MOOGAMBIGAI CHARITABLE AND EDUCATIONAL TRUST

RAJARAJESWARI COLLEGE OF ENGINEERING

An Autonomous Institution

Under VTU, Approved by AICTE, UGC & GoK

No. 14, Ramohalli Cross, Kumbalagodu, Mysore Road, Bengaluru

CSE, ECE, ISE

SCHEME & SYLLABUS

UG PROGRAM

DEPARTMENT OF CSE (IC)

3rd and 4th Semester

Academic Year 2025-26

(2024 Scheme)

www.rrce.org

MOOGAMBIGAI CHARITABLE AND EDUCATIONAL TRUST

Rajarajeswari College of Engineering

(An Autonomous Institution under Visvesvaraya Technological University, Belagavi)
#14, Ramohalli Cross, Kumbalagodu, Mysore Road, Bengaluru–560074

Computer Science & Engineering

[IoT, Cybersecurity including Blockchain Technology]

Bachelor of Engineering (B.E)

Scheme and Syllabus of III & IV Semester

(2024 Scheme)

VISION

To empower young minds through technology, research and innovation, to produce technically competent and socially responsible professionals in higher education.

MISSION

1. To deliver excellence in education through innovative teaching, impactful research, and continuous skill development, preparing students to meet global challenges with technical expertise and ethical responsibility.
2. To foster a transformative learning environment that integrates technology, research and practical experience, empowering students to become skilled professionals and socially conscious leaders.
3. To cultivate a culture of lifelong learning and professional excellence by encouraging creativity, research, and community engagement, equipping students with the skills to thrive in a dynamic world.
4. To provide a holistic educational experience that combines advanced technology, hands-on research, and community-focused learning, shaping students into competent, ethical professionals who contribute positively to society.

QUALITY POLICY

Rajarajeswari College of Engineering is committed to imparting quality technical education that nurtures competent, ethical professionals with global relevance. We ensure academic excellence through a dynamic, outcome-based curriculum, experienced faculty, and cutting-edge infrastructure. Continuous improvement is driven by innovation, research and strong industry collaboration. We foster holistic development and a progressive environment that supports lifelong learning, teamwork, and professional growth.

CORE VALUES

Academic Excellence, Integrity, Innovation, Global Competence, Continuous Improvement.

Computer Science & Engineering
[IoT, Cybersecurity including Blockchain Technology]

DEPARTMENT VISION

To empower students with the knowledge, skills, and ethical values to become pioneer in the dynamic fields of Internet of Things (IoT), Cybersecurity, and Blockchain, driving innovation, securing digital ecosystems, and shaping a trusted, decentralized future.

DEPARTMENT MISSION

To guide the education, Design & innovation in IoT, Cybersecurity, and Blockchain technology, preparing the next generation of engineers to make significant contributions to the society.

PROGRAM OUTCOMES (POs)

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

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

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

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

PO5: Engineering Tool Usage: Create, select and apply appropriate techniques, resources and modern engineering & IT tools, including prediction and modeling recognizing their limitations to solve complex engineering problems. (WK2 and WK6)

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

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

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

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

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

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

PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

PEO1: Skills-Graduates will exhibit a strong foundation in IoT, Cybersecurity, and Blockchain Technology, applying their knowledge to develop innovative solutions to real-world problems.

PEO2: Knowledge-Graduates will demonstrate continuous professional development through advanced studies, certifications, or active participation in professional societies, contributing to their career growth and the advancement of technology.

PEO3: Attitude- Graduates will take on leadership roles and effectively collaborate within multidisciplinary teams, showcasing strong communication, project management, and team-building skills.

PROGRAM SPECIFIC OUTCOMES (PSOs)

PSO1: Graduates will be able to design and implement IoT systems that integrate various sensors, actuators, and communication networks to solve real-world problems.

PSO2: Graduates will be proficient in implementing cybersecurity measures to protect data integrity and privacy in IoT and blockchain systems.

PSO3: Graduates will demonstrate the ability to work collaboratively in interdisciplinary teams to develop comprehensive IoT and cybersecurity solutions.

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MOOGAMBIGAI CHARITABLE AND EDUCATIONAL TRUST

Rajarajeswari College of Engineering

(An Autonomous Institution under Visvesvaraya Technological University, Belagavi)

Department of Computer Science & Engineering

[IoT, Cybersecurity including Blockchain Technology]

Scheme of Teaching and Examinations – 2024

(Effective from the Academic Year 2025-26)

Semester: III

S.No	Course Category and Course Code		Course Title	TD / PSB	Teaching Hours / Week & Credits					Examination			
					Lecture	Tutorial	Practical	SDA	Credits	CIE Marks	SEE Duration Hrs	SEE Marks	Total Marks
					L	T	P	S					
1.	BSC	B24MC301	Mathematics III for CS (Common to CSE, ISE, AIML, CSE(IC), CSD)	Maths	**3**	**0**	**0**	**0**	**3**	**50**	**3**	**50**	**100**
2.	PCC	B24CS302	Data Structures and its Applications (Common to CSE, ISE, AIML, CSE(IC), CSD)	CSE	**3**	**0**	**0**	**0**	**3**	**50**	**3**	**50**	**100**
3.	IPCC	B24CS303	Digital Design and Computer Organization (Common to CSE, ISE, AIML, CSE(IC), CSD)	AIML	**3**	**0**	**2**	**0**	**4**	**50**	**3**	**50**	**100**
4.	IPCC	B24CS304	Operating Systems (Common to CSE, ISE, AIML, CSE(IC), CSD)	ISE	**3**	**0**	**2**	**0**	**4**	**50**	**3**	**50**	**100**
5.	PCCL	B24CS305L	Data Structures and its applications Lab (Common to CSE, ISE, AIML, CSE(IC), CSD)	CSE	**0**	**0**	**2**	**0**	**1**	**50**	**3**	**50**	**100**
6.	ESC	B24YY36X	ESC/ETC/PLC - III	AI/CS/IS/IC/CG	**3**	**0**	**0**	**0**	**3**	**50**	**3**	**50**	**100**
7.	UHV	B24SCK307	Social Connect and Responsibility	Any Dept.	**0**	**0**	**2**	**0**	**1**	**50**	**3**	**50**	**100**
8.	AEC/ SEC	B24YY38X	Ability Enhancement Course / Skill Enhancement Course – III (Theory/Lab)	AI/CS/IS/IC/CG	**1** **0**	**0** **0**	**0** **2**	**0**	**1**	**50**	**1** **3**	**50**	**100**
9.	NCMC	B24NCK39X	National Service Scheme / National Cadet Corps / Physical Education / Yoga/ Music	HSMC	**1**	**0**	**0**		**PP**	**50**		**-**	**50**
								TOTAL	**20**	**450**		**400**	**850**

BSC: Basic Science Course, HSMC: Humanity, Social sciences including Management courses, IPCC: Integrated Professional Core Course, PCC: Professional Core Course, PCCL: Professional Core Course laboratory, UHV: Universal Human Value Course, NCMC: Non-Credit Mandatory Course, AEC: Ability Enhancement Course, SEC: Skill Enhancement Course, ESC: Engineering Science Course, ETC: Emerging Technology Course, PLC: Programming Language Course L: Lecture, T: Tutorial, P: Practical S:SDA-Skill Development Activity, CIE: Continuous Internal Evaluation, SEE: Semester End Evaluation, PP/NP: Pass/Not Pass, YY: Programme Code (EC, CS, IS etc), X: 1/2/3/4**,** K: Indicates Common Course to all the streams of Engineering

Engineering Science Course /Emerging Technology Course / Programming Language Course (ESC/ETC/PLC) - III			
B24IC361	Fundamentals of Blockchain	B24IC362	Object Oriented Programming with C++
B24IC363	Foundation of Cyber Security	B24AI364	Web Technologies (All branches)

Ability Enhancement Course / Skill Enhancement Course (AEC/SEC) – III			
B24IC381	Cyber Law	B24IC382	Unix Shell Programming
B24IC383	Cyber Security Laboratory	B24IC384	Data Visualization with Python

Non Credit Mandatory Courses (NCMC)			
B24NCK391	National Service Scheme (NSS)	B24NCK392	National Cadet Corps (NCC)
B24NCK393	Physical Education (PE)	B24NCK394	Yoga
B24NCK395	Music		

All students have to register for any one of the courses namely National Service Scheme (NSS), Physical Education (PE), National Cadet Corps (NCC), Music and Yoga (YOG) with the concerned coordinator of the course during the first week of III/IV/V/VI semesters. Colleges are required to submit the Continuous Internal Evaluation (CIE) marks for the activities completed by students under selected course each semester. The students should be allowed to engage in different activities/courses each semester. For example, a student who participates in sports in the 3rd semester could choose to undertake NSS in the next semester and Yoga in another semester. This approach aligns with the student-centric focus of the National Education Policy (NEP) 2022 and helps distribute the workload related Physical Education/NSS/Yoga/NCC/Music of more evenly across different departments. Activities shall be carried out between III semester to the VI semester (for 4 semesters). Successful completion of the registered course and requisite CIE score is mandatory for the award of the degree. The events shall be appropriately scheduled by the colleges and the same shall be reflected in the calendar prepared for the NSS, PE, and Yoga activities. **These courses shall not be considered for vertical progression as well as for the calculation of SGPA and CGPA, but completion of the course is mandatory for the award of degree.**

HoD **Dean-Academics** **Principal**

Semester: IV

S.No	Course Category and Course Code		Course Title	TD / PSB	Teaching Hours / Week & Credits					Examination			
					Lecture	Tutorial	Practical	SDA	Credits	CIE Marks	SEE Duration Hrs	SEE Marks	Total Marks
					L	T	P	S					
1.	PCC	B24IC401	Microcontroller and Embedded Systems	CSE[IC]	3	0	0	0	3	50	3	50	100
2.	PCC	B24CS402	Database Management Systems (Common to CSE, ISE, AIML, CSE(IC), CSD)	CSE	3	0	0	0	3	50	3	50	100
3.	IPCC	B24IC403	Web Application Security	CSE[IC]	3	0	2	0	4	50	3	50	100
4.	IPCC	B24CS404	Design and Analysis of Algorithms (Common to CSE, ISE, AIML, CSE(IC), CSD)	CG	3	0	2	0	4	50	3	50	100
5.	PCCL	B24CS405L	Database Management Systems Lab (Common to CSE, ISE, AIML, CSE(IC), CSD)	CSE	0	0	2	0	1	50	3	50	100
6.	ESC	B24YY46X	ESC/ETC/PLC - IV	AI/CS/IS/IC/CG	3	0	0	0	3	50	3	50	100
7.	UHV	B24UHK407	Universal Human values	Any Dept.	1	0	0	0	1	50	1	50	100
8.	AEC/ SEC	B24YY48X	Ability Enhancement Course / Skill Enhancement Course – III (Theory/Lab)	AI/CS/IS/IC/CG	1 0	0 0	0 2	0	1	50	1 3	50	100
9.	NCMC	B24NCK49X	National Service Scheme / National Cadet Corps / Physical Education / Yoga / Music	HSMC	1	0	0		PP	50		-	50
								TOTAL	20	450		400	850

BSC: Basic Science Course, HSMC: Humanity, Social sciences including Management courses, IPCC: Integrated Professional Core Course, PCC: Professional Core Course, PCCL: Professional Core Course laboratory, UHV: Universal Human Value Course, NCMC: Non-Credit Mandatory Course, AEC: Ability Enhancement Course, SEC: Skill Enhancement Course, ESC: Engineering Science Course, ETC: Emerging Technology Course, PLC: Programming Language Course L: Lecture, T: Tutorial, P: Practical S:SDA-Skill Development Activity, CIE: Continuous Internal Evaluation, SEE: Semester End Evaluation, PP/NP: Pass/Not Pass, YY: Programme Code (EC, CS, IS etc), X: 1/2/3/4, K: Indicates Common Course to all the streams of Engineering

Engineering Science Course /Emerging Technology Course / Programming language Course (ESC/ETC/PLC) - IV			
B24AI461	Discrete Mathematics with Graph Theory	B24IC462	Optimization Techniques
B24IC463	Foundations of Ethical Hacking	B24IC464	Foundations of Data Science

Ability Enhancement Course / Skill Enhancement Course (AEC/SEC) – IV			
B24IS481	Microsoft Power BI	B24CS482	DevOps
B24IC483	Data Science Laboratory	B24IC484	Embedded System and IoT

Non Credit Mandatory Courses (NCMC)			
B24NCK491	National Service Scheme (NSS)	B24NCK492	National Cadet Corps (NCC)
B24NCK493	Physical Education (PE)	B24NCK494	Yoga
B24NCK495	Music		

All students have to register for any one of the courses namely National Service Scheme (NSS), Physical Education (PE), National Cadet Corps (NCC), Music and Yoga (YOG) with the concerned coordinator of the course during the first week of III/IV/V/VI semesters. Colleges are required to submit the Continuous Internal Evaluation (CIE) marks for the activities completed by students under selected course each semester. The students should be allowed to engage in different activities/courses each semester. For example, a student who participates in sports in the 3rd semester could choose to undertake NSS in the next semester and Yoga in another semester. This approach aligns with the student-centric focus of the National Education Policy (NEP) 2022 and helps distribute the workload related Physical Education/NSS/Yoga/NCC/Music of more evenly across different departments. Activities shall be carried out between III semester to the VI semester (for 4 semesters). Successful completion of the registered course and requisite CIE score is mandatory for the award of the degree. The events shall be appropriately scheduled by the colleges and the same shall be reflected in the calendar prepared for the NSS, PE, and Yoga activities. **These courses shall not be considered for vertical progression as well as for the calculation of SGPA and CGPA, but completion of the course is mandatory for the award of degree.**

HoD **Dean-Academics** **Principal**

III - Semester Syllabus

SEMESTER-III					
MATHEMATICS-III FOR CS **Category: BSC** **(Common to CSE/ISE/AIML/CSE(IC)/CSD)**					
Course Code	:	B24MC301	CIE	:	50 Marks
Teaching Hours L : T : P	:	3:0:0	SEE	:	50 Marks
Total Hours	:	45(T)	Total	:	100 Marks
Credits	:	3	SEE Duration	:	3 Hrs

Course Objectives	
1.	To introduce the concept of random variables, probability distributions, specific discrete and continuous distributions with practical application in Computer Science Engineering and social life situations.
2.	To understand and analyze the probabilistic relationship between multiple random variables and determining relationships like co-variance and correlation.
3.	To Provide the principles of statistical inferences and the basics of hypothesis testing with emphasis on some commonly encountered hypotheses.
4.	To Determine whether an input has a statistically significant effect on the system's response through ANOVA testing.

Module-1: Probability Distributions	**No. of Hours**
Review of basic probability theory. Random variables (discrete and continuous), probability mass and density functions. Mathematical expectation, mean and variance. Binomial, Poisson and normal distributions- problems (derivations for mean and standard deviation for Binomial and Poisson distributions only)-Illustrative examples. Exponential distribution.	9
Module-2: Joint probability distribution & Markov Chain	**No. of Hours**
Joint Probability distribution for two discrete random variables, expectation, covariance and correlation. Markov Chain: Introduction to Stochastic Process, Probability Vectors, Stochastic matrices, Regular stochastic matrices, Markov chains, Higher transition probabilities, Stationary distribution of Regular Markov chains and absorbing states.	9
Module-3: Statistical Inference 1	**No. of Hours**
Introduction, sampling distribution, standard error, testing of hypothesis, levels of significance,test of significances, confidence limits, simple sampling of attributes, test of significance for large samples, comparison of large samples.	9
Module-4 :Statistical Inference 2	**No. of Hours**
Sampling variables, central limit theorem and confidences limit for unknown mean. Test of Significance for means of two small samples, students distribution, Chi-square distribution as a test of goodness of fit. F-Distribution.	9
Module-5 :Design of Experiments & ANOVA	**No. of Hours**
Principles of experimentation in design, Analysis of completely randomized design, randomized block design. The ANOVA Technique, Basic Principle of ANOVA, One-way ANOVA, Two-way ANOVA, Latin-square Design, and Analysis of Co-Variance.	9

Course Outcomes: At the end of the course, the students will be able to	
CO1	Explain the basic concepts of probability, random variables, probability distribution.
CO2	Apply suitable probability distribution models for the given scenario.
CO3	Apply the notion of a discrete-time Markov chain and n-step transition probabilities to solve the given problem.
CO4	Use statistical methodology and tools in the engineering problem-solving process and compute the confidence intervals for the mean of the population.
CO5	Compute the confidence intervals for the mean of the population. Apply the ANOVA test related to engineering problems.

Text Books	
1.	Ronald E. Walpole, Raymond H Myers, Sharon L Myers & Keying Ye "Probability & Statistics for Engineers & Scientists", Pearson Education, 9th edition, 2017.
2.	Peter Bruce, Andrew Bruce & Peter Gedeck "Practical Statistics for Data Scientists" O'Reilly Media, Inc., 2nd edition 2020.

Reference Text Books	
1.	Erwin Kreyszig, "Advanced Engineering Mathematics", John Wiley & Sons, 9th Edition, 2006.
2.	B. S. Grewal "Higher Engineering Mathematics", Khanna publishers, 44th Edition, 2021.
3.	G Haribaskaran "Probability, Queuing Theory & Reliability Engineering", Laxmi Publication, Latest Edition, 2006

Web links and Video lectures (e-Resources)

1. https://nptel.ac.in/courses/12286025
2. VTU EDUSAT PROGRAMME – 20
3. http://www.class-central.com/subject/math(MOOCs)

ASSESSMENT DETAILS BOTH (CIE AND SEE)

The weightage of continuous Internal Evaluation (CIE) is 50% and for the Semester End Examination (SEE) is 50%. The minimum passing mark for the CIE is 40% of maximum marks (20 marks out of 50). The minimum passing mark for SEE is 35% of maximum marks (18 marks out of 50). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each course. Student has to secure a minimum 40% (40 marks out of 100) in the total of the CIE and SEE together.

CONTINUOUS INTERNAL EVALUATION (CIE)

CIE FOR THE THEORY:

1. Three tests each of 50 marks, after the completion of the syllabus 40%, 70% and 100% respectively.
2. Average of best two internal assessment tests each of 50 marks, scale down to 30 marks.
3. Any two assessment methods as per regulations i.e. Two assignments / Two Quizzes/ Weekly test / project work for 40 marks, scaled down to 20 marks.
4. Total marks scored (30+20 = 50 marks).
5. The minimum passing mark for the CIE is 40% of maximum marks (20 marks out of 50).

SEMESTER END EXAMINATION (SEE)

1. The question paper shall be set for 100 marks and duration of SEE is 3 hours.
2. The question paper will have two parts: Part-A and Part-B.
3. **Part-A** should contain minimum **Two or Four** quiz questions from each module of 02 marks/ 01 marks each. **Part-A is Compulsory** and it carries 20 Marks.
4. **Part-B** contains total 10 questions.
5. Two questions of 16 marks (with minimum of 3 sub questions) from each module with internal choice.
6. Students should answer five full questions, selecting one full question from each module.
7. Question papers to be set as per the Blooms Taxonomy levels.

