemented with limited impact on societal issues. Usage of latest tools	Few of the required concepts implemented are meeting the objectives with GUI. Project has some of the authentic functionality implemented with slightly impact on societal issues. Usage of latest tools	Project has no authentic features implemented and has no impact on real world concerns.
Development of software prototype & Demonstration	All objectives are well-defined and achieved through the software module. It works well and demonstrated properly. The modules are well-integrated to achieve their goals.	All objectives are defined and achieved through the software module. It works fine and demonstrated properly. The modules are integrated without errors to achieve their goals.	Most of the objectives are defined and achieved through the software module. It works and demonstrated properly.	Few of the objectives are defined and achieved through the software module. It works and demonstrated properly.	None of the defined objectives are achieved and has no outcomes.
Documentation (Report Submission)	All the required concepts and tools used in the project are documented clearly and effectively. Specific purpose of usage are documented for each concept designed and implemented. Plagiarism Check Report with similarity index below 5%.	Most of the required concepts and tools used in the project are documented clearly. Purpose of usage are documented for each concept designed and implemented. Plagiarism Check Report with similarity index below 10%.	Basic documentation has to be included for the required concepts and tools. Purpose of usage are documented for each function. Plagiarism Check Report with similarity index below 15%.	Few of the required concepts and tools used in the project are documented. Plagiarism Check Report with similarity index below 20%.	No documentation included. No Plagiarism check.

Individual Contribution to the project	Distribution of workload among the team members is clearly defined. The goal of the project is fully achieved. Student contributed his/her 100% work to achieve the goal of the project.	Distribution of workload among the team members is defined. The project is fully completed. Student contributed partially to finish the work allocated to him/her.	Distribution of workload among the team members is partially defined. The goal of the project is partially achieved. Student contribution to achieve the goal of the project is average.	Distribution of workload among the team members is not well defined. The goal of the project is partially achieved. Student contribution is less to achieve the goal of the project.	Distribution of workload among the team members is not defined. The goal of the project is not achieved. Student does not contribute to achieve the goal of the project.

CIE Assessment Pattern (50 Marks – Lab)

RBT Levels		Review-1	Review-2	Review-3	Report Submission with plagiarism certificate
		60	**60**	**80**	**50**
L1	Remember	-	-	-	
L2	Understand	10	-	-	20
L3	Apply	20	10	20	20
L4	Analyze	20	20	20	10
L5	Evaluate	-	10	20	-
L6	Create	10	20	20	-

SEE Assessment Pattern (50 Marks – Lab)

RBT Levels		Exam Marks Distribution (50)
L1	Remember	50
L2	Understand	50
L3	Apply	100
L4	Analyze	50
L5	Evaluate	-
L6	Create	-

OUTCOME BASED EDUCATION

Outcome-based education (OBE) is an educational theory that bases each part of and 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

COURSE OUTCOME

↓

PROGGRAM OUTCOME

↓

PROGRAM EDUCATIONAL OBJECTIVES

↓

DEPARTMENTAL MISSION

↓

DEPARTMENTAL VISION

APPENDIX B

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.

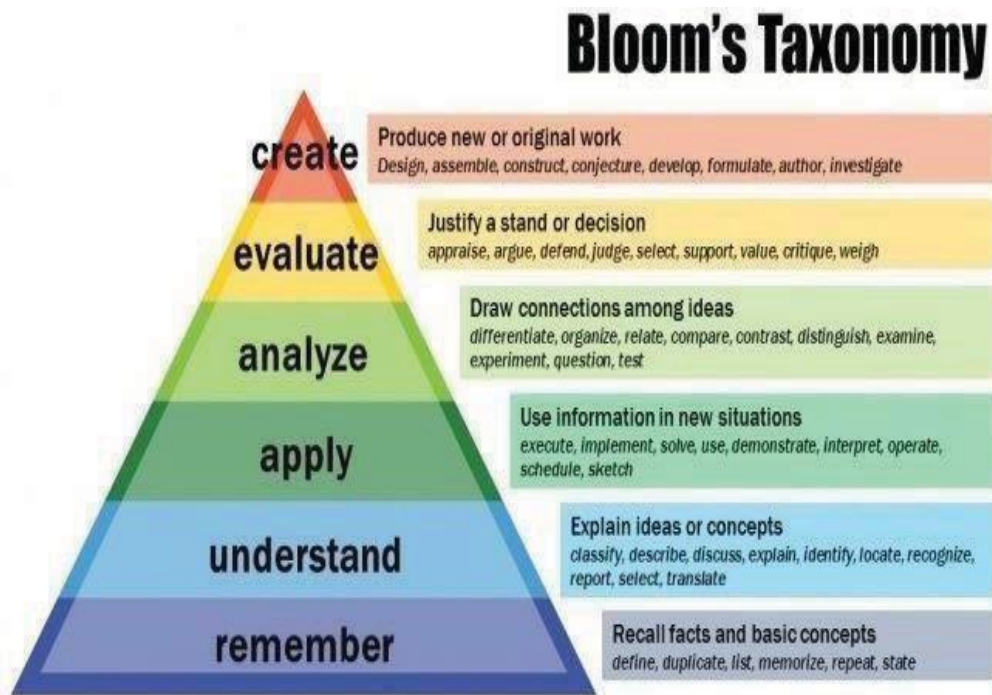**Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multi-disciplinary environments.

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 C

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.

Bloom's Taxonomy

create — Produce new or original work
Design, assemble, construct, conjecture, develop, formulate, author, investigate

evaluate — Justify a stand or decision
appraise, argue, defend, judge, select, support, value, critique, weigh

analyze — Draw connections among ideas
differentiate, organize, relate, compare, contrast, distinguish, examine, experiment, question, test

apply — Use information in new situations
execute, implement, solve, use, demonstrate, interpret, operate, schedule, sketch

understand — Explain ideas or concepts
classify, describe, discuss, explain, identify, locate, recognize, report, select, translate

remember — Recall facts and basic concepts
define, duplicate, list, memorize, repeat, state

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