CO-PO Mapping

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO8	PO11
CO1	3	3	2	1	-	-	-	-	1	-	2
CO2	3	3	2	1	-	-	-	-	1	-	2
CO3	3	3	2	1	-	-	-	-	1	-	2
CO4	3	3	2	1	-	-	-	-	1	-	2
CO5	3	3	2	1	-	-	-	-	1	-	2

Level 3 - High, Level 2 - Moderate, Level 1 – Low

SEMESTER-III					
DATA STRUCTURES AND ITS APPLICATIONS **Category: PCC** **(Common to CSE, ISE, AIML, CSE(IC), CSD)**					
Course Code	:	B24CS302	CIE	:	50 Marks
Teaching Hours L : T : P	:	3:0:0	SEE	:	50 Marks
Total Hours	:	45(T)	Total	:	100 Marks
Credits	:	3	SEE Duration	:	3 Hrs

Course Objectives	
1.	Explain fundamentals of data structures and their applications essential for programming/problem solving.
2.	Apply stack, Queue and recursion operations to solve real world problems.
3.	Illustrate linear representation of data structures: Stack, Queues, Lists, Trees and Graphs.
4.	Demonstrate sorting and searching algorithms.
5.	Find suitable data structure during application development/Problem Solving.

Module – 1: Introduction	**No. of Hours**
Introduction: Data Structures, Classifications (Primitive & Non Primitive), Data structure Operations, Review of Arrays, Structures, Self-Referential Structures, and Unions. Pointers and Dynamic Memory Allocation Functions. Representation of Linear Arrays in Memory, Dynamically allocated arrays. Array Operations: Traversing, inserting, deleting, searching, and sorting. Multidimensional Arrays, Polynomials and Sparse Matrices. Strings: Basic Terminology, Storing, Operations and Pattern Matching algorithms. Programming Examples.	9
Module – 2: Stacks, Queues and Recursion	**No. of Hours**
Stacks: Definition, Stack Operations, Array Representation of Stacks, Stacks using Dynamic Arrays, Stack Applications: Polish notation, Infix to postfix conversion, evaluation of postfix expression. Recursion - Factorial, GCD, Fibonacci Sequence, Tower of Hanoi, Ackerman's function. Queues: Definition, Array Representation, Queue Operations, Circular Queues, Circular queues using Dynamic arrays, Dequeues, Priority Queues, A Mazing Problem. Multiple Stacks and Queues. Programming Examples.	9
Module – 3: Linked Lists	**No. of Hours**
Linked Lists: Definition, Representation of linked lists in Memory, Memory allocation; Garbage Collection. Linked list operations: Traversing, Searching, Insertion, and Deletion. Doubly Linked lists, Circular linked lists, and header linked lists. Linked Stacks and Queues. Applications of Linked lists – Polynomials, Sparse matrix representation. Programming Examples	9
Module – 4: Trees	**No. of Hours**
Trees: Terminology, Binary Trees, Properties of Binary trees, Array and linked Representation of Binary Trees, Binary Tree Traversals - Inorder, postorder, preorder; Additional Binary tree operations. Threaded binary trees, Binary Search Trees – Definition, Insertion, Deletion, Traversal, Searching, Application of Trees-Evaluation of Expression, Programming Examples	9
Module – 5 Graphs	**No. of Hours**
Graphs: Definitions, Terminologies, Matrix and Adjacency List Representation Of Graphs, Elementary Graph operations, Traversal methods: Breadth First Search and Depth First Search. Sorting and Searching: Insertion Sort, Radix sort, Address Calculation Sort. Hashing: Hash Table organizations, Hashing Functions, Static and Dynamic Hashing. Files and Their Organization: Data Hierarchy, File Attributes, Text Files and Binary Files, Basic File Operations, File Organizations and Indexing	9

Course Outcomes: At the end of the course, the students will be able to	
CO1	Use different types of data structures, operations and algorithms
CO2	Apply searching and sorting operations on files
CO3	Use stack, Queue, Lists, Trees and Graphs in problem solving
CO4	Implement all data structures in a high-level language for problem solving.
CO5	Identify the alternative implementations of data structure to solve real world problems

Text Books	
1.	Ellis Horowitz and Sartaj Sahni, Fundamentals of Data Structures in C, 2nd Edition, Universities Press, 2014.
2.	Seymour Lipschutz, Data Structures Schaum's Outlines, Revised 1st Edition, McGraw Hill, 2014.

Reference Text Books	
1.	Gilberg & Forouzan, Data Structures: A Pseudo-code approach with C, 2nd Ed, Cengage Learning, 2014.
2.	Reema Thareja, Data Structures using C, 3rd edition, Oxford press, 2012.
3.	Jean-Paul Tremblay & Paul G. Sorenson, An Introduction to Data Structures with Applications, 2nd Edition, McGraw Hill, 2013

ASSESSMENT DETAILS BOTH (CIE AND SEE)

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CO2	2	2	-	1	1	1	-	1	-	2	2
CO3	1	1	-	1	1	-	-	1	-	2	1
CO4	1	1	-	1	1	1	-	1	-	1	1
CO5	1	1	-	1	1	-	-	1	-	1	1

Level 3 - High, Level 2 - Moderate, Level 1 - Low

SEMESTER-III					
DIGITAL DESIGN AND COMPUTER ORGANIZATION **Category: IPCC** **(Common to CSE, ISE, AIML, CSE(IC), CSD)**					
Course Code	:	B24CS303	CIE	:	50 Marks
Teaching Hours L : T : P	:	3:0:2	SEE	:	50 Marks
Total Hours	:	45(T)+15(P)	Total	:	100 Marks
Credits	:	4	SEE Duration	:	3 Hrs

Course Objectives	
1.	To demonstrate the functionalities of binary logic system
2.	To explain the working of combinational and sequential logic system
3.	To realize HDL Verilog programmes
4.	To realize the basic structure of computer system
5.	To illustrate the working of I/O operations and processing unit

Module – 1: Introduction to Digital Design	**No. of Hours**
Binary Logic, Basic Theorems And Properties Of Boolean Algebra, Boolean Functions, Digital Logic Gates, Introduction, The Map Method, Four-Variable Map, Don't-Care Conditions, NAND and NOR Implementation, Other Hardware Description Language – Verilog Model of a simple circuit. Text book 1: 1.9, 2.4, 2.5, 2.8, 3.1, 3.2, 3.3, 3.5, 3.6, 3.9	9
Module – 2: Combinational Logic	**No. of Hours**
Introduction, Combinational Circuits, Design Procedure, Binary Adder- Subtractor, Decoders, Encoders, Multiplexers. HDL Models of Combinational Circuits – Adder, Multiplexer, Encoder. Sequential Logic: Introduction, Sequential Circuits, Storage Elements: Latches, Flip-Flops. Text book 1: 4.1, 4.2, 4.4, 4.5, 4.9, 4.10, 4.11, 4.12, 5.1, 5.2, 5.3, 5.4.	9
Module – 3: Basic Structure of Computers	**No. of Hours**
Functional Units, Basic Operational Concepts, Bus structure, Performance – Processor Clock, Basic Performance Equation, Clock Rate, Performance Measurement. Machine Instructions and Programs: Memory Location and Addresses, Memory Operations, Instruction and Instruction sequencing, Addressing Modes. Text book 2: 1.2, 1.3, 1.4, 1.6, 2.2, 2.3, 2.4, 2.5	9
Module – 4: Input/output Organization	**No. of Hours**
Accessing I/O Devices, Interrupts – Interrupt Hardware, Enabling and Disabling Interrupts, Handling Multiple Devices, Direct Memory Access: Bus Arbitration, Speed, size and Cost of memory systems. Cache Memories – Mapping Functions. Text book 2: 4.1, 4.2.1, 4.2.2, 4.2.3, 4.4, 5.4, 5. 5.	9
Module – 5: Basic Processing Unit	**No. of Hours**
Some Fundamental Concepts: Register Transfers, Performing ALU operations, fetching a word from Memory, Storing a word in memory. Execution of a Complete Instruction. Pipelining: Basic concepts, Role of Cache memory, Pipeline Performance. Text book 2: 7.1, 7.2, 8.1	9

Course Outcomes: At the end of the course, the students will be able to	
CO1	Apply the K–Map techniques to simplify various Boolean expressions.
CO2	Design different types of combinational and sequential circuits along with Verilog programs.
CO3	Describe the fundamentals of machine instructions, addressing modes and Processor performance.
CO4	Explain the approaches involved in achieving communication between processor and I/O devices.
CO5	Analyze internal Organization of Memory and Impact of cache/Pipelining on Processor Performance.

Text Books	
1.	M. Morris Mano & Michael D. Ciletti, Digital Design With an Introduction to Verilog Design, 5th edition, Pearson Education.
2.	Carl Hamacher, ZvonkoVranesic, SafwatZaky, Computer Organization, 5th Edition, Tata McGraw Hill.

Web links and Video lectures (e-Resources):
1. Web links and Video Lectures (e-Resources): https://cse11-iiith.vlabs.ac.in/

ASSESSMENT DETAILS BOTH (CIE AND SEE)

The weightage of continuous Internal Evaluation (CIE) is 50% and for the Semester End Examination (SEE) is 50%. The minimum passing mark for the CIE is 40% of maximum marks (20 marks out of 50). The minimum passing mark for SEE is 35% of maximum marks (18 marks out of 50). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each course. Student has to secure a minimum 40% (40 marks out of 100) in the total of the CIE and SEE together.

The CIE marks for the theory component of the Integrated Course (IC) shall be 30 marks and for the laboratory component 20 marks.

CONTINUOUS INTERNAL EVALUATION (CIE)

CIE FOR THE THEORY COMPONENT OF IC:

1. Three tests each of 50 marks, after the completion of the syllabus 40%, 70% and 100% respectively.
2. Average of best two internal assessment tests each of 50 marks, scale down to 30 marks.
3. Any two assessment methods as per regulations i.e. Two assignments / Two Quizzes / Weekly test / project work for (20+20) marks, scaled down to **20 marks.**
4. Total marks scored **(30+20 = 50 marks)** scaled down to **25.**

CIE FOR THE PRACTICAL COMPONENT OF IC:

1. On completion of every experiment / program in the laboratory, the students shall be evaluated and marks shall be awarded on the same day.
2. Each experiment is evaluated for 10 marks and scaled down to **5 marks.**
3. Laboratory test at the end of the 15th week of the semester / after completion of all the experiments shall be conducted for **50 marks** and scaled down to **20 marks.**
4. Total marks scored for lab component: **05+20=25 marks**.
5. The minimum marks to be secured in CIE to appear for SEE shall be 10(40% of maximum marks 25) in the theory and 10(40% of Maximum marks 25) in the practical.
6. The laboratory component of the **integrated course** shall be CIE only. However, in SEE, the questions from the practical component shall be included.

Theory				
IA Test	**Exam conducted for**	**Scaled down to**	**Average of best two tests**	**Total**
IA-1	**50**	**30**	**30**	**50/2=25**
IA-2	**50**	**30**		
IA-3	**50**	**30**		
Two Assignments	**2×10=20**	**10**	**10**	
Two Quizzes	**2×10=20**	**10**	**10**	

LAB			
Continuous performance and record writing	**Each experiments evaluated for 10 marks**	**Scaled down to 05 marks**	**5+20=25**
Internal Test + Viva voce	**Exam conducted for 50 marks**	**Scaled down to 20 marks**	

SEMESTER END EXAMINATION (SEE)

1. The question paper shall be set for 100 marks and duration of SEE is 3 hours.
2. The question paper will have two parts: Part-A and Part-B.
3. **Part-A** should contain minimum **Two or Four** quiz questions from each module of 02 marks/ 01 marks each. **Part-A is Compulsory** and carries 20 Marks.
4. **Part-B** contains total 10 questions. Two questions of 16 marks (with minimum of 3 sub questions) from each module with internal choice. Students should answer five full questions, selecting one full question from each module.
5. Students have to answer for 100 marks and marks scored out of 100 shall be proportionally reduced to 50 marks.
6. The maximum marks from the practical component to be included in the SEE question paper is **16 marks.**
7. Question papers to be set as per the Blooms Taxonomy levels.

LABORATORY

Practical Component of IPCC (10 Experiments)

Sl. No	Name of the experiments
1.	Given a 4-variable logic expression, simplify it using appropriate technique and simulate the same using basic gates.
2.	Design a 4 bit full adder and subtractor and simulate the same using basic gates.
3.	Design a 2 bit half adder and subtractor and simulate the same using NAND and NOR gates
4.	Given a 4-variable logic expression, simplify it using appropriate technique and simulate the same using Verilog HDL
5.	Design Verilog HDL to implement simple circuits using structural, Data flow and Behavioural model.
6.	Design Verilog HDL to implement Binary Adder-Subtractor – Half and Full Adder, Half and Full Subtractor.
7.	Design Verilog HDL to implement Decimal adder.
8.	Design Verilog program to implement Different types of multiplexer like 2:1, 4:1 and 8:1.
9.	Design Verilog program to implement types of De-Multiplexer.
10.	Design Verilog program for implementing various types of Flip-Flops such as SR, JK and D.

CO-PO Mapping

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	1	-	-	-	3	1	-	-	1	2
CO2	2	2	-	-	-	2	1	-	-	2	2
CO3	1	1	-	-	-	1	2	-	-	2	1
CO4	1	1	-	-	-	1	2	-	-	1	1
CO5	1	1	-	-	-	1	2	-	-	1	1

Level 3 - High, Level 2 - Moderate, Level 1 - Low

SEMESTER-III					
OPERATING SYSTEMS **Category: IPCC** **(Common to CSE, ISE, AIML, CSE(IC), CSD)**					
Course Code	:	B24CS304	CIE	:	50 Marks
Teaching Hours L : T : P:S	:	3:0:2	SEE	:	50 Marks
Total Hours	:	45 (T) + 15 (P)	Total	:	100 Marks
Credits	:	4	SEE Duration	:	3 Hrs

Course Objectives	
1.	Introduce the fundamental concepts of operating systems, their functions, and types.
2.	Explain process management, scheduling algorithms, and inter-process communication.
3.	Describe memory management techniques, including paging, segmentation, and virtual memory.
4.	Illustrate file systems, storage management, and input-output operations.
5.	Explore synchronization mechanisms, deadlocks, and security aspects in operating systems.
6.	Provide insights into modern operating systems such as Linux, Windows, and mobile OS.

Module – 1: Introduction to Operating Systems	**No. of Hours**
Definition, Purpose, and Evolution of Operating Systems, Types of Operating Systems: Batch, Time-Sharing, Distributed, Real-Time, and Mobile OS, Operating System Structure: Monolithic, Layered, Microkernel, and Hybrid, System Calls and Operating System Services	9
Module – 2: Process Management & CPU Scheduling	**No. of Hours**
Processes: Concept, Process Control Block (PCB), Process States, Threads: Single vs. Multi-threading, User vs. Kernel Threads, CPU Scheduling: Scheduling Criteria, Preemptive & Non-preemptive Scheduling, Scheduling Algorithms: FCFS, SJF, Priority Scheduling, Round Robin, Multi-Level Queue Scheduling, Inter process Communication (IPC) and Synchronization, Deadlocks: Detection, Prevention, Avoidance (Banker's Algorithm), Recovery	9
Module – 3: Memory Management	**No. of Hours**
Memory Allocation: Contiguous & Non-Contiguous Allocation, Paging and Segmentation, Virtual Memory: Demand Paging, Page Replacement Algorithms (FIFO, LRU, Optimal), Thrashing and Working Set Model	9
Module – 4: File System & Storage Management	**No. of Hours**
File Concepts: File Attributes, File Types, File Access Methods, File System Structure: Directory Structure, File Allocation Methods (Contiguous, Linked, Indexed), Disk Scheduling Algorithms: FCFS, SSTF, SCAN, C-SCAN, LOOK, File Protection & Security	9
Module – 5: I/O Systems, Security, and Case Studies	**No. of Hours**
I/O Hardware, Device Drivers, Interrupt Handling, Security and Protection in Operating Systems, Authentication and Access Control Mechanisms, Case Study: UNIX/Linux, Windows, Android Operating System	9

Course Outcomes: At the end of the course, the students will be able to	
CO1	Understand the basic structure, functionalities, and design principles of an operating system.
CO2	Analyze process scheduling techniques and inter-process communication mechanisms.
CO3	Implement memory management techniques such as paging, segmentation, and virtual memory.
CO4	Evaluate file system structures, disk scheduling algorithms, and storage management strategies.
CO5	Apply synchronization techniques to avoid race conditions and deadlocks.

Textbooks	
1.	Abraham Silberschatz, Peter B. Galvin, Greg Gagne-"Operating System Concepts, 10th Edition, Wiley, 2018".
2.	William Stallings – "Operating Systems: Internals and Design Principles, 9th Edition, Pearson, 2018".

Reference Text Books	
1.	Andrew S. Tanenbaum – "Modern Operating Systems, 4th Edition, Pearson, 2015".
2.	Dhananjay M.Dhamdhere –"Operating Systems: A Concept-Based Approach, 3rd Edition, McGraw-Hill, 2017".
3.	Gary Nutt – "Operating Systems, 3rd Edition, Pearson, 2004".

LABORATORY

Practical Component of IPCC (10 Experiments)

Sl. No	Name of the Experiment
1.	Demonstrate how a child process is created using fork() and how it executes a new program using exec()
2.	Create a program where the parent process writes to a pipe and the child reads from it (unidirectional communication).
3.	Use shmget(), shmat(), and semctl() to demonstrate shared memory-based communication between two processes.
4.	Implement both First Come First Serve and Shortest Job First (non-preemptive) scheduling algorithms and compare their performance.
5.	Simulate Round Robin (preemptive) and Priority (non-preemptive or preemptive) scheduling with average time calculations.
6.	Simulate logical to physical address mapping using a page table. Take page number and offset as input.
7.	Demonstrate address translation using segment table consisting of base and limit values.
8.	Simulate a hierarchical file system where users can create, delete, search files and directories (like mkdir, rm, ls).
9.	Simulate the Banker's Algorithm to determine whether a system is in a safe state for resource allocation.
10.	Write a C program that uses system() calls to run shell commands (e.g., list files, view processes) and parse the output for analysis.

ASSESSMENT DETAILS BOTH (CIE AND SEE)

The weightage of continuous Internal Evaluation (CIE) is 50% and for the Semester End Examination (SEE) is 50%. The minimum passing mark for the CIE is 40% of maximum marks (20 marks out of 50). The minimum passing mark for SEE is 35% of maximum marks (18 marks out of 50). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each course. Student has to secure a minimum 40% (40 marks out of 100) in the total of the CIE and SEE together.

The CIE marks for the theory component of the Integrated Course (IC) shall be 30 marks and for the laboratory component 20 marks.

CONTINUOUS INTERNAL EVALUATION (CIE)

CIE FOR THE THEORY COMPONENT OF IC:

1. Three tests each of 50 marks, after the completion of the syllabus 40%, 70% and 100% respectively.
2. Average of best two internal assessment tests each of 50 marks, scale down to 30 marks.
3. Any two assessment methods as per regulations i.e. Two assignments / Two Quizzes / Weekly test / project work for (20+20) marks, scaled down to **20 marks.**
4. Total marks scored **(30+20 = 50 marks)** scaled down to **25.**

CIE FOR THE PRACTICAL COMPONENT OF IC:

1. On completion of every experiment / program in the laboratory, the students shall be evaluated and marks shall be awarded on the same day.
2. Each experiment is evaluated for 10 marks and scaled down to **5 marks.**
3. Laboratory test at the end of the 15th week of the semester / after completion of all the experiments shall be conducted for **50 marks** and scaled down to **20 marks.**
4. Total marks scored for lab component: **05+20=25 marks**.
5. The minimum marks to be secured in CIE to appear for SEE shall be 10(40% of maximum marks 25) in the theory and 10(40% of Maximum marks 25) in the practical.
6. The laboratory component of the **integrated course** shall be CIE only. However, in SEE, the questions from the practical component shall be included.

Theory				
IA Test	**Exam conducted for**	**Scaled down to**	**Average of best two tests**	**Total**
IA-1	**50**	**30**	**30**	**50/2=25**
IA-2	**50**	**30**		
IA-3	**50**	**30**		
Two Assignments	**2×10=20**	**10**	**10**	
Two Quizzes	**2×10=20**	**10**	**10**	

LAB			
Continuous performance and record writing	**Each experiments evaluated for 10 marks**	**Scaled down to 05 marks**	**5+20=25**
Internal Test + Viva voce	**Exam conducted for 50 marks**	**Scaled down to 20 marks**	

SEMESTER END EXAMINATION (SEE)

1. The question paper shall be set for 100 marks and duration of SEE is 3 hours.
2. The question paper will have two parts: Part-A and Part-B.
3. **Part-A** should contain minimum **Two or Four** quiz questions from each module of 02 marks/ 01 marks each. **Part-A is Compulsory** and carries 20 Marks.
4. **Part-B** contains total 10 questions. Two questions of 16 marks (with minimum of 3 sub questions) from each module with internal choice. Students should answer five full questions, selecting one full question from each module.
5. Students have to answer for 100 marks and marks scored out of 100 shall be proportionally reduced to 50 marks.
6. The maximum marks from the practical component to be included in the SEE question paper is **16 marks.**
7. Question papers to be set as per the Blooms Taxonomy levels.

CO-PO Mapping

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	2	1	-	-	-	-	-	-	-	2
CO2	2	1	2	1	3	-	-	-	-	-	1
CO3	2	1	2	1	2	-	-	-	-	-	1
CO4	2	2	-	-	1	-	-	-	-	-	2
CO5	1	1	2	1	-	-	-	-	-	-	1

Level 3 – High, Level 2 – Moderate, Level 1 –Low

SEMESTER-III					
DATA STRUCTURES AND ITS APPLICATIONS LAB **Category: PCCL** **(Common to CSE, ISE, AIML, CSE(IC), CSD)**					
Course Code	:	B24CS305L	CIE	:	50 Marks
Teaching Hours L : T : P	:	0:0:2	SEE	:	50 Marks
Total Hours	:	15(P)	Total	:	100 Marks
Credits	:	1	SEE Duration	:	3 Hrs

Course Objectives	
1.	To implement linear data structures such as arrays, stacks, queues, linked lists
2.	To apply suitable data structures for solving various computational problems effectively and efficiently
3.	To implement nonlinear data structures such as trees, and graphs
4.	Apply nonlinear data structure to provide the solution for the given problem
5.	To familiarize students with file handling and explore applications of data structures in real-world scenarios

SL NO	**NAME OF THE PROGRAM**
1.	Develop a Program in C for the following: a) Declare a calendar as an array of 7 elements (A dynamically Created array) to represent 7 days of a week. Each Element of the array is a structure having three fields. The first field is the name of the Day (A dynamically allocated String), The second field is the date of the Day (A integer), the third field is the description of the activity for a particular day (A dynamically allocated String). b) Write functions create(), read() and display(); to create the calendar, to read the data from the keyboard and to print weeks activity details report on screen.
2.	Develop a Program in C for the following operations on Strings. a. Read a main String (STR), a Pattern String (PAT) and a Replace String (REP) b. Perform Pattern Matching Operation: Find and Replace all occurrences of PAT in STR with REP if PAT exists in STR. Report suitable messages in case PAT does not exist in STR Support the program with functions for each of the above operations. Don't use Built-in functions.
3.	Develop a menu driven Program in C for the following operations on STACK of Integers (Array Implementation of Stack with maximum size MAX) a. Push an Element on to Stack b. Pop an Element from Stack c. Demonstrate how Stack can be used to check Palindrome d. Demonstrate Overflow and Underflow situations on Stack e. Display the status of Stack f. Exit Support the program with appropriate functions for each of the above operations
4.	Develop a Program in C for converting an Infix Expression to Postfix Expression. Program should support for both parenthesized and free parenthesized expressions with the operators: +, -, *, /, % (Remainder), ^ (Power) and alphanumeric operands.
5.	Develop a Program in C for the following Stack Applications a. Evaluation of Suffix expression with single digit operands and operators: +, -, *, /, %,^ .

	b. Solving Tower of Hanoi problem with n disks
6.	Develop a menu driven Program in C for the following operations on Circular QUEUE of Characters (Array Implementation of Queue with maximum size MAX) a. Insert an Element on to Circular QUEUE b. Delete an Element from Circular QUEUE c. Demonstrate Overflow and Underflow situations on Circular QUEUE d. Display the status of Circular QUEUE e. Exit Support the program with appropriate functions for each of the above operations
7.	Develop a menu driven Program in C for the following operations on Singly Linked List (SLL) of Student Data with the fields: USN, Name, Programme, Sem, PhNo a. Create a SLL of N Students Data by using front insertion. b. Display the status of SLL and count the number of nodes in it c. Perform Insertion / Deletion at End of SLL d. Perform Insertion / Deletion at Front of SLL(Demonstration of stack) e. Exit
8.	Develop a menu driven Program in C for the following operations on Doubly Linked List (DLL) of Employee Data with the fields: SSN, Name, Dept, Designation,Sal, PhNo a. Create a DLL of N Employees Data by using end insertion. b. Display the status of DLL and count the number of nodes in it c. Perform Insertion and Deletion at End of DLL d. Perform Insertion and Deletion at Front of DLL e. Demonstrate how this DLL can be used as Double Ended Queue. f. Exit
9.	Develop a Program in C for the following operationson Singly Circular Linked List (SCLL) with header nodes a. Represent and Evaluate a Polynomial P(x,y,z) = 6x2y2z-4yz5+3x3yz+2xy5z-2xyz3 b. Find the sum of two polynomials POLY1(x,y,z) and POLY2(x,y,z) and store the result in POLYSUM(x,y,z) Support the program with appropriate functions for each of the above operations
10.	Develop a menu driven Program in C for the following operations on Binary Search Tree (BST) of Integers . a. Create a BST of N Integers: 6, 9, 5, 2, 8, 15, 24, 14, 7, 8, 5, 2 b. Traverse the BST in Inorder, Preorder and Post Order c. Search the BST for a given element (KEY) and report the appropriate message d. Exit
11.	Develop a Program in C for the following operations on Graph(G) of Cities a. Create a Graph of N cities using Adjacency Matrix.

	b. Print all the nodes reachable from a given starting node in a digraph using DFS/BFS
12.	Given a File of N employee records with a set K of Keys (4-digit) which uniquely determine the records in file F. Assume that file F is maintained in memory by a Hash Table (HT) of m memory locations with L as the set of memory addresses (2-digit) of locations in HT. Let the keys in K and addresses in L are Integers. Develop a Program in C that uses Hash function H: K →L as H(K)=K mod m (remainder method), and implement hashing technique to map a given key K to the address space L. Resolve the collision (if any) using linear probing.

Course Outcomes: At the end of the course, the students will be able to	
CO1	Apply the concepts of pointers and structures in problem solving.
CO2	Use different types of linked lists to solve problems.
CO3	Demonstrate stack and queue data structures to solve problems.
CO4	Illustrate the operations performed on tree data structures, hash functions for problem solving.

ASSESSMENT DETAILS BOTH (CIE AND SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks).

A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

CONTINUOUS INTERNAL EVALUATION (CIE)

Component	Scale down to	Total Marks
Conduction of experiments and Record Writing (Each Experiment evaluated for 10 marks)	20	20
Internal Lab Test 1(After 6 experiments) Exam conduction for 50 marks	15	15
Internal Lab Test 2 (After 6 experiments) Exam conduction for 50 marks	15	15
	CIE	**50**

SEMESTER END EXAMINATION (SEE)

1. SEE marks for the practical course are 50 Marks. Practical examinations are to be conducted between the schedules mentioned in the academic calendar of the Institution.
2. All laboratory experiments are to be included for practical examination.
3. Students can pick one question (experiment) from the questions lot prepared by the examiners.
4. Evaluation of test write-up, conduction procedure, result and viva will be conducted jointly by examiners.
5. Rubrics suggested for SEE, writeup-20%, Conduction procedure and result in -60%, Viva-voce 20% of maximum marks. SEE for practical shall be evaluated for 100 marks and scored marks shall be scaled down to 50 marks.
6. Change of experiment is allowed only once and 15% of Marks allotted to the procedure part are to be made zero. The minimum duration of SEE is 03 hours.

CO-PO Mapping

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	1	-	1	1	-	-	-	-	-	1
CO2	3	1	2	2	1	-	-	-	-	-	-
CO3	3	1	2	1	1	-	-	-	-	-	1
CO4	3	1	-	2	1	-	-	-	-	-	1
CO5	2	1	2	1	2	-	-	-	2	2	-

Level 3 – High, Level 2 – Moderate, Level 1 -Low

SEMESTER-III					
FUNDAMENTALS OF BLOCKCHAIN **Category: ESC/ETC/PLC-III**					
Course Code	:	B24IC361	CIE	:	50 Marks
Teaching Hours L : T : P	:	3:0:0	SEE	:	50 Marks
Total Hours	:	45(T)	Total	:	100 Marks
Credits	:	3	SEE Duration	:	3 Hrs

Course Objectives	
1.	Learn the Basic concepts of Blockchain.
2.	Learn and Illustrate the Crptograpgy method/functions.
3.	Know the various protocols and mining techniques in Block chain.
4.	Learn the concepts of Bit coin mining

Module – 1: Block chain Fundamentals	**No. of Hours**
Tracing Block chain's Origin, Revolutionizing the Traditional Business Network, How Blockchain Works, What Makes a Blockchain Suitable for Business? Introduction to Cryptography: Cryptographic Hash Functions, SHA256, Hash Pointers and Data Structures, Merkle tree.	9
Module – 2: Digital Signatures	**No. of Hours**
Elliptic Curve Digital Signature Algorithm (ECDSA), Public Keys as Identities, A Simple Crypto currency.	9
Module – 3: Centralization vs. Decentralization	**No. of Hours**
Distributed Consensus, Consensus without identity using a block chain, Incentives and proof of work. Mechanics of Bit coin: Bit coin transactions, Bit coin Scripts, Applications of Bit coin scripts, Bit coin blocks, The Bit coin network.	9
Module – 4: Storage of and Usage of Bit coins	**No. of Hours**
Simple Local Storage, Hot and Cold Storage, Splitting and Sharing Keys, Online Wallets and Exchanges, Payment Services, Transaction Fees, Currency Exchange Markets.	9
Module – 5: Bit coin Mining	**No. of Hours**
The Task of Bit coin miners, Mining Hardware, Mining pools, Mining incentives and strategies. Bit coin and Anonymity: Anonymity Basics, Mixing, Zero coin and Zero cash.	9

Course Outcomes: At the end of the course, the students will be able to	
CO1	Understand the basic principles of block chain technology
CO2	Apply cryptographic functions along with their implementation strategies.
CO3	Analyze the various protocols and mining techniques in Block chain
CO4	Analyze the various protocols and mining techniques in Block chain

Text Books	
1.	BlockChain for dummies, Manav Gupta, Second IBM Limited Edition, 2018, John Wiley & Sons
2.	Bitcoin and Cryptocurrency Technologies, Arvind Narayanan, Joseph Bonneau, Edward Felten, Andrew Miller and Steven Goldfeder, 2016

Reference Text Books	
1.	Blockchain: Blueprint for a New Economy,Melanie Swan, 1st edition, 2015, O'Reilly Media.
2.	Bitcoin: Programming the Open Blockchain, Andreas M. Antonopoulos, Mastering, 2nd edition, 2017, O'Reilly Media.

Web links and Video lectures (e-Resources)
1. NPTEL & MOOC courses titled blockchain technology
2. blockgeeks.comguide/what-is-block-chain-technology https://nptel.ac.in/courses/106105184/

ASSESSMENT DETAILS BOTH (CIE AND SEE)

The weightage of continuous Internal Evaluation (CIE) is 50% and for the Semester End Examination (SEE) is 50%. The minimum passing mark for the CIE is 40% of maximum marks (20 marks out of 50). The minimum passing mark for SEE is 35% of maximum marks (18 marks out of 50). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each course. Student has to secure a minimum 40% (40 marks out of 100) in the total of the CIE and SEE together.

CONTINUOUS INTERNAL EVALUATION (CIE)

CIE FOR THE THEORY:

1. Three tests each of 50 marks, after the completion of the syllabus 40%, 70% and 100% respectively.
2. Average of best two internal assessment tests each of 50 marks, scale down to 30 marks.
3. Any two assessment methods as per regulations i.e. Two assignments / Two Quizzes/ Weekly test / project work for 40 marks, scaled down to 20 marks.
4. Total marks scored (30+20 = 50 marks).
5. The minimum passing mark for the CIE is 40% of maximum marks (20 marks out of 50).

SEMESTER END EXAMINATION (SEE)

1. The question paper shall be set for 100 marks and duration of SEE is 3 hours.
2. The question paper will have two parts: Part-A and Part-B.
3. **Part-A** should contain minimum **Two or Four** quiz questions from each module of 02 marks/ 01 marks each. **Part-A is Compulsory** and it carries 20 Marks.
4. **Part-B** contains total 10 questions.
5. Two questions of 16 marks (with minimum of 3 sub questions) from each module with internal choice.
6. Students should answer five full questions, selecting one full question from each module.
7. Question papers to be set as per the Blooms Taxonomy levels.

CO-PO Mapping

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

Level 3 - High, Level 2 - Moderate, Level 1 - Low

SEMESTER-III					
OBJECT ORIENTED PROGRAMMING WITH C++ **Category: ESC/ETC/PLC-III** **(Common to CSE, CSD, CSE(IC))**					
Course Code	:	B24IC362	CIE	:	50 Marks
Teaching Hours L : T : P	:	2:0:2	SEE	:	50 Marks
Total Hours	:	30(T) +15(P)	Total	:	100 Marks
Credits	:	3	SEE Duration	:	3 Hrs

Course Objectives	
1.	To understand object-oriented programming using C++and Gain knowledge about the capability to store information together in an object.
2.	To illustrate the capability of a class to rely upon another class and functions.
3.	To Create and process data in files using file I/O functions
4.	To understand the generic programming features of C++ including Exception handling

Module – 1: An overview of C++	**No. of Hours**
What is object-Oriented Programming? Introducing C++ Classes, The General Form of a C++ Program. **Classes and Objects:** Classes, Friend Functions, Friend Classes, Inline Functions, Parameterized Constructors, Static Class Members, When Constructors and Destructors are Executed, The Scope Resolution Operator, Passing Objects to functions, Returning Objects, Object Assignment	6
Module – 2: Arrays, Pointers, References, and the Dynamic Allocation Operators:	**No. of Hours**
Arrays of Objects, Pointers to Objects, The Pointer, Pointers to derived types, Pointers to class members. **Functions Overloading, Copy Constructors:** Functions Overloading, Overloading Constructor Functions. Copy Constructors, Default Function Arguments, Function Overloading and Ambiguity.	6
Module – 3: Operator Overloading	**No. of Hours**
Creating a Member Operator Function, Operator Overloading Using a Friend Function, Overloading new and delete **Inheritance:** Base-Class Access Control, Inheritance and Protected Members, Inheriting Multiple Base Classes , Constructors, Destructors and Inheritance, Granting Access, Virtual Base Classes	6
Module – 4: Virtual Functions and Polymorphism	**No. of Hours**
Virtual Functions, The Virtual Attribute is Inherited, Virtual Functions are Hierarchical, Pure Virtual Functions, Using Virtual Functions, Early vs Late Binding. **Templates:** Generic Functions, Applying Generic Functions, Generic Classes. The type name and export Keywords. The Power of Templates	6
Module – 5: Exception Handling	**No. of Hours**
Exception Handling Fundamentals, Handling Derived-Class Exceptions, Exception Handling Options, Applying Exception Handling. **The C++ I/O System Basics:** C++ Streams, The C++ Classes, Formatted I/O **File I/O:**<fstream> and File Classes, Opening and Closing a File, Reading and Writing Text Files, Detecting EOF.	6

Course Outcomes: At the end of the course, the students will be able to	
CO1	Illustrate the basic concepts of object-oriented programming.
CO2	Design appropriate classes for the given real world scenario.
CO3	Use the knowledge of inheritance for developing optimized solutions
CO4	Apply the concepts of templates and exception handling for the given problem
CO5	Use the concepts of input output streams for file operations

LABORATORY

Practical Component of IPCC (10 Experiments)

Sl. No.	List of experiments
1.	Develop a C++ program to find the largest of three numbers
2.	Develop a C++ program to sort the elements in ascending and descending order.
3.	Develop a C++ program using classes to display student name, roll number, marks obtained in two subjects and total score of student
4.	Develop a C++ program for a bank empolyee to print name of the employee, account_no. & balance. Print invalid balance if amount<500, Display the same, also display the balance after withdraw and deposit.
5.	Develop a C++ program to demonstrate function overloading for the following prototypes. add(int a, int b) add(double a, double b)
6.	Develop a C++ program using Operator Overloading for overloading Unary minus operator.
7.	Develop a C++ program to implement Multiple inheritance for performing arithmetic operation of two numbers
8.	Develop a C++ program using Constructor in Derived classes to initialize alpha, beta and gamma and display corresponding values.
9.	Develop a C++ program to create a text file, check file created or not, if created it will write some text into the file and then read the text from the file.
10.	Develop a C++ program to write and read time in/from binary file using fstream
11.	Develop a function which throws a division by zero exception and catch it in catch block. Write a C++ program to demonstrate usage of try, catch and throw to handle exception.
12.	Develop a C++ program that handles array out of bounds exception using C++.

Text Books	
1.	Herbert schildt, The Complete Reference C++, 4th edition, TMH, 2005

Reference Text Books	
1.	Balagurusamy E, Object Oriented Programming with C++, Tata McGraw Hill Education Pvt.Ltd., 6th Edition 2016.
2.	Bhave , " Object Oriented Programming With C++", Pearson Education , 2004.
3.	A K Sharma , "Object Oriented Programming with C++", Pearson Education, 2014

Web links and Video lectures (e-Resources)
1. 1. Basics of C++ - https://www.youtube.com/watch?v=BClS40yzssA 2. Functions of C++ - https://www.youtube.com/watch?v=p8ehAjZWjPw 3. https://www.w3schools.com/cpp/cpp_intro.asp 4. https://www.edx.org/course/introduction-to-c-3

ASSESSMENT DETAILS BOTH (CIE AND SEE)

The weightage of continuous Internal Evaluation (CIE) is 50% and for the Semester End Examination (SEE) is 50%. The minimum passing mark for the CIE is 40% of maximum marks (20 marks out of 50). The minimum passing mark for SEE is 35% of maximum marks (18 marks out of 50). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each course. Student has to secure a minimum 40% (40 marks out of 100) in the total of the CIE and SEE together.

The CIE marks for the theory component of the Integrated Course (IC) shall be 30 marks and for the laboratory component 20 marks.

CONTINUOUS INTERNAL EVALUATION (CIE)

CIE FOR THE THEORY COMPONENT OF IC:

1. Three tests each of 50 marks, after the completion of the syllabus 40%, 70% and 100% respectively.
2. Average of best two internal assessment tests each of 50 marks, scale down to 30 marks.
3. Any two assessment methods as per regulations i.e. Two assignments / Two Quizzes / Weekly test / project work for (20+20) marks, scaled down to **20 marks.**
4. Total marks scored **(30+20 = 50 marks)** scaled down to **25.**

CIE FOR THE PRACTICAL COMPONENT OF IC:

1. On completion of every experiment / program in the laboratory, the students shall be evaluated and marks shall be awarded on the same day.
2. Each experiment is evaluated for 10 marks and scaled down to **5 marks.**
3. Laboratory test at the end of the 15th week of the semester / after completion of all the experiments shall be conducted for **50 marks** and scaled down to **20 marks.**
4. Total marks scored for lab component: **05+20=25 marks**.
5. The minimum marks to be secured in CIE to appear for SEE shall be 10(40% of maximum marks 25) in the theory and 10(40% of Maximum marks 25) in the practical.
6. The laboratory component of the **integrated course** shall be CIE only. However, in SEE, the questions from the practical component shall be included.

Theory				
IA Test	**Exam conducted for**	**Scaled down to**	**Average of best two tests**	**Total**
IA-1	**50**	**30**	**30**	**50/2=25**
IA-2	**50**	**30**		
IA-3	**50**	**30**		
Two Assignments	**2×10=20**	**10**	**10**	
Two Quizzes	**2×10=20**	**10**	**10**	

LAB			
Continuous performance and record writing	**Each experiments evaluated for 10 marks**	**Scaled down to 05 marks**	**5+20=25**
Internal Test + Viva voce	**Exam conducted for 50 marks**	**Scaled down to 20 marks**	

SEMESTER END EXAMINATION (SEE)

1. The question paper shall be set for 100 marks and duration of SEE is 3 hours.
2. The question paper will have two parts: Part-A and Part-B.
3. **Part-A** should contain minimum **Two or Four** quiz questions from each module of 02 marks/ 01 marks each. **Part-A is Compulsory** and carries 20 Marks.
4. **Part-B** contains total 10 questions. Two questions of 16 marks (with minimum of 3 sub questions) from each module with internal choice. Students should answer five full questions, selecting one full question from each module.
5. Students have to answer for 100 marks and marks scored out of 100 shall be proportionally reduced to 50 marks.
6. The maximum marks from the practical component to be included in the SEE question paper is **16 marks.**
7. Question papers to be set as per the Blooms Taxonomy levels.

CO-PO Mapping

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	1	1	-	-	-	-	-	-	1	-
CO2	3	1	1	1	2	-	-	-	1	1	1
CO3	2	1	1	1	1	-	-	-	1	1	1
CO4	2	1	1	-	2	-	-	-	-	1	-
CO5	2	1	1	1	2	-	-	-	-	1	-

Level 3 - High, Level 2 - Moderate, Level 1 - Low

SEMESTER-III					
FOUNDATION OF CYBER SECURITY **Category: ESC/ETC/PLC-III**					
Course Code	:	B24IC363	CIE	:	50 Marks
Teaching Hours L : T : P	:	3:0:0	SEE	:	50 Marks
Total Hours	:	45(T)	Total	:	100 Marks
Credits	:	3	SEE Duration	:	3 Hrs

Course Objectives	
1.	To learn cybercrime and cyberlaw.
2.	To understand the cyber attacks and tools for mitigating them.
3.	To understand information gathering.
4.	To learn how to detect a cyber attack.
5.	To learn how to prevent a cyber attack.

Module – 1: Introduction	**No. of 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.	9
Module – 2: Attacks and Countermeasures-Oswap	**No. of 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.	9
Module – 3: Reconnaissance	**No. of 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.	9
Module – 4: Intrusion Detection	**No. of Hours**
-Host -Based Intrusion Detection – Network -Based Intrusion Detection – Distributed or Hybrid Intrusion Detection – Intrusion Detection Exchange Format – Honeypots – Example System Snort.	9
Module – 5: Intrusion Prevention	**No. of 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.	9

Course Outcomes: At the end of the course, the students will be able to	
CO1	Explain the basics of cyber security, cyber crime and cyber law
CO2	Classify various types of attacks and learn the tools to launch the attacks
CO3	Apply various tools to perform information gathering
CO4	Apply intrusion techniques to detect intrusion
CO5	Apply intrusion prevention techniques to prevent intrusion

Textbooks	
1.	Anand Shinde, “Introduction to Cyber Security Guide to the World of Cyber Security”, Notion Press, 2021 (Unit 1)
2.	Nina Godbole, Sunit Belapure, “Cyber Security: Understanding Cyber Crimes, Computer Forensics and Legal Perspectives”, Wiley Publishers, 2011 (Unit 1)

Reference Textbooks	
1.	David Kim, Michael G. Solomon, “Fundamentals of Information Systems Security”, Jones & Bartlett Learning Publishers, 2013 (Unit 2) 2. 34.
2.	Patrick Engebretson, “The Basics of Hacking and Penetration Testing: Ethical Hacking and Penetration Testing Made easy”, Elsevier, 2011 (Unit 3)

3.	Kimberly Graves, "CEH Official Certified Ethical hacker Review Guide", Wiley Publishers, 2007 (Unit 3)
4.	William Stallings, Lawrie Brown, "Computer Security Principles and Practice",3rd Edition, Pearson Education, 2015 (Units 4 and 5)

E-Resources	
1.	https://owasp.org/www-project-top-ten

ASSESSMENT DETAILS BOTH (CIE AND SEE)

The weightage of continuous Internal Evaluation (CIE) is 50% and for the Semester End Examination (SEE) is 50%. The minimum passing mark for the CIE is 40% of maximum marks (20 marks out of 50). The minimum passing mark for SEE is 35% of maximum marks (18 marks out of 50). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each course. Student has to secure a minimum 40% (40 marks out of 100) in the total of the CIE and SEE together.

CONTINUOUS INTERNAL EVALUATION (CIE)

CIE FOR THE THEORY:

1. Three tests each of 50 marks, after the completion of the syllabus 40%, 70% and 100% respectively.
2. Average of best two internal assessment tests each of 50 marks, scale down to 30 marks.
3. Any two assessment methods as per regulations i.e. Two assignments / Two Quizzes/ Weekly test / project work for 40 marks, scaled down to 20 marks.
4. Total marks scored (30+20 = 50 marks).
5. The minimum passing mark for the CIE is 40% of maximum marks (20 marks out of 50).

SEMESTER END EXAMINATION (SEE)

1. The question paper shall be set for 100 marks and duration of SEE is 3 hours.
2. The question paper will have two parts: Part-A and Part-B.
3. **Part-A** should contain minimum **Two or Four** quiz questions from each module of 02 marks/ 01 marks each. **Part-A is Compulsory** and it carries 20 Marks.
4. **Part-B** contains total 10 questions.
5. Two questions of 16 marks (with minimum of 3 sub questions) from each module with internal choice.
6. Students should answer five full questions, selecting one full question from each module.
7. Question papers to be set as per the Blooms Taxonomy levels.

CO-PO Mapping

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	1	1	1	1	-	1	-	-	-	-	1
CO2	1	3	1	3	2	1	-	-	-	-	-
CO3	2	1	1	1	-	1	-	-	-	-	1
CO4	3	3	2	2	2	1	-	-	-	-	-
CO5	3	2	1	1	1	1	-	1	-	-	1

Level 3 - High, Level 2 - Moderate, Level 1 - Low

SEMESTER-III					
WEB TECHNOLOGIES **Category: ESC/ETC/PLC-III** **(Common to CSE, AIML, CSE(IC), ISE)**					
Course Code	:	B24AI364	CIE	:	50 Marks
Teaching Hours L : T : P	:	3:0:0	SEE	:	50 Marks
Total Hours	:	45(T)	Total	:	100 Marks
Credits	:	3	SEE Duration	:	3 Hrs

Course Objectives	
1.	To orient students to Web Programming fundamental
2.	To develop hands-on skills in building dynamic and interactive web applications using modern web development technologies and frameworks.
3.	To enhance problem-solving abilities and encourage creativity and innovation in designing and implementing web applications
4.	To Work collaboratively on web development projects to enhance teamwork, communication, and project management skills
5.	To understand modern web application frameworks and to explore popular development tools and frameworks.

Module – 1: Website Basics, Html 5, Css 3, Web 2.0	**No. of Hours**
Web Essentials: Clients, Servers and Communication – The Internet – World wide web – HTTP Request Message – HTTP Response Message – Web Clients – Web Servers – HTML5 – Tables – Lists – Image – HTML5 control elements – Drag and Drop – Audio – Video controls - CSS3 – Inline, embedded and external style sheets – Rule cascading – Inheritance – Backgrounds – Border Images – Colors – Shadows – Text – Transformations – Transitions – Animations. Bootstrap Framework.	9
Module – 2: Client Side Programming	**No. of Hours**
Java Script: An introduction to JavaScript–JavaScript DOM Model-Exception Handling-Validation Built-in objects-Event Handling- DHTML with JavaScript- JSON introduction – Syntax – Function Files.	9
Module – 3: Server Side Programming	**No. of Hours**
Servlets: Java Servlet Architecture- Servlet Life Cycle- Form GET and POST actions- Session Handling- Understanding Cookies- DATABASE CONNECTIVITY: JDBC.	9
Module – 4: PHP and XML	**No. of Hours**
An introduction to PHP: PHP- Using PHP- Variables- Program control- Built-in functions- Form Validation. XML: Basic XML- Document Type Definition- XML Schema, XML Parsers and Validation, XSL.	9
Module – 5: Introduction to Angular JS and Web Applications Frameworks	**No. of Hours**
Introduction to AngularJS, MVC Architecture, Understanding ng attributes, Expressions and data binding, Conditional Directives, Style Directives, Controllers, Filters, Forms, Routers, Modules, Services; Web Applications Frameworks and Tools – Firebase- Docker- Node JS- React- DjangoUI & UX.	9

Course Outcomes: At the end of the course, the students will be able to	
CO1	Construct a basic website using HTML and Cascading Style Sheets
CO2	Build dynamic web page with validation using Java Script objects and by applying different event handling mechanisms.
CO3	Develop server side programs using Servlets and JSP.
CO4	Construct simple web pages in PHP and to represent data in XML format
CO5	Develop interactive web applications.

Textbooks	
1.	Deitel and Deitel and Nieto, Internet and World Wide Web - How to Program, Prentice Hall, 5th Edition, 2011.
2.	Jeffrey C and Jackson, Web Technologies A Computer Science Perspective, Pearson Education, 2011.
3.	Angular 6 for Enterprise-Ready Web Applications, Doguhan Uluca, 1st edition, Packt Publishing

Reference Textbooks	
1.	Stephen Wynkoop and John Burke ―Running a Perfect Website‖, QUE, 2nd Edition,1999.
2.	Chris Bates, Web Programming – Building Intranet Applications, 3rd Edition, Wiley Publications, 2009
3.	Gopalan N.P. and Akilandeswari J., ―Web Technology‖, Prentice Hall of India, 2011.
4.	Angular: Up and Running: Learning Angular, Step by Step, Shyam Seshadri, 1st edition, O′Reilly
5.	UttamK.Roy, ―Web Technologies‖, Oxford University Press, 2011

ASSESSMENT DETAILS BOTH (CIE AND SEE)

The weightage of continuous Internal Evaluation (CIE) is 50% and for the Semester End Examination (SEE) is 50%. The minimum passing mark for the CIE is 40% of maximum marks (20 marks out of 50). The minimum passing mark for SEE is 35% of maximum marks (18 marks out of 50). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each course. Student has to secure a minimum 40% (40 marks out of 100) in the total of the CIE and SEE together.

CONTINUOUS INTERNAL EVALUATION (CIE)

CIE FOR THE THEORY:

1. Three tests each of 50 marks, after the completion of the syllabus 40%, 70% and 100% respectively.
2. Average of best two internal assessment tests each of 50 marks, scale down to 30 marks.
3. Any two assessment methods as per regulations i.e. Two assignments / Two Quizzes/ Weekly test / project work for 40 marks, scaled down to 20 marks.
4. Total marks scored (30+20 = 50 marks).
5. The minimum passing mark for the CIE is 40% of maximum marks (20 marks out of 50).

SEMESTER END EXAMINATION (SEE)

1. The question paper shall be set for 100 marks and duration of SEE is 3 hours.
2. The question paper will have two parts: Part-A and Part-B.
3. **Part-A** should contain minimum **Two or Four** quiz questions from each module of 02 marks/ 01 marks each. **Part-A is Compulsory** and it carries 20 Marks.
4. **Part-B** contains total 10 questions.
5. Two questions of 16 marks (with minimum of 3 sub questions) from each module with internal choice.
6. Students should answer five full questions, selecting one full question from each module.
7. Question papers to be set as per the Blooms Taxonomy levels.

CO-PO Mapping

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	2	2	3	3	3	-	-	-	2	-	3
CO2	3	2	3	2	3	-	-	-	2	-	3
CO3	1	2	2	3	3	-	-	-	1	-	2
CO4	3	3	3	2	3	-	-	-	2	-	3
CO5	2	2	3	1	2	-	-	-	3	-	2

Level 3 - High, Level 2 - Moderate, Level 1 - Low

SEMESTER-III					
CYBER LAW					
Category: AEC/SEC-III					
Course Code	:	B24IC381	CIE	:	50 Marks
Teaching Hours L : T : P	:	1:0:0	SEE	:	50 Marks
Total Hours	:	15(T)	Total	:	100 Marks
Credits	:	1	SEE Duration	:	1Hrs

Course Objectives	
1.	To understand and identify different types cybercrime and cyber offences
2.	To recognized Indian IT Act 2008 and its latest amendments
3.	To learn various types of security standards compliances

Module – 1: Introduction to Cyber Law Cyber Space	**No. of Hours**
Fundamental definitions, Interface of Technology and Law, Jurisprudence and-Jurisdiction in Cyber Space, Indian Context of Jurisdiction, Enforcement Agencies, Need for IT Act	3
Module – 2: Indian IT Act 2000 and Amendments Information Technology Act, 2000	**No. of Hours**
Aims and Objectives, Overview of the Act, Jurisdiction, Electronic Governance, Legal Recognition of Electronic Records and Electronic Evidence, Digital Signature Certificates.	3
Module – 3: Cyber Crime and Releveant Cyber Law's Case Study	**No. of Hours**
Cyber Crimes, Hacking, Child Pornography, Cyber Stalking, Denial of Service Attack, Virus Dissemination, Software Piracy, Internet Relay Chat (IRC) Crime, Credit Card Fraud, Net Extortion, Phishing, etc. - Cyber Terrorism, Violation of Privacy on Internet - Data Protection and Privacy, Case Study on Indian Court cases.	3
Module – 4: Intellectual Property Rights in Cyberspace	**No. of Hours**
Intellectual Property Rights, Copyrights, Software – Copyrights vs Patents, Authorship and Assignment Issues, Copyright in Internet, Multimedia and Copyright Issues, Software Piracy, Trademarks, Trademarks in Internet, Copyright and Trademark cases.	3
Module – 5: Intellectual Property Rights in Cyberspace	**No. of Hours**
Indian Position and Case Law The legal position on Computer-related Patents, Indian Position on Patents, Case Law, Domain names –registration, Domain Name Disputes, Cyber Squatting-IPR cases.	3

Course Outcomes: At the end of the course, the students will be able to	
CO1	Understand the fundamental of cyberspace and need for the cyber law.
CO2	Learn about Indian IT Act-2000,2008 and subsequent amendments.
CO3	Know the different types of cyber crimes and various legal sections as per cyber law to deal with it
CO4	Understand the complexity of Intellectual Property Rights in Cyberspace and how to protect it
CO5	Know the Indian Acts available to protect Intellectual Property Rights in Cyberspace

Textbooks	
1.	Cyber Law and IT Protection, Harish Chander, 2nd Edition, PHI,2022

Reference Textbooks	
1.	Cyber Law - An Exhaustive Section Wise Commentary on The Information Technology Act, Pavan Duggal, Universal Law Publishing Co., 2017
2.	Cyber Crimes, Talat Fatima, Eastern Book Company, 2016

ASSESSMENT DETAILS (BOTH CIE AND SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

CONTINUOUS INTERNAL EVALUATION (CIE)

CIE FOR THE THEORY:

1. Three tests each of 50 marks (Multiple Choice Questions), after the completion of the syllabus 40%, 70% and 100% respectively.
2. Average of best two internal assessment tests each of 50 marks, scale down to 30 marks.
3. Any two assessment methods as per regulations i.e. Two assignments / Two Quizzes/ Weekly test / project work for 40 marks, scaled down to 20 marks.
4. Total marks scored (30+20 = 50 marks).
5. The minimum passing mark for the CIE is 40% of maximum marks (20 marks out of 50).

SEMESTER END EXAMINATION (SEE)

SEE paper shall be set for 50 questions, each of the 01 marks. The pattern of the question paper is MCQ (multiple choice questions). The time allotted for SEE is 01 hour. The student has to secure a minimum of 35% of the maximum marks meant for SEE.

CO-PO Mapping

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	2	1	-	1	-	2	2	-	-	1	-
CO2	2	2	-	1	-	2	2	-	-	1	-
CO3	2	1	-	1	-	2	2	-	-	1	-
CO4	2	1	-	1	-	2	2	-	-	1	-
CO5	2	1	-	1	-	2	2	-	-	1	-

Level 3 - High, Level 2 - Moderate, Level 1 - Low

SEMESTER-III					
UNIX SHELL PROGRAMMING **Category: AEC/SEC-III**					
Course Code	:	B24IC382	CIE	:	50 Marks
Teaching Hours L : T : P	:	0:0:2	SEE	:	50 Marks
Total Hours	:	15(P)	Total	:	100 Marks
Credits	:	1	SEE Duration	:	3 Hrs

Course Objectives	
1.	To learn basic knowledge about architecture of Unix/Linux and different basic Commands of Unix/Linux.
2.	To learn how to use process management.
3.	Capability to name and state the function of unix commands.
4.	To learn the shell programming.
5.	To learn basics of filter commands.

Sl. No.	**Experiments for Conduction**
1.	a. Write Shell Program to Read a number and write the number in words. b. Write Shell Program to Read the base and height of a triangle and find its area.
2.	Write Shell Program to Convert Fahrenheit to Celsius Temperature or Celsius to Fahrenheit Temperature.
3.	Write Shell Program to Read any year and find whether leap year or not.
4.	Write Shell Program to Read two numbers and display all the odd numbers between those two numbers.
5.	Write Shell Program to Read a number and reverse the number for example 123 should output as 321.
6.	Find out whether file has read, write and execute permission.
7.	Write Script to find out biggest number from given three nos. Numbers are supplies as command line argument. Print error if sufficient arguments are not supplied.
8.	Write Script to see current date, time, username, and current directory.
9.	Write shell script to convert file names from UPPERCASE to lowercase file names or vice versa.
10.	How to write script, that will print, Message "Hello World" , in Bold and Blink effect, and in different colors like red, brown etc using echo command.

Course Outcomes: At the end of the course, the students will be able to	
CO1	Understand architecture and basic commands of Unix/Linux.
CO2	Understanding the basic set of commands and utilities in Linux systems.
CO3	Understanding how to Write shell programming and investigate & manage processes.
CO4	Understand the basic structure of shell programming and understand the conditional statements and looping statements.
CO5	Understand the concepts of basic filter commands.

ASSESSMENT DETAILS BOTH (CIE AND SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks).

A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

CONTINUOUS INTERNAL EVALUATION (CIE)

Component	Scale down to	Total Marks
Conduction of experiments and Record Writing (Each Experiment evaluated for 10 marks)	20	20
Internal Lab Test 1(After 6 experiments) Exam conduction for 50 marks	15	15
Internal Lab Test 2 (After 6 experiments) Exam conduction for 50 marks	15	15
	CIE	**50**

SEMESTER END EXAMINATION (SEE)

1. SEE marks for the practical course are 50 Marks. Practical examinations are to be conducted between the schedules mentioned in the academic calendar of the Institution.
2. All laboratory experiments are to be included for practical examination.
3. Students can pick one question (experiment) from the questions lot prepared by the examiners.
4. Evaluation of test write-up, conduction procedure, result and viva will be conducted jointly by examiners.
5. Rubrics suggested for SEE, writeup-20%, Conduction procedure and result in -60%, Viva-voce 20% of maximum marks. SEE for practical shall be evaluated for 100 marks and scored marks shall be scaled down to 50 marks.
6. Change of experiment is allowed only once and 15% of Marks allotted to the procedure part are to be made zero. The minimum duration of SEE is 03 hours.

CO-PO Mapping

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	1	1	-	1	-	-	-	-	-	-
CO2	3	2	2	1	-	2	1	-	-	-	-
CO3	1	2	3	-	1	-	2	-	-	-	-
CO4	2	1	1	1	-	2		-	-	-	-
CO5	2	1	2	-	1	-	1	-	-	-	-

SEMESTER-III					
CYBER SECURITY LABORATORY **Category: AEC/SEC-III**					
Course Code	:	B24IC383	CIE	:	50 Marks
Teaching Hours L : T : P	:	0:0:2	SEE	:	50 Marks
Total Hours	:	15(P)	Total	:	100 Marks
Credits	:	1	SEE Duration	:	3 Hrs

Course Objectives	
1.	To learn cybercrime and cyberlaw.
2.	To understand the cyber attacks and tools for mitigating them.
3.	To understand information gathering.
4.	To learn how to detect a cyber attack.
5.	To learn how to prevent a cyber attack.

Sl. No.	**Experiments for Conduction**
1.	Install Kali Linux on Virtual box
2.	Explore Kali Linux and bash scripting
3.	Perform open source intelligence gathering using Netcraft, Whois Lookups, DNS Reconnaissance, Harvester and Maltego
4.	Understand the nmap command d and scan a target using nmap
5.	Install metasploitable2 on the virtual box and search for unpatched vulnerabilities
6.	Use Metasploit to exploit an unpatched vulnerability
7.	Install Linus server on the virtual box and install ssh
8.	Use Fail2banto scan log files and ban Ips that show the malicious signs
9.	Launch brute-force attacks on the Linux server using Hydra.
10.	Perform real-time network traffic analysis and data pocket logging using Snort

Course Outcomes: At the end of the course, the students will be able to	
CO1	Explain the basics of cyber security, cyber crime and cyber law
CO2	Classify various types of attacks and learn the tools to launch the attacks
CO3	Apply various tools to perform information gathering
CO4	Apply intrusion techniques to detect intrusion
CO5	Apply intrusion prevention techniques to prevent intrusion

ASSESSMENT DETAILS BOTH (CIE AND SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks).

A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

CONTINUOUS INTERNAL EVALUATION (CIE)

Component	Scale down to	Total Marks
Conduction of experiments and Record Writing (Each Experiment evaluated for 10 marks)	20	20
Internal Lab Test 1(After 6 experiments) Exam conduction for 50 marks	15	15
Internal Lab Test 2 (After 6 experiments) Exam conduction for 50 marks	15	15
	CIE	**50**

SEMESTER END EXAMINATION (SEE)

1. SEE marks for the practical course are 50 Marks. Practical examinations are to be conducted between the schedules mentioned in the academic calendar of the Institution.
2. All laboratory experiments are to be included for practical examination.
3. Students can pick one question (experiment) from the questions lot prepared by the examiners.
4. Evaluation of test write-up, conduction procedure, result and viva will be conducted jointly by examiners.
5. Rubrics suggested for SEE, writeup-20%, Conduction procedure and result in -60%, Viva-voce 20% of maximum marks. SEE for practical shall be evaluated for 100 marks and scored marks shall be scaled down to 50 marks.
6. Change of experiment is allowed only once and 15% of Marks allotted to the procedure part are to be made zero. The minimum duration of SEE is 03 hours.

CO-PO Mapping

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	1	1	1	1	-	1	-	-	-	-	1
CO2	1	3	1	3	2	1	-	-	-	-	-
CO3	2	1	1	1	-	1	-	-	-	-	1
CO4	3	3	2	2	2	1	-	-	-	-	-
CO5	3	2	1	1	1	1	-	1	-	-	1

SEMESTER-III					
DATA VISUALIZATION WITH PYTHON **Category: AEC/SEC-III**					
Course Code	:	B24IC384	CIE	:	50 Marks
Teaching Hours L : T : P	:	0:0:2	SEE	:	50 Marks
Total Hours	:	15(P)	Total	:	100 Marks
Credits	:	1	SEE Duration	:	3 Hrs

Course Objectives	
1.	Demonstrate the use of IDLE or PyCharm IDE to create Python Applications
2.	Using Python programming language to develop programs for solving real-world problems
3.	Implementation of Matplotlib for drawing different Plots
4.	Demonstrate working with Seaborn, Bokeh.
5.	Working with Plotly for 3D, Time Series and Maps.

Sl. No	**Suggested experiments**
1.	a) Write a python program to find the best of two test average marks out of three test's marks accepted from the user. b) Develop a Python program to check whether a given number is palindrome or not andalso count the number of occurrences of each digit in the input number. Datatypes: https://www.youtube.com/watch?v=gCCVsvgR2KU Operators: https://www.youtube.com/watch?v=v5MR5JnKcZI Flow Control: https://www.youtube.com/watch?v=PqFKRqpHrjwFor loop: https://www.youtube.com/watch?v=0ZvaDa8eT5s While loop: https://www.youtube.com/watch?v=HZARImviDxg Exceptions: https://www.youtube.com/watch?v=6SPDvPK38tw
2.	a) Defined as a function F as Fn = Fn-1 + Fn-2. Write a Python program which accepts a value for N (where N >0) as input and pass this value to the function. Display suitable error message if the condition for input value is not followed. b) Develop a python program to convert binary to decimal, octal to hexadecimal using functions. Functions:https://www.youtube.com/watch?v=BVfCWuca9nw Arguments:https://www.youtube.com/watch?v=ijXMGpoMkhQ Return value: https://www.youtube.com/watch?v=nuNXiEDnM44
3.	a) Write a Python program that accepts a sentence and find the number of words, digits, uppercase letters and lowercase letters. b) Write a Python program to find the string similarity between two given strings Sample Output: Sample Output: Original string: Original string: Python Exercises Python Exercises Python Exercises Python Exercise Similarity between two said strings: Similarity between two said strings:1.0 0.967741935483871

	Strings: https://www.youtube.com/watch?v=lSItwlnF0eU String functions: https://www.youtube.com/watch?v=9a3CxJyTq00
4.	a) Write a Python program to Demonstrate how to Draw a Bar Plot using Matplotlib. b) Write a Python program to Demonstrate how to Draw a Scatter Plot using Matplotlib. https://www.youtube.com/watch?v=RRHQ6Fs1b8w&list=PLjVLYmrlmjGcC0B_FP3bkJJIPkV5GuZR&index=3 https://www.youtube.com/watch?v=7ABCuhWO9II&list=PLjVLYmrlmjGcC0B_FP3bkJJIPkV5GuZR&index=4
5.	a) Write a Python program to Demonstrate how to Draw a Histogram Plot using Matplotlib. b) Write a Python program to Demonstrate how to Draw a Pie Chart using Matplotlib. https://www.youtube.com/watch?v=Qk7caotaQUQ&list=PLjVLYmrlmjGcC0B_FP3bkJJIPkV5GuZR&index=6 https://www.youtube.com/watch?v=PSji21jUNO0&list=PLjVLYmrlmjGcC0B_FP3bkJJIPkV5GuZR&index=7
6.	a) Write a Python program to illustrate Linear Plotting using Matplotlib. b) Write a Python program to illustrate liner plotting with line formatting using Matplotlib. https://www.youtube.com/watch?v=UO98lJQ3QGI&list=PL-osiE80TeTvipOqomVEeZ1HRrcEvtZB_
7.	Write a Python program which explains uses of customizing seaborn plots with Aesthetic functions. https://www.youtube.com/watch?v=6GUZXDef2U0
8.	Write a Python program to explain working with bokeh line graph using Annotations and Legends. a) Write a Python program for plotting different types of plots using Bokeh. https://www.youtube.com/watch?v=HDvxYoRadcA
9.	Write a Python program to draw 3D Plots using Plotly Libraries. https://www.youtube.com/watch?v=cCck7hCanpw&list=PLE50-h6JzC4onXqkv9H3HtPbBVA8M94&index=4
10.	a) Write a Python program to draw Time Series using Plotly Libraries. b) Write a Python program for creating Maps using Plotly Libraries. https://www.youtube.com/watch?v=xnJ2TNrGYik&list=PLE50-h6JzC4onXqkv9H3HtPbBVA8M94&index=5 https://www.youtube.com/watch?v=D35m2CdMhVs&list=PLE50-dh6JzC4onXqkv9H3HtPbBVA8M94&index=6

Course Outcomes: At the end of the course, the students will be able to	
CO1	Understand good visual design principles to visualise data and findings effectively
CO2	Process and prepare real-world data sets for analysis and visualisation
CO3	Create graphs using different Python visualisation packages, such as Matplotlilb, Seaborn and Bokeh
CO4	Build both static and interactive visualisations

ASSESSMENT DETAILS BOTH (CIE AND SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks).

A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

CONTINUOUS INTERNAL EVALUATION (CIE)

Component	Scale down to	Total Marks
Conduction of experiments and Record Writing (Each Experiment evaluated for 10 marks)	20	20
Internal Lab Test 1(After 6 experiments) Exam conduction for 50 marks	15	15
Internal Lab Test 2 (After 6 experiments) Exam conduction for 50 marks	15	15
	CIE	**50**

SEMESTER END EXAMINATION (SEE)

1. SEE marks for the practical course are 50 Marks. Practical examinations are to be conducted between the schedules mentioned in the academic calendar of the Institution.
2. All laboratory experiments are to be included for practical examination.
3. Students can pick one question (experiment) from the questions lot prepared by the examiners.
4. Evaluation of test write-up, conduction procedure, result and viva will be conducted jointly by examiners.
5. Rubrics suggested for SEE, writeup-20%, Conduction procedure and result in -60%, Viva-voce 20% of maximum marks. SEE for practical shall be evaluated for 100 marks and scored marks shall be scaled down to 50 marks.
6. Change of experiment is allowed only once and 15% of Marks allotted to the procedure part are to be made zero. The minimum duration of SEE is 03 hours.

CO-PO Mapping

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	3	3	3	2	-	-	-	-	-	2
CO2	3	2	3	3	2	-	-	-	-	-	2
CO3	2	2	-	2	2	-	-	-	-	-	1
CO4	1	2	-	-	1	-	-	-	-	-	1

IV - Semester Syllabus

SEMESTER-IV					
MICROCONTROLLER & EMBEDDED SYSTEMS **Category: PCC**					
Course Code	:	B24IC401	CIE	:	50 Marks
Teaching Hours L : T : P	:	3 : 0 : 0	SEE	:	50 Marks
Total Hours	:	45(T)	Total	:	100 Marks
Credits	:	3	SEE Duration	:	3 Hrs

Course Objectives	
1.	Understand the architectural features and instruction set of 32 bit ARM microcontrollers.
2.	Apply instructions of assembly language for programming ARM.
3.	Interpret the basic hardware components and their selection method based on the characteristics and attributes of an embedded system.
4.	Explain the need of real time operating system for embedded system applications. Develop/test/Conduct the experiments on an ARM7TDMI/LPC2148 evaluation board using Embedded 'C' and Keil Vision tool/Compiler

Module – 1: Microprocessors versus Microcontrollers, ARM Embedded Systems	**No. of Hours**
The RISC design philosophy, The ARM Design Philosophy, Embedded System Hardware, Embedded System Software, ARM Processor Fundamentals: Registers, Current Program Status Register, Pipeline, Exceptions, Interrupts, and the Vector Table , Core Extensions.	9
Module – 2: Introduction to the ARM Instruction Set	**No. of Hours**
Data Processing Instructions , Programme Instructions, Software Interrupt Instructions, Program Status Register Instructions, Coprocessor Instructions, Loading Constants ARM programming using Assembly language: Writing Assembly code, Profiling and cycle counting, instruction scheduling, Register Allocation, Conditional Execution, Looping Constructs	9
Module – 3: Embedded System Components	**No. of Hours**
Embedded Vs General computing system, History of embedded systems, Classification of Embedded systems, Major applications areas of embedded systems, purpose of embedded systems Core of an Embedded System including all types of processor/controller, Memory, Sensors, Actuators, LED, 7 segment LED display, stepper motor, Keyboard, Push button switch.	9
Module – 4: Embedded System Design Concepts	**No. of Hours**
Characteristics and Quality Attributes of Embedded Systems, Operational quality attributes, nonoperational quality attributes, Embedded Systems-Application and Domain specific, Hardware Software Co-Design and Program Modelling.	9
Module – 5: RTOS and IDE for Embedded System Design	**No. of Hours**
Operating System basics, Types of operating systems, Task, process and threads (Only POSIX Threads with an example program), Thread preemption, Multiprocessing and Multitasking, Task Communication (without any program), Task synchronization issues – Racing and Deadlock, Concept of Binary and counting semaphores (Mutex example without any program), How to choose an RTOS, Integration and testing of Embedded hardware and firmware.	9

Course Outcomes: At the end of the course, the students will be able to	
CO1	Explain the architectural features and instructions of ARM microcontroller
CO2	Apply the knowledge gained for Programming ARM for different applications.
CO3	Demonstrate Interfacing of external devices and I/O with ARM microcontroller.
CO4	Interpret the basic hardware components and their selection method based on the characteristics and attributes of an embedded system.
CO5	Develop the hardware /software co-design and firmware design approaches.

Text Books	
1.	Andrew N Sloss, Dominic Symes and Chris Wright, ARM system developers guide, Elsevier, Morgan Kaufman publishers, 2008.

2.	Shibu K V, "Introduction to Embedded Systems", Tata McGraw Hill Education, Private Limited, 2nd Edition

Reference Text Books	
1.	Raghunandan..G.H, Microcontroller (ARM) and Embedded System, Cengage learning Publication,2019
2.	The Insider's Guide to the ARM7 Based Microcontrollers, Hitex Ltd.,1st edition, 2005.
3.	Steve Furber, ARM System-on-Chip Architecture, 2nd Edition, Pearson, 2015.
4.	Raj Kamal, Embedded System, Tata McGraw-Hill Publishers, 2nd Edition, 2008.

Web links and Video lectures (e-Resources)
http://www.digimat.in/nptel/courses/video/106105193/L01.html http://www.digimat.in/nptel/courses/video/106105159/L01.html http://www.digimat.in/nptel/courses/video/106105036/L01.html

ASSESSMENT DETAILS BOTH (CIE AND SEE)

The weightage of continuous Internal Evaluation (CIE) is 50% and for the Semester End Examination (SEE) is 50%. The minimum passing mark for the CIE is 40% of maximum marks (20 marks out of 50). The minimum passing mark for SEE is 35% of maximum marks (18 marks out of 50). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each course. Student has to secure a minimum 40% (40 marks out of 100) in the total of the CIE and SEE together.

CONTINUOUS INTERNAL EVALUATION (CIE)

CIE FOR THE THEORY:

1. Three tests each of 50 marks, after the completion of the syllabus 40%, 70% and 100% respectively.
2. Average of best two internal assessment tests each of 50 marks, scale down to 30 marks.
3. Any two assessment methods as per regulations i.e. Two assignments / Two Quizzes/ Weekly test / project work for 40 marks, scaled down to 20 marks.
4. Total marks scored (30+20 = 50 marks).
5. The minimum passing mark for the CIE is 40% of maximum marks (20 marks out of 50).

SEMESTER END EXAMINATION (SEE)

1. The question paper shall be set for 100 marks and duration of SEE is 3 hours.
2. The question paper will have two parts: Part-A and Part-B.
3. **Part-A** should contain minimum **Two or Four** quiz questions from each module of 02 marks/ 01 marks each. **Part-A is Compulsory** and it carries 20 Marks.
4. **Part-B** contains total 10 questions.
5. Two questions of 16 marks (with minimum of 3 sub questions) from each module with internal choice.
6. Students should answer five full questions, selecting one full question from each module.
7. Question papers to be set as per the Blooms Taxonomy levels.

SEMESTER-IV					
DATABASE MANAGEMENT SYSTEMS **Category: PCC** **(Common to CSE, ISE, AIML, IOTCSE(IC), CSD)**					
Course Code	:	B24CS402	CIE	:	50 Marks
Teaching Hours L : T : P	:	3:0:0	SEE	:	50 Marks
Total Hours	:	45(T)	Total	:	100 Marks
Credits	:	3	SEE Duration	:	3 Hrs

Course Objectives	
1.	To introduce the fundamental concepts of database systems and data models, particularly the relational model.
2.	To understand and apply relational algebra and relational calculus for query formulation.
3.	To develop SQL queries for data definition, manipulation, and control.
4.	To understand the concepts of normalization and apply it to improve database design and eliminate anomalies.
5.	To gain knowledge of transaction processing, concurrency control, and recovery techniques to ensure data integrity and consistency.

Module – 1: Introduction to Databases	**No. of Hours**
Introduction, Characteristics of database approach, Advantages of using the DBMS approach, History of database applications. **Overview of Database Languages and Architectures**: Data Models, Schemas, and Instances. Three schema architecture and data independence, database languages, and interfaces, The Database System environment. **Conceptual Data Modelling using Entities and Relationships**: Entity types, Entity sets , attributes and structural constraints, Weak entity types, ER diagrams.	9
Module – 2: Relational Model	**No. of Hours**
Relational Model Concepts, Relational Model Constraints and relational database schemas, Update operations, transactions, and dealing with constraint violations. **Relational Algebra:** Unary and Binary relational operations, additional relational operations (aggregate, grouping) Examples of Queries in relational algebra. **Mapping Conceptual Design into a Logical Design:** Relational Database Design using ER-to-Relational mapping.	9
Module – 3: Structured Query Language (SQL)	**No. of Hours**
Overview of SQL, Data Definition Commands, Data Manipulation commands, Integrity constraints - key constraints, Domain Constraints, Referential integrity constraints(RIC), Entity integrity constraints(EIC), check constraints, Data Control commands, Transaction Control Commands, aggregate function - group by, having clause **SQL-Advance Quaries:** Views in SQL, Nested and co-related queries, Exists & Not Exists, joins & outer joins , specifiying constratints as assertions and action Triggers.	9
Module – 4: Relational & Normalization	**No. of Hours**
Database Design: Pitfalls in Relational-Database designs, Concept of normalization, Function Dependencies, Normal Forms- 1NF, 2NF, 3NF, multivalued dependency and 4NF, Join dependencies and 5NF, BCNF	9
Module – 5: Transaction Management and Recovery	**No. of Hours**
Transaction Concept, ACID properties, Transaction States, Implementation of atomicity and durability, Concurrent Executions, Serializability, Concurrency Control Protocols: Lock-based, Timestamp based, Validation Based, Deadlock Handling, Recovery System: Failure classification, Log based recovery, Shadow Paging, ARIES recovery algorithm.	9

Course Outcomes: At the end of the course, the students will be able to	
CO1	Design an optimized database.
CO2	Design entity relationship for the given scenario.

CO3	Construct SQL queries to perform operations on the database.
CO4	Demonstrate appropriate transaction management and recovery techniques for a given problem..
CO5	Apply indexing mechanisms for efficient retrieval of information from database

Text Books	
1.	Fundamentals of Database Systems, Ramez Elmasri and Shamkant B. Navathe, 7th Edition, 2017, Pearson.
2.	Database management systems, Ramakrishnan, and Gehrke, 3rd Edition, 2014, McGraw Hill
3.	Elmasri and Navathe, —Fundamentals of Database Systems, 7th Edition, Pearson education, 2016.

Reference Text Books	
1.	Abraham Silberschatz, Henry F. Korth and S. Sudarshan's Database System Concepts 6th Edition Tata Mcgraw Hill Education Private Limited
2.	G. K. Gupta —Database Management Systems, 3rd Edition, McGraw – Hill, 2018
3.	Dr. P.S. Deshpande, SQL and PL/SQL for Oracle 10g, Black Book, Dreamtech Press, 2012

Web links and Video lectures (e-Resources)
1. https://www.youtube.com/watch?v=3EJlovevfcA
2. https://www.youtube.com/watch?v=9TwMRs3qTcU
3. https://www.youtube.com/watch?v=ZWl0Xow304I

ASSESSMENT DETAILS BOTH (CIE AND SEE)

The weightage of continuous Internal Evaluation (CIE) is 50% and for the Semester End Examination (SEE) is 50%. The minimum passing mark for the CIE is 40% of maximum marks (20 marks out of 50). The minimum passing mark for SEE is 35% of maximum marks (18 marks out of 50). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each course. Student has to secure a minimum 40% (40 marks out of 100) in the total of the CIE and SEE together.

CONTINUOUS INTERNAL EVALUATION (CIE)

CIE FOR THE THEORY:

1. Three tests each of 50 marks, after the completion of the syllabus 40%, 70% and 100% respectively.
2. Average of best two internal assessment tests each of 50 marks, scale down to 30 marks.
3. Any two assessment methods as per regulations i.e. Two assignments / Two Quizzes/ Weekly test / project work for 40 marks, scaled down to 20 marks.
4. Total marks scored (30+20 = 50 marks).
5. The minimum passing mark for the CIE is 40% of maximum marks (20 marks out of 50).

SEMESTER END EXAMINATION (SEE)

1. The question paper shall be set for 100 marks and duration of SEE is 3 hours.
2. The question paper will have two parts: Part-A and Part-B.
3. **Part-A** should contain minimum **Two or Four** quiz questions from each module of 02 marks/ 01 marks each. **Part-A is Compulsory** and it carries 20 Marks.
4. **Part-B** contains total 10 questions.
5. Two questions of 16 marks (with minimum of 3 sub questions) from each module with internal choice.
6. Students should answer five full questions, selecting one full question from each module.
7. Question papers to be set as per the Blooms Taxonomy levels.

CO-PO Mapping

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	1	-	-	-	3	1	-	-	1	2
CO2	2	2	-	-	-	2	1	-	-	2	2
CO3	1	1	-	-	-	1	2	-	-	2	1
CO4	1	1	-	-	-	1	2	-	-	1	1
CO5	1	1	-	-	-	1	2	-	-	1	1

Level 3 - High, Level 2 - Moderate, Level 1 - Low

SEMESTER- IV					
WEB APPLICATION SECURITY					
Category: IPCC					
Course Code	:	B24IC403	CIE	:	50 Marks
Teaching Hours L : T : P	:	3:0:2	SEE	:	50 Marks
Total Hours	:	45(T)+15(P)	Total	:	100 Marks
Credits	:	4	SEE Duration	:	3 Hrs

Course Objectives	
1.	To understand the fundamentals of web application security
2.	To focus on wide aspects of secure development and deployment of web applications
3.	To learn how to build secure APIs
4.	To learn the basics of vulnerability assessment and penetration testing
5.	To get an insight about Hacking techniques and Tools

Module – 1: Fundamentals of Web Application Security	**No. of Hours**
The history of Software Security-Recognizing Web Application Security Threats, Web Application Security, Authentication and Authorization, Secure Socket layer, Transport layer Security, Session Management-Input Validation	9
Module – 2: Secure Development and Deployment	**No. of Hours**
Web Applications Security - Security Testing, Security Incident Response Planning, The Microsoft Security Development Lifecycle (SDL), OWASP Comprehensive Lightweight Application Security Process (CLASP), The Software Assurance Maturity Model (SAMM)	9
Module – 3: Secure API Development	**No. of Hours**
API Security- Session Cookies, Token Based Authentication, Securing Natter APIs: Addressing threats with Security Controls, Rate Limiting for Availability, Encryption, Audit logging, Securing service-to-service APIs: API Keys , OAuth2, Securing Microservice APIs: Service Mesh, Locking Down Network Connections, Securing Incoming Requests	9
Module – 4: Vulnerability Assessment and Penetration Testing	**No. of Hours**
Vulnerability Assessment Lifecycle, Vulnerability Assessment Tools: Cloud-based vulnerability scanners, Host-based vulnerability scanners, Network-based vulnerability scanners, Database based vulnerability scanners, Types of Penetration Tests: External Testing, Web Application Testing, Internal Penetration Testing, SSID or Wireless Testing, Mobile Application Testing.	9
Module – 5: Hacking Techniques and Tools	**No. of Hours**
Social Engineering, Injection, Cross-Site Scripting(XSS), Broken Authentication and Session Management, Cross-Site Request Forgery, Security Misconfiguration, Insecure Cryptographic Storage, Failure to Restrict URL Access, Tools: Comodo, OpenVAS, Nexpose, Nikto, Burp Suite, etc.	9

Course Outcomes: At the end of the course, the students will be able to	
CO1	Understanding the basic concepts of web application security and the need for it
CO2	Be acquainted with the process for secure development and deployment of web applications
CO3	Acquire the skill to design and develop Secure Web Applications that use Secure APIs
CO4	Be able to get the importance of carrying out vulnerability assessment and penetration testing
CO5	Acquire the skill to think like a hacker and to use hackers tool sets

Text Books	
1.	Andrew Hoffman, Web Application Security: Exploitation and Countermeasures for Modern Web Applications, First Edition, 2020, O'Reilly Media, Inc.
2.	Bryan Sullivan, Vincent Liu, Web Application Security: A Beginners Guide, 2012, The McGraw-Hill Companies.
3.	Neil Madden, API Security in Action, 2020, Manning Publications Co., NY, USA.

Reference Text Books	
1.	Michael Cross, Developer's Guide to Web Application Security, 2007, Syngress Publishing, Inc.
2.	Ravi Das and Greg Johnson, Testing and Securing Web Applications, 2021, Taylor & Francis Group, LLC.

3.	Prabath Siriwardena, Advanced API Security, 2020, Apress Media LLC, USA
4.	Malcom McDonald, Web Security for Developers, 2020, No Starch Press, Inc.
5.	Allen Harper, Shon Harris, Jonathan Ness, Chris Eagle, Gideon Lenkey, and Terron Williams Grey Hat Hacking: The Ethical Hacker's Handbook, Third Edition, 2011, The McGraw-Hill Companies.

LABORATORY

Practical Component of IPCC (12 Experiments)

Sl. No	Practical Exercises
1.	Install Wireshark and explore the various protocols. • Analyze the difference between HTTP v/s HTTPS • Analyze the various security mechanisms embedded with different protocols.
2.	Identify the vulnerabilities using OWASP ZAP tool.
3.	Create simple REST API using python for following operation. • GET • PUSH • POST • DELETE
4.	Install Burp Suite to do following vulnerabilities • SQL injection • Cross-site scripting (XSS)
5.	Attack the website using Social Engineering method.

ASSESSMENT DETAILS BOTH (CIE AND SEE)

The weightage of continuous Internal Evaluation (CIE) is 50% and for the Semester End Examination (SEE) is 50%. The minimum passing mark for the CIE is 40% of maximum marks (20 marks out of 50). The minimum passing mark for SEE is 35% of maximum marks (18 marks out of 50). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each course. Student has to secure a minimum 40% (40 marks out of 100) in the total of the CIE and SEE together.

The CIE marks for the theory component of the Integrated Course (IC) shall be 30 marks and for the laboratory component 20 marks.

CONTINUOUS INTERNAL EVALUATION (CIE)

CIE FOR THE THEORY COMPONENT OF IC:

1. Three tests each of 50 marks, after the completion of the syllabus 40%, 70% and 100% respectively.
2. Average of best two internal assessment tests each of 50 marks, scale down to 30 marks.
3. Any two assessment methods as per regulations i.e. Two assignments / Two Quizzes / Weekly test / project work for (20+20) marks, scaled down to **20 marks.**
4. Total marks scored **(30+20 = 50 marks)** scaled down to **25.**

CIE FOR THE PRACTICAL COMPONENT OF IC:

1. On completion of every experiment / program in the laboratory, the students shall be evaluated and marks shall be awarded on the same day.
2. Each experiment is evaluated for 10 marks and scaled down to **5 marks.**

3. Laboratory test at the end of the 15th week of the semester / after completion of all the experiments shall be conducted for **50 marks** and scaled down to **20 marks.**
4. Total marks scored for lab component: **05+20=25 marks**.
5. The minimum marks to be secured in CIE to appear for SEE shall be 10(40% of maximum marks 25) in the theory and 10(40% of Maximum marks 25) in the practical.
6. The laboratory component of the **integrated course** shall be CIE only. However, in SEE, the questions from the practical component shall be included.

Theory				
IA Test	**Exam conducted for**	**Scaled down to**	**Average of best two tests**	**Total**
IA-1	**50**	**30**	**30**	**50/2=25**
IA-2	**50**	**30**		
IA-3	**50**	**30**		
Two Assignments	**2×10=20**	**10**	**10**	
Two Quizzes	**2×10=20**	**10**	**10**	

LAB			
Continuous performance and record writing	**Each experiments evaluated for 10 marks**	**Scaled down to 05 marks**	**5+20=25**
Internal Test + Viva voce	**Exam conducted for 50 marks**	**Scaled down to 20 marks**	

SEMESTER END EXAMINATION (SEE)

1. The question paper shall be set for 100 marks and duration of SEE is 3 hours.
2. The question paper will have two parts: Part-A and Part-B.
3. **Part-A** should contain minimum **Two or Four** quiz questions from each module of 02 marks/ 01 marks each. **Part-A is Compulsory** and carries 20 Marks.
4. **Part-B** contains total 10 questions. Two questions of 16 marks (with minimum of 3 sub questions) from each module with internal choice. Students should answer five full questions, selecting one full question from each module.
5. Students have to answer for 100 marks and marks scored out of 100 shall be proportionally reduced to 50 marks.
6. The maximum marks from the practical component to be included in the SEE question paper is **16 marks.**
7. Question papers to be set as per the Blooms Taxonomy levels.

CO-PO Mapping

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	2	1	-	1	2	-	1	1	-	1	1
CO2	2	1	-	1	2	1	-	1	-	1	1
CO3	1	1	1	1	3	-	-	-	-	1	1
CO4	2	1	1	1	2	1	-	-	-	1	1
CO5	2	1	1	1	1	-	-	1	-	1	1

Level 1-High, Level 2-Moderate, Level 3- Low

SEMESTER-IV					
DESIGN AND ANALYSIS OF ALGORITHMS **Category: IPCC** **(Common to CSE, ISE, AIML, CSE(IC), CSD)**					
Course Code	:	B24CS404	CIE	:	50 Marks
Teaching Hours L : T : P	:	3:0:2	SEE	:	50 Marks
Total Hours	:	45(T)+15(P)	Total	:	100 Marks
Credits	:	4	SEE Duration	:	3 Hrs

Course Objectives	
1.	To learn the methods for analyzing algorithms and evaluating their performance.
2.	To demonstrate the efficiency of algorithms using asymptotic notations.
3.	To solve problems using various algorithm design methods, including brute force, greedy, divide and conquer, decrease and conquer, transform and conquer, dynamic programming, backtracking, and branch and bound.
4.	To learn the concepts of P and NP complexity classes.
5.	To apply algorithmic techniques in real-world problem solving and enhance logical and analytical thinking

Module – 1: Introduction	**No. of Hours**
What is an Algorithm?, Fundamentals of Algorithmic Problem Solving. FUNDAMENTALS OF THE ANALYSIS OF ALGORITHM EFFICIENCY: Analysis Framework, Asymptotic Notations and Basic Efficiency Classes, Mathematical Analysis of Non recursive Algorithms, Mathematical Analysis of Recursive Algorithms. BRUTE FORCE APPROACHES: Selection Sort and Bubble Sort, Sequential Search and Brute Force String Matching.	9
Module – 2 : Decrease-and-Conquer	**No. of Hours**
BRUTE FORCE APPROACHES: Exhaustive Search (Travelling Salesman probem and Knapsack Problem). DECREASE-AND-CONQUER: Insertion Sort, Topological Sorting. DIVIDE AND CONQUER: Merge Sort, Quick Sort, Binary Tree Traversals, Multiplication of Large Integers and Strassen's Matrix Multiplication	9
Module – 3: Transform-and-Conquer	**No. of Hours**
Balanced Search Trees, Heaps and Heapsort. SPACE-TIME TRADEOFFS: Sorting by Counting: Comparison counting sort, Input Enhancement in String Matching: Horspool's Algorithm	9
Module – 4: Dynamic Programming	**No. of Hours**
Three basic examples, The Knapsack Problem and Memory Functions, Warshall's and Floyd's Algorithms. THE GREEDY METHOD: Prim's Algorithm, Kruskal's Algorithm, Dijkstra's Algorithm, Huffman Trees and Codes	9
Module – 5: Limitations of Algorithmic Power	**No. of Hours**
LIMITATIONS OF ALGORITHMIC POWER: Decision Trees, P, NP, and NP-Complete Problems. COPING WITH LIMITATIONS OF ALGORITHMIC POWER: Backtracking (n-Queens problem, Subset-sum problem), Branch-and-Bound (Knapsack problem), Approximation algorithms for NP-Hard problems (Knapsack problem).	9

Course Outcomes: At the end of the course, the students will be able to	
CO1	Apply asymptotic notational method to analyze the performance of the algorithms in terms of time complexity.
CO2	Demonstrate divide & conquer approaches and decrease & conquer approaches to solve computationa problems.
CO3	Make use of transform & conquer and dynamic programming design approaches to solve the given real world or complex computational problems
CO4	Apply greedy and input enhancement methods to solve graph & string based computational problems.
CO5	Analyse various classes (P,NP and NP Complete) of problems

Text Books	
1.	Introduction to the Design and Analysis of Algorithms, By Anany Levitin, 3rd Edition (Indian), 2017, Pearson.

Reference Text Books	
1.	Computer Algorithms/C++, Ellis Horowitz, SatrajSahni and Rajasekaran, 2nd Edition, 2014, Universities Pres
2.	Introduction to Algorithms, Thomas H. Cormen, Charles E. Leiserson, Ronal L. Rivest, Clifford Stein, 3rd Edition, PHI.
3.	Design and Analysis of Algorithms, S. Sridhar, Oxford (Higher Education)

Web links and Video lectures (e-Resources)
1. https://www.youtube.com/watch?v=EolP-WNP-Zc&pp=ygUQI2J0ZWNoZGFhc3ViamVjdA%3D%3D&themeRefresh=1 2. https://www.youtube.com/watch?v=NqKkxQamroo 3. https://www.youtube.com/playlist?list=PLxCzCOWd7aiHcmS4i14bI0VrMbZTUvlTa

ASSESSMENT DETAILS BOTH (CIE AND SEE)

The weightage of continuous Internal Evaluation (CIE) is 50% and for the Semester End Examination (SEE) is 50%. The minimum passing mark for the CIE is 40% of maximum marks (20 marks out of 50). The minimum passing mark for SEE is 35% of maximum marks (18 marks out of 50). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each course. Student has to secure a minimum 40% (40 marks out of 100) in the total of the CIE and SEE together.

The CIE marks for the theory component of the Integrated Course (IC) shall be 30 marks and for the laboratory component 20 marks.

CONTINUOUS INTERNAL EVALUATION (CIE)

CIE FOR THE THEORY COMPONENT OF IC:

1. Three tests each of 50 marks, after the completion of the syllabus 40%, 70% and 100% respectively.
2. Average of best two internal assessment tests each of 50 marks, scale down to 30 marks.
3. Any two assessment methods as per regulations i.e. Two assignments / Two Quizzes / Weekly test / project work for (20+20) marks, scaled down to **20 marks.**
4. Total marks scored **(30+20 = 50 marks)** scaled down to **25.**

CIE FOR THE PRACTICAL COMPONENT OF IC:

1. On completion of every experiment / program in the laboratory, the students shall be evaluated and marks shall be awarded on the same day.
2. Each experiment is evaluated for 10 marks and scaled down to **5 marks.**
3. Laboratory test at the end of the 15th week of the semester / after completion of all the experiments shall be conducted for **50 marks** and scaled down to **20 marks.**
4. Total marks scored for lab component: **05+20=25 marks**.
5. The minimum marks to be secured in CIE to appear for SEE shall be 10(40% of maximum marks 25) in the theory and 10(40% of Maximum marks 25) in the practical.
6. The laboratory component of the **integrated course** shall be CIE only. However, in SEE, the questions from the practical component shall be included.

Theory				
IA Test	**Exam conducted for**	**Scaled down to**	**Average of best two tests**	**Total**
IA-1	**50**	**30**	**30**	**50/2=25**
IA-2	**50**	**30**		
IA-3	**50**	**30**		
Two Assignments	**2×10=20**	**10**	**10**	
Two Quizzes	**2×10=20**	**10**	**10**	

LAB			
Continuous performance and record writing	**Each experiments evaluated for 10 marks**	**Scaled down to 05 marks**	**5+20=25**
Internal Test + Viva voce	**Exam conducted for 50 marks**	**Scaled down to 20 marks**	

SEMESTER END EXAMINATION (SEE)

1. The question paper shall be set for 100 marks and duration of SEE is 3 hours.
2. The question paper will have two parts: Part-A and Part-B.
3. **Part-A** should contain minimum **Two or Four** quiz questions from each module of 02 marks/ 01 marks each. **Part-A is Compulsory** and carries 20 Marks.
4. **Part-B** contains total 10 questions. Two questions of 16 marks (with minimum of 3 sub questions) from each module with internal choice. Students should answer five full questions, selecting one full question from each module.
5. Students have to answer for 100 marks and marks scored out of 100 shall be proportionally reduced to 50 marks.
6. The maximum marks from the practical component to be included in the SEE question paper is **16 marks.**
7. Question papers to be set as per the Blooms Taxonomy levels.

LABORATORY

Practical Component of IPCC (12 Experiments)

Sl. No	Name of the experiments
1.	Design and implement C/C++ Program to find Minimum Cost Spanning Tree of a given connected undirected graph using Kruskal's algorithm.
2.	Design and implement C/C++ Program to find Minimum Cost Spanning Tree of a given connected undirected graph using Prim's algorithm
3.	a. Design and implement C/C++ Program to solve All-Pairs Shortest Paths problem using Floyd's algorithm. b. Design and implement C/C++ Program to find the transitive closure using Warshal's algorithm.
4.	Design and implement C/C++ Program to find shortest paths from a given vertex in a weighted connected graph to other vertices using Dijkstra's algorithm
5.	Design and implement C/C++ Program to obtain the Topological ordering of vertices in a given digraph
6.	Design and implement C/C++ Program to solve 0/1 Knapsack problem using Dynamic Programming method.

7.	Design and implement C/C++ Program to solve discrete Knapsack and continuous Knapsack problems using greedy approximation method.
8.	Design and implement C/C++ Program to find a subset of a given set S = {sl , s2,.....,sn} of n positive integers whose sum is equal to a given positive integer d.
9.	Design and implement C/C++ Program to sort a given set of n integer elements using Selection Sort method and compute its time complexity.
10.	Design and implement C/C++ Program to sort a given set of n integer elements using Quick Sort method and compute its time complexity
11.	Design and implement C/C++ Program to sort a given set of n integer elements using Merge Sort method and compute its time complexity.
12.	Design and implement C/C++ Program for N Queen's problem using Backtracking.

CO-PO Mapping

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	1	-	2	1	-	-	1	-	1	2
CO2	2	2	-	2	1	-	-	1	-	2	2
CO3	1	1	-	2	1	-	-	-	-	2	1
CO4	1	1	-	2	1	-	-	-	-	1	1
CO5	1	1	-	2	1	-	-	-	-	1	1

Level 3 - High, Level 2 - Moderate, Level 1 - Low

SEMESTER-IV					
DATABASE MANAGEMENT SYSTEMS LAB **Category: PCCL** **(Common to CSE, ISE, CSE(IC), AIML, CSD)**					
Course Code	:	B24CS405L	CIE	:	50 Marks
Teaching Hours L : T : P	:	0 : 0 : 2	SEE	:	50 Marks
Total hours	:	15(P)	Total	:	100 Marks
Credits	:	1	SEE Duration	:	3 Hrs

Course Objectives	
1.	To Provide a strong foundation in database concepts, technology, and practice.
2.	To Practice SQL programming through a variety of database problems
3.	To Understand the relational database design principles.
4.	To Demonstrate the use of concurrency and transactions in database.
5.	To Design and build database applications for real world problems.

Sl. No	**List of Experiments**
	PART-A
1.	Implementation of DDL commands of SQL with suitable examples • Create • Alter • Drop • Truncate • Rename
2.	Implementation of DML commands of SQL with suitable examples • Insert • Update • Delete • Select
3.	Implementation of different types of function with suitable examples • Aggregate Function • Using Parentheses • Column Aliases • Literal Character Strings • Duplicate Row
4.	Implementation of different types of operators in SQL • Arithmetic Operators • Concatenation Operator • Comparison Operator (=,>,>=,<,<=,<>) • Other Comparison Operator (BETWEEN, IN, LIKE, IS NULL) • Logical Operator (AND, OR, NOT)
5.	Implementation of different types of Joins • Inner Join • Outer Join i. Left outer join ii. Right outer join iii. Full outer Join • Natural Join

6.	Study and Implementation of • Group By & having clause • Order by clause • Sorting in Descending & Ascending order
7.	Study & Implementation of different types of constraints. • Primary Key & Foreign Key Constraints • NOT NULL Constraints • Default 1 Constraints • Check constraints • Domain Constraints • Entity Integrity Constraints • Referential Integrity Constraints
	PART-B
8.	Consider the following schema for a Library Database: BOOK(Book_id, Title, Publisher_Name, Pub_Year) BOOK_AUTHORS(Book_id, Author_Name) PUBLISHER(Name, Address, Phone) BOOK_COPIES(Book_id,Programme_id,No-of_Copies) BOOK_LENDING(Book_id,Programme_id,Card_No,Date_Out, Due_Date) LIBRARY_PROGRAMME(Programme_id, Programme_Name, Address) Write SQL queries to 1. Retrieve details of all books in the library–id, title, name of publisher, authors, number of copies in each Programme, etc. 2. Get the particulars of borrowers who have borrowed more than 3 books,but from Jan 2017 to Jun 2017. 3. Delete a book in BOOK table. Update the contents of other tables to reflect this data manipulation operation. 4. Partition the BOOK table base don year of publication .Demonstrate its working with a simple query. 5.Create a view of all books and its number of copies that are currently available in the Library.
9.	Consider the following schema for Order Database: SALESMAN(Salesman_id, Name, City, Commission) CUSTOMER(Customer_id, Cust_Name, City, Grade, Salesman_id) ORDERS(Ord_No,Purchase_Amt,Ord_Date,Customer_id,Salesman_id) Write SQL queries to 1. Count the customers with grades above Bangalore's average. 2. Find the name and numbers of all salesman who had more than one customer. 3. List all the salesman and indicate those who have and don't have customers in their cities (Use UNION operation.) 4. Create a view that finds the salesman who has the customer with the highest order of a day 5. Demonstrate the DELETE operation by removing salesman with id 1000. All his orders must also be deleted.
10.	Consider the schema for Movie Database: ACTOR(Act_id, Act_Name, Act_Gender) DIRECTOR(Dir_id, Dir_Name, Dir_Phone) MOVIES(Mov_id,Mov_Title,Mov_Year,Mov_Lang, Dir_id) MOVIE_CAST(Act_id, Mov_id, Role)

	RATING(Mov_id,Rev_Stars) Write SQL queries to 1. List the titles of all movies directed by„Hitchcock". 2. Find the movie names where one or more actors acted in two or more movies. 3. List all actors who acted in a movie before 2000 and also in a movie after 2015 (use JOIN operation). 4. Find the title of movies and number of stars for each movie that has at least one rating and find the highest number of stars that movie received. Sort the result by movie title. 5. Update rating of all movies directed b 'Steven Spielber'to 5.

Course Outcomes: At the end of the course, the students will be able to	
CO1	Create, Update and query on the database.
CO2	Demonstrate the working of different concepts of DBMS
CO3	Implement SQL commands for database schema creation and modification.
CO4	Apply Primary and Foreign Key constraints to enforce entity integrity and referential integrity
CO5	Explain the purpose and functionality of different types of joins in relational databases

ASSESSMENT DETAILS BOTH (CIE AND SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks).

A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

CONTINUOUS INTERNAL EVALUATION (CIE)

Component	Scale down to	Total Marks
Conduction of experiments and Record Writing (Each Experiment evaluated for 10 marks)	20	20
Internal Lab Test 1(After 6 experiments) Exam conduction for 50 marks	15	15
Internal Lab Test 2 (After 6 experiments) Exam conduction for 50 marks	15	15
	CIE	**50**

SEMESTER END EXAMINATION (SEE)

1. SEE marks for the practical course are 50 Marks. Practical examinations are to be conducted between the schedules mentioned in the academic calendar of the Institution.
2. All laboratory experiments are to be included for practical examination.
3. Students can pick one question (experiment) from the questions lot prepared by the examiners.
4. Evaluation of test write-up, conduction procedure, result and viva will be conducted jointly by examiners.
5. Rubrics suggested for SEE, writeup-20%, Conduction procedure and result in -60%, Viva-voce 20% of maximum marks. SEE for practical shall be evaluated for 100 marks and scored marks shall be scaled down to 50 marks.
6. Change of experiment is allowed only once and 15% of Marks allotted to the procedure part are to be made zero. The minimum duration of SEE is 03 hours.

CO-PO Mapping

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	3	3	3	2	-	-	-	-	1	1
CO2	3	3	3	3	2	-	-	-	-	1	1
CO3	3	3	3	3	2	-	-	-	-	1	1
CO4	3	3	3	3	2	-	-	-	-	1	1
CO5	3	3	3	3	2	-	-	-	-	1	1

Level 3 - High, Level 2 - Moderate, Level 1 - Low

SEMESTER-IV					
DISCRETE MATHEMATICS WITH GRAPH THEORY **Category: ESC/ETC/PLC-IV** **(Common to CSE(IC), AIML)**					
Course Code	:	B24AI461	CIE	:	50 Marks
Teaching Hours L : T : P	:	3:0:0	SEE	:	50 Marks
Total Hours	:	45(T)	Total	:	100 Marks
Credits	:	3	SEE Duration	:	3 Hrs

Course Objectives	
1	To help students understand discrete and continuous mathematical structures
2	Analyzing and solving combinatorial problems using logical reasoning and creativity
3	To impart basics of relations and functions
4	Analyze and solve problems involving graph connectivity
5	Analyze and solve problems involving tree structures

Module-1: Mathematical Logic	**No. of Hours**
Statements and notations, Connectives, Truth Tables, Tautology, Equivalence implication, Normal forms, Quantifiers, Universal quantifiers. Rules of inference, Proof of contradiction, Automatic Theorem Proving.	9
Module-2: Relations And Functions	**No. of Hours**
Relations: Properties of Binary Relations, Equivalence Relation, Transitive closure, Compatibility and Partial ordering relations, Lattices, Hasse diagram. Functions: inverse Function, Composition of functions, Recursive Functions.	9
Module-3: Elementary Combinatorics	**No. of Hours**
Basis of counting, Combinations & Permutations, With repetitions, Constrained repetitions, Binomial Coefficients, Binomial Multinomial theorems, The principles of Inclusion – Exclusion, Pigeon- hole principles and its applications.	9
Module-4: Fundamental Concepts Of Graphs	**No. of Hours**
Basic definitions of graphs and multigraphs adjacency matrices, isomorphism, girth, decompositions, independent sets and cliques, graph complements, vertex coloring, chromatic number, important graph like cubes and the Petersen graph .Paths, cycles, and trails Eulerian circuits. Vertex degrees and counting large bipartite subgraphs, the handshake lemma, Havel-Hakimi Theorem. Directed graphs: weak connectivity, connectivity, strong components, Induction and other fundamental proof techniques	9
Module-5: Trees and Connectivity	**No. of Hours**
Basics: equivalent characterizations of trees, forests ,Spanning trees, Distance and center, Optimization, prims, Kruskal's Theorem and Dijkstra's Theorem, Connectivity, Vertex cuts, separating sets, bonds vertex and edge connectivity, Menger's Theorem, undirected vertex and edge versions.	9

Course Outcomes: At the end of the course, the students will be able to	
CO1	Apply concepts of logical reasoning and mathematical proof techniques in proving theorems and statements
CO2	Apply basic counting techniques to solve the combinatorial problems
CO3	Apply the basic concepts of relations, functions and partially order sets for computer representations
CO4	Use the basic concepts of graph theory and some related theoretical problems
CO5	Analyze and solve problems involving tree structures

Text Books	
1.	Ralph P. Grimaldi: "Discrete and Combinatorial Mathematics", 5th Edition, Pearson Education. 2004.
2.	West, Introduction to Graph Theory, 2nd edition., Prentice Hall

Reference Text Books	
1.	Ralph P. Grimaldi, B V Ramana: "Discrete Mathematical Structures an Applied Introduction", 5th Edition,

	Pearson Education, 2004.
2.	Basavaraj S Anami and Venakanna S Madalli: "Discrete Mathematics – A Concept-based approach", Universities Press, 2016
3.	Kenneth H. Rosen: "Discrete Mathematics and its Applications", 6th Edition, McGraw Hill, 2007.

Web links and Video lectures (e-Resources)
1. https://nptel.ac.in/courses/122106025
2. VTU EDUSAT PROGRAMME – 20
3. http://www.class-central.com/subject/math(MOOCs)

ASSESSMENT DETAILS BOTH (CIE AND SEE)

The weightage of continuous Internal Evaluation (CIE) is 50% and for the Semester End Examination (SEE) is 50%. The minimum passing mark for the CIE is 40% of maximum marks (20 marks out of 50). The minimum passing mark for SEE is 35% of maximum marks (18 marks out of 50). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each course. Student has to secure a minimum 40% (40 marks out of 100) in the total of the CIE and SEE together.

CONTINUOUS INTERNAL EVALUATION (CIE)

CIE FOR THE THEORY:

1. Three tests each of 50 marks, after the completion of the syllabus 40%, 70% and 100% respectively.
2. Average of best two internal assessment tests each of 50 marks, scale down to 30 marks.
3. Any two assessment methods as per regulations i.e. Two assignments / Two Quizzes/ Weekly test / project work for 40 marks, scaled down to 20 marks.
4. Total marks scored (30+20 = 50 marks).
5. The minimum passing mark for the CIE is 40% of maximum marks (20 marks out of 50).

SEMESTER END EXAMINATION (SEE)

1. The question paper shall be set for 100 marks and duration of SEE is 3 hours.
2. The question paper will have two parts: Part-A and Part-B.
3. **Part-A** should contain minimum **Two or Four** quiz questions from each module of 02 marks/ 01 marks each. **Part-A is Compulsory** and it carries 20 Marks.
4. **Part-B** contains total 10 questions.
5. Two questions of 16 marks (with minimum of 3 sub questions) from each module with internal choice.
6. Students should answer five full questions, selecting one full question from each module.
7. Question papers to be set as per the Blooms Taxonomy levels.

CO-PO Mapping

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	3	2	1	-	-	-	-	1	-	2
CO2	3	3	2	1	-	-	-	-	1	-	2
CO3	3	3	2	1	-	-	-	-	1	-	2
CO4	3	3	2	1	-	-	-	-	1	-	2
CO5	3	3	2	1	-	-	-	-	1	-	2

Level 3 - High, Level 2 - Moderate, Level 1 - Low

SEMESTER-IV					
OPTIMIZATION TECHNIQUES **Category: ESC/ETC/PLC-IV** **(Common to CSE(IC), AIML)**					
Course Code	:	B24IC462	CIE	:	50 Marks
Teaching Hours L : T : P	:	3 : 0 : 0	SEE	:	50 Marks
Total Hours	:	45(T)	Total	:	100 Marks
Credits		3	SEE Duration	:	3 Hrs

Course Objectives	
1.	The objective of this course is to make students to learn principles of optimization
2.	To implement the optimization Concepts for the structural engineering problems.
3.	To evaluate different methods of optimization.

Module – 1: Introduction to optimization	**No. of Hours**
Introduction to Classical Methods & Linear Programming Problems Terminology, Design Variables, Constraints, Objective Function, Problem Formulation. Calculus method, Kuhn Tucker conditions.	9
Module – 2: Linear Programming Problem	**No. of Hours**
Linear Programming Problem, Simplex method, Two-phase method, Big-M method, duality, Integer linear Programming, Dynamic Programming, Sensitivity analysis.	9
Module – 3: Single Variable Optimization Problems	**No. of Hours**
Optimality Criterion, Bracketing Methods, Region Elimination Methods, Interval Halving Method, Fibonacci Search Method, Golden Section Method. Gradient Based Methods: Newton-Raphson Method, Bisection Method.	9
Module – 4: Multivariable and Constrained Optimization Techniques	**No. of Hours**
Multi Variable and Constrained Optimization Technique, Optimality criteria, Direct search Method, Simplex search methods, Hooke-Jeeve‘s pattern search method, Powell‘s conjugate direction method, Gradient based method.	9
Module – 5: Intelligent Optimization Techniques	**No. of Hours**
Introduction to Intelligent Optimization, Genetic Algorithm: Types of reproduction operators, crossover & mutation, Simulated Annealing Algorithm, Particle Swarm Optimization (PSO), Genetic Programming (GP): Principles of genetic programming, terminal sets, functional sets, differences between GA & GP	9

Course Outcomes: At the end of the course, the students will be able to	
CO1	Comprehend the techniques and applications of Engineering optimization.
CO2	Analyze characteristics of a general linear programming problem
CO3	Apply basic concepts of mathematics to formulate an optimization problem
CO4	Analyse various methods of solving the unconstrained minimization problem
CO5	Analyze and appreciate variety of performance measures for various optimization problems

Text Books	
1.	S. S. Rao, Engineering Optimisation: Theory and Practice , Wiley, 2008.
2.	K. Deb, Optimization for Engineering design algorithms and Examples , Prentice Hall, 2nd edition 2012.

Reference Text Books	
1.	C.J. Ray, Optimum Design of Mechanical Elements , Wiley, 2007.
2.	R. Saravanan, Manufacturing Optimization through Intelligent Techniques , Taylor & Francis Publications, 2006.
3.	D. E. Goldberg, Genetic algorithms in Search, Optimization, and Machine Learning , Addison-Wesley Longman Publishing, 1989.

Web links and Video lectures (e-Resources)
https://www.youtube.com/watch?v=wEdZLKMMZ8o&list=PLwdnzlV3ogoXKKb9nABDWYltTDgi37lYD
https://www.youtube.com/watch?v=GMTvoKRfxQw&list=PLGbjwqYC00hsy6XGalOBAphm2tdeLbgK0
https://www.youtube.com/watch?v=fszNBvdfKrY

ASSESSMENT DETAILS BOTH (CIE AND SEE)

The weightage of continuous Internal Evaluation (CIE) is 50% and for the Semester End Examination (SEE) is 50%. The minimum passing mark for the CIE is 40% of maximum marks (20 marks out of 50). The minimum passing mark for SEE is 35% of maximum marks (18 marks out of 50). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each course. Student has to secure a minimum 40% (40 marks out of 100) in the total of the CIE and SEE together.

CONTINUOUS INTERNAL EVALUATION (CIE)

CIE FOR THE THEORY:

1. Three tests each of 50 marks, after the completion of the syllabus 40%, 70% and 100% respectively.
2. Average of best two internal assessment tests each of 50 marks, scale down to 30 marks.
3. Any two assessment methods as per regulations i.e. Two assignments / Two Quizzes/ Weekly test / project work for 40 marks, scaled down to 20 marks.
4. Total marks scored (30+20 = 50 marks).
5. The minimum passing mark for the CIE is 40% of maximum marks (20 marks out of 50).

SEMESTER END EXAMINATION (SEE)

1. The question paper shall be set for 100 marks and duration of SEE is 3 hours.
2. The question paper will have two parts: Part-A and Part-B.
3. **Part-A** should contain minimum **Two or Four** quiz questions from each module of 02 marks/ 01 marks each. **Part-A is Compulsory** and it carries 20 Marks.
4. **Part-B** contains total 10 questions.
5. Two questions of 16 marks (with minimum of 3 sub questions) from each module with internal choice.
6. Students should answer five full questions, selecting one full question from each module.
7. Question papers to be set as per the Blooms Taxonomy levels.

CO-PO Mapping

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	2	-	-	-	-	-	-	-	-	-	-
CO2	2	2	-	1	1	-	-	-	-	-	-
CO3	-	-	-	-	-	-	1	1	-	-	-
CO4	2	-	3	-	1	-	-	-	-	-	-
CO5	-	-	2	-	-	1	-	-	-	-	-

Level 3 - High, Level 2 - Moderate, Level 1 - Low

SEMESTER-IV					
FOUNDATION OF ETHICAL HACKING **Category: ESC/ETC/PLC-IV**					
Course Code	:	B24IC463	CIE	:	50 Marks
Teaching Hours L : T : P	:	3:0:0	SEE	:	50 Marks
Total Hours	:	45(T)	Total	:	100 Marks
Credits	:	3	SEE Duration	:	3 Hrs

Course Objectives	
1.	To understand the basics of computer based vulnerabilities.
2.	To explore different foot printing, reconnaissance and scanning methods.
3.	To expose the enumeration and vulnerability analysis methods.
4.	To understand hacking options available in Web and wireless applications.
5.	To explore the options for network protection.
6.	To practice tools to perform ethical hacking to expose the vulnerabilities.

Module – 1: Introduction	**No. of Hours**
Ethical Hacking Overview - Role of Security and Penetration Testers .- Penetration-Testing Methodologies- Laws of the Land - Overview of TCP/IP- The Application Layer - The Transport Layer - The Internet Layer - IP Addressing .- Network and Computer Attacks - Malware - Protecting Against Malware Attacks.- Intruder Attacks - Addressing Physical Security	9
Module – 2: Foot Printing, Reconnaissance and Scanning Networks	**No. of Hours**
Footprinting Concepts - Footprinting through Search Engines, Web Services, Social Networking Sites, Website, Email - Competitive Intelligence - Footprinting through Social Engineering - Footprinting Tools - Network Scanning Concepts - Port-Scanning Tools - Scanning Techniques - Scanning Beyond IDS and Firewall	9
Module – 3: Enumeration and Vulnerability Analysis	**No. of Hours**
Enumeration Concepts - NetBIOS Enumeration – SNMP, LDAP, NTP, SMTP and DNS Enumeration - Vulnerability Assessment Concepts - Desktop and Server OS Vulnerabilities - Windows OS Vulnerabilities - Tools for Identifying Vulnerabilities in Windows- Linux OS Vulnerabilities- Vulnerabilities of Embedded Oss	9
Module – 4: System Hacking	**No. of Hours**
Hacking Web Servers - Web Application Components- Vulnerabilities - Tools for Web Attackers and Security Testers Hacking Wireless Networks - Components of a Wireless Network – Wardriving- Wireless Hacking - Tools of the Trade.	9
Module – 5: Network Protection Systems	**No. of Hours**
Access Control Lists. - Cisco Adaptive Security Appliance Firewall - Configuration and Risk Analysis Tools for Firewalls and Routers - Intrusion Detection and Prevention Systems - NetworkBased and Host-Based IDSs and IPSs - Web Filtering - Security Incident Response Teams – Honeypots.	9

Course Outcomes: At the end of the course, the students will be able to	
CO1	To express knowledge on basics of computer based vulnerabilities
CO2	To gain understanding on different foot printing, reconnaissance and scanning methods
CO3	To demonstrate the enumeration and vulnerability analysis methods
CO4	To gain knowledge on hacking options available in Web and wireless applications
CO5	To acquire knowledge on the options for network protection.

Text Books	
1.	Michael T. Simpson, Kent Backman, and James E. Corley, Hands-On Ethical Hacking and Network Defense, Course Technology, Delmar Cengage Learning, 2010.
2.	The Basics of Hacking and Penetration Testing - Patrick Engebretson, SYNGRESS, Elsevier, 2013.
3.	The Web Application Hacker's Handbook: Finding and Exploiting Security Flaws, Dafydd Stuttard and Marcus Pinto, 2011.

Reference Text Books	
1.	Black Hat Python: Python Programming for Hackers and Pentesters, Justin Seitz , 2014.

ASSESSMENT DETAILS BOTH (CIE AND SEE)

The weightage of continuous Internal Evaluation (CIE) is 50% and for the Semester End Examination (SEE) is 50%. The minimum passing mark for the CIE is 40% of maximum marks (20 marks out of 50). The minimum passing mark for SEE is 35% of maximum marks (18 marks out of 50). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each course. Student has to secure a minimum 40% (40 marks out of 100) in the total of the CIE and SEE together.

CONTINUOUS INTERNAL EVALUATION (CIE)

CIE FOR THE THEORY:

1. Three tests each of 50 marks, after the completion of the syllabus 40%, 70% and 100% respectively.
2. Average of best two internal assessment tests each of 50 marks, scale down to 30 marks.
3. Any two assessment methods as per regulations i.e. Two assignments / Two Quizzes/ Weekly test / project work for 40 marks, scaled down to 20 marks.
4. Total marks scored (30+20 = 50 marks).
5. The minimum passing mark for the CIE is 40% of maximum marks (20 marks out of 50).

SEMESTER END EXAMINATION (SEE)

1. The question paper shall be set for 100 marks and duration of SEE is 3 hours.
2. The question paper will have two parts: Part-A and Part-B.
3. **Part-A** should contain minimum **Two or Four** quiz questions from each module of 02 marks/ 01 marks each. **Part-A is Compulsory** and it carries 20 Marks.
4. **Part-B** contains total 10 questions.
5. Two questions of 16 marks (with minimum of 3 sub questions) from each module with internal choice.
6. Students should answer five full questions, selecting one full question from each module.
7. Question papers to be set as per the Blooms Taxonomy levels

CO-PO Mapping

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	2	1	-	-	-	-	-	-	-	-	-
CO2	2	1	1	2	-	-	-	1	-	-	1
CO3	2	2	1	1	-	-	-	2	-	-	-
CO4	2	1	1	-	-	-	-	1	-	-	1
CO5	2	1	1	1	-	-	-	-	-	-	1

Level 3 – High, Level 2 – Moderate, Level 1 – Low

SEMESTER-IV					
FOUNDATION OF DATA SCIENCE **Category: ESC/ETC/PLC-IV**					
Course Code	:	B24IC464	CIE	:	50 Marks
Teaching Hours L : T : P	:	3:0:0	SEE	:	50 Marks
Total Hours	:	45(T)	Total	:	100 Marks
Credits	:	3	SEE Duration	:	3 Hrs

Course Objectives	
1.	To understand the data science fundamentals and process.
2.	To learn to describe the data for the data science process.
3.	To learn to describe the relationship between data.
4.	To utilize the Python libraries for Data Wrangling.
5.	To present and interpret data using visualization libraries in Python.

Module – 1: Introduction	**No. of Hours**
Data Science: Benefits and uses – facets of data - Data Science Process: Overview – Defining research goals – Retrieving data – Data preparation - Exploratory Data analysis – build the model– presenting findings and building applications - Data Mining - Data Warehousing – Basic Statistical descriptions of Data	9
Module – 2: Describing Data	**No. of Hours**
Types of Data - Types of Variables -Describing Data with Tables and Graphs –Describing Data with Averages - Describing Variability - Normal Distributions and Standard (z) Scores	9
Module – 3: Describing Relationships	**No. of Hours**
Correlation –Scatter plots –correlation coefficient for quantitative data –computational formula for correlation coefficient – Regression –regression line –least squares regression line – Standard error of estimate – interpretation of r2 –multiple regression equations –regression towards the mean	9
Module – 4: Python Libraries for Data Wrangling	**No. of Hours**
Basics of Numpy arrays –aggregations –computations on arrays –comparisons, masks, boolean logic – fancy indexing – structured arrays – Data manipulation with Pandas – data indexing and selection – operating on data – missing data – Hierarchical indexing – combining datasets – aggregation and grouping – pivot tables	9
Module – 5: Data Visualization	**No. of Hours**
Importing Matplotlib – Line plots – Scatter plots – visualizing errors – density and contour plots – Histograms – legends – colors – subplots – text and annotation – customization – three dimensional plotting - Geographic Data with Basemap - Visualization with Seaborn	9

Course Outcomes: At the end of the course, the students will be able to	
CO1	Define the data science process
CO2	Understand different types of data description for data science process
CO3	Gain knowledge on relationships between data
CO4	Use the Python Libraries for Data Wrangling
CO5	Apply visualization Libraries in Python to interpret and explore data

Text Books	
1.	David Cielen, Arno D. B. Meysman, and Mohamed Ali, “Introducing Data Science”, Manning Publications, 2016. (Unit I)
2.	Robert S. Witte and John S. Witte, “Statistics”, 11th Edition, Wiley Publications, 2017. (Units II and III)
3.	Jake VanderPlas, “Python Data Science Handbook”, O’Reilly, 2016. (Units IV and V)

Reference Text Books	
1.	Allen B. Downey, “Think Stats: Exploratory Data Analysis in Python”, Green Tea Press,2014

ASSESSMENT DETAILS BOTH (CIE AND SEE)

The weightage of continuous Internal Evaluation (CIE) is 50% and for the Semester End Examination (SEE) is

50%. The minimum passing mark for the CIE is 40% of maximum marks (20 marks out of 50). The minimum passing mark for SEE is 35% of maximum marks (18 marks out of 50). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each course. Student has to secure a minimum 40% (40 marks out of 100) in the total of the CIE and SEE together.

CONTINUOUS INTERNAL EVALUATION (CIE)

CIE FOR THE THEORY:

1. Three tests each of 50 marks, after the completion of the syllabus 40%, 70% and 100% respectively.
2. Average of best two internal assessment tests each of 50 marks, scale down to 30 marks.
3. Any two assessment methods as per regulations i.e. Two assignments / Two Quizzes/ Weekly test / project work for 40 marks, scaled down to 20 marks.
4. Total marks scored (30+20 = 50 marks).
5. The minimum passing mark for the CIE is 40% of maximum marks (20 marks out of 50).

SEMESTER END EXAMINATION (SEE)

1. The question paper shall be set for 100 marks and duration of SEE is 3 hours.
2. The question paper will have two parts: Part-A and Part-B.
3. **Part-A** should contain minimum **Two or Four** quiz questions from each module of 02 marks/ 01 marks each. **Part-A is Compulsory** and it carries 20 Marks.
4. **Part-B** contains total 10 questions.
5. Two questions of 16 marks (with minimum of 3 sub questions) from each module with internal choice.
6. Students should answer five full questions, selecting one full question from each module.
7. Question papers to be set as per the Blooms Taxonomy levels.

CO-PO Mapping

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	2	2	1	2	2	-	-	-	1	1	1
CO2	2	1	-	1	1	-	-	-	2	1	1
CO3	2	2	1	2	2	1	1	-	1	2	1
CO4	3	2	2	1	2	-	-	-	1	1	2
CO5	2	2	1	2	2	-	-	-	1	1	1

Level 3 - High, Level 2 - Moderate, Level 1 - Low

SEMESTER IV					
MICROSOFT POWER BI **Category: AEC/SEC-IV** **(Common to CSE, ISE, AIML, CSE(IC), CSD)**					
Course Code	:	B24IS481	CIE	:	50 Marks
Teaching Hours L : T : P	:	1:0:0	SEE	:	50 Marks
Total Hours	:	15(T)	Total	:	100 Marks
Credits	:	1	SEE Duration	:	1 Hrs

Course Objectives	
1.	Understand the Core Concepts and Architecture of Power BI
2.	Import, Transform, and Model Data Effectively
3.	Design and Develop Interactive Reports and Dashboards
4.	Implement Advanced Data Analysis Using DAX
5.	Publish, Share, and Collaborate on Power BI Reports

Module – 1: Introduction to Business Intelligence and Power BI	**No. of Hours**
Overview of Business Intelligence (BI) , Introduction to Microsoft Power BI , Power BI Desktop vs. Power BI Service vs. Power BI Mobile , Installing and navigating Power BI Desktop, Power BI Ecosystem Overview, Use Cases of Power BI in Different Industries, Power BI File Types and Formats, Navigating the Power BI Desktop Interface, Power BI Community and Support Resources	3
Module – 2 : Data Loading and Transformation (Power Query)	**No. of Hours**
Connecting to various data sources (Excel, SQL Server, Web, CSV, etc.) Using Power Query Editor for data transformation Cleaning, shaping, and filtering data Merging and appending queries Creating custom columns Data types and handling missing values, Connecting to Diverse Data Sources, Data Transformation Techniques, Parameterization and Function Creation, Data Type Handling and Locale Settings	3
Module – 3: Data Preparation with Power Query	**No. of Hours**
Introduction to Power Query Editor, Basic data cleaning and transformation Removing nulls and duplicates,Changing data types,Filtering rows and columns, Creating simple calculated columns Data Profiling and Diagnostics, Text Data Preparation, Numerical Data Preparation, Date and Time Handling, Conditional Column Creation	3
Module – 4: Data Visualization and Report Building	**No. of Hours**
Overview of visualization types (bar charts, line charts, maps, gauges, etc.), Formatting and customizing visualizations, Adding slicers, filters, and drill-throughs Creating and organizing multiple report pages Using themes and templates for consistency Understanding Visual Types and Use-Cases Interactivity and Navigation, Accessibility and UX Design Principles	3
Module – 5: Power BI Integration and Advanced Features	**No. of Hours**
Power BI with Excel (PivotTables, PowerPivot), Using Power BI with SharePoint and Teams, Power BI with Power Automate and Power Apps (basic overview), Embedding Power BI reports in websites and portals	3

Course Outcomes: At the end of the course, the students will be able to	
CO1	Understand the architecture, components, and functionalities of the Power BI ecosystem including Desktop, Service, and Mobile platforms.
CO2	Demonstrate the ability to connect to various data sources and perform data transformation using Power Quer for clean and structured datasets.
CO3	Develop data models with relationships, calculated columns, and DAX measures to support accurate and efficient data analysis.
CO4	Create interactive and visually appealing reports and dashboards using a variety of visualization tools and techniques in Power BI.
CO5	Publish and share reports through the Power BI Service, enabling collaboration, scheduled data refresh, and secure data distribution.

Text Books	
1.	**Data Visualization with Microsoft Power BI Authors:** Alex Kolokolov & Maxim Zelensky,**Publisher:** O'Reilly Media,**Release:** September 2024
2.	Microsoft Power BI Cookbook – Third Edition ,**Authors:** Greg Deckler & Brett Powell, **Publisher:** Packt Publishing, **Release:** July 2024

Reference Text Books	
1.	Expert Data Modeling with Power BI – Second Edition , Authors: **Soheil Bakhshi & Christian Wade** Publisher: **Packt Publishing,** Release: **April 2023**
2.	Microsoft Power BI Performance Best Practices – Second Edition, **Authors:** Thomas LeBlanc & Bhavik Merchant **Publisher:** Packt Publishing **Release:** August 2024
3.	Microsoft Power BI: The Complete Masterclass – 2025 Edition by Nikolai Schuler

Web links and Video lectures (e-Resources)
1. https://learn.microsoft.com/en-us/training/powerplatform/power-bi
2. https://www.youtube.com/watch?v=e6QD8lP-m6E
3. https://www.youtube.com/watch?v=e6QD8lP-m6E

ASSESSMENT DETAILS (BOTH CIE AND SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

CONTINUOUS INTERNAL EVALUATION (CIE)

CIE FOR THE THEORY:

1. Three tests each of 50 marks, after the completion of the syllabus 40%, 70% and 100% respectively.
2. Average of best two internal assessment tests each of 50 marks, scale down to 30 marks.
3. Any two assessment methods as per regulations i.e. Two assignments / Two Quizzes/ Weekly test / project work for 40 marks, scaled down to 20 marks.
4. Total marks scored (30+20 = 50 marks).
5. The minimum passing mark for the CIE is 40% of maximum marks (20 marks out of 50).

SEMESTER END EXAMINATION (SEE)

SEE paper shall be set for 50 questions, each of the 01 marks. The pattern of the question paper is MCQ (multiple choice questions). The time allotted for SEE is 01 hour. The student has to secure a minimum of 35% of the maximum marks meant for SEE.

CO-PO Mapping

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	1	1	1	2	-	-	-	-	1	1
CO2	3	3	2	2	3	-	-	-	-	1	0
CO3	3	2	2	1	3	-	-	-	-	1	0
CO4	2	1	3	2	3	-	-	-	1	2	1
CO5	2	1	2	2	3	-	-	-	2	2	2

SEMESTER-IV					
DEVOPS **Category: AEC/SEC-IV** **(Common to CSE, ISE, AIML, CSE(IC), CSD)**					
Course Code	:	B24CS482	CIE	:	50 Marks
Teaching Hours L : T : P	:	0 : 0 : 2	SEE	:	50 Marks
Total Hours	:	15(P)	Total	:	100 Marks
Credits	:	1	SEE Duration	:	3 Hrs

Course Objectives	
1.	To introduce DevOps terminology, definition & concepts
2.	To understand the different Version control tools like Git, Mercurial
3.	To understand the concepts of Continuous Integration/ Continuous Testing/ Continuous Deployment)
4.	To understand Configuration management using Ansible
5.	Illustrate the benefits and drive the adoption of cloud-based Devops tools to solve real world problems

Sl. No	**List of Experiments**
1.	Introduction to Maven and Gradle: Overview of Build Automation Tools, Key Differences Between Maven and Gradle, Installation and Setup
2.	Working with Maven: Creating a Maven Project, Understanding the POM File, Dependency Management and Plugins
3.	Working with Gradle: Setting Up a Gradle Project, Understanding Build Scripts (Groovy and Kotlin DSL), Dependency Management and Task Automation
4.	Practical Exercise: Build and Run a Java Application with Maven, Migrate the Same Application to Gradle
5.	Introduction to Jenkins: What is Jenkins? Installing Jenkins on Local or Cloud Environment, Configuring Jenkins for First Use
6.	Continuous Integration with Jenkins: Setting Up a CI Pipeline, Integrating Jenkins with Maven/Gradle, Running Automated Builds and Tests
7.	Configuration Management with Ansible: Basics of Ansible: Inventory, Playbooks, and Modules, Automating Server Configurations with Playbooks, Hands-On: Writing and Running a Basic Playbook
8.	Practical Exercise: Set Up a Jenkins CI Pipeline for a Maven Project, Use Ansible to Deploy Artifacts Generated by Jenkins
9.	Introduction to Azure DevOps: Overview of Azure DevOps Services, Setting Up an Azure DevOps Account and Project
10.	Creating Build Pipelines: Building a Maven/Gradle Project with Azure Pipelines, Integrating Code Repositories (e.g., GitHub, Azure Repos), Running Unit Tests and Generating Reports
11.	Creating Release Pipelines: Deploying Applications to Azure App Services, Managing Secrets and Configuration with Azure Key Vault, Hands-On: Continuous Deployment with Azure Pipelines
12.	Practical Exercise and Wrap-Up: Build and Deploy a Complete DevOps Pipeline, Discussion on Best Practices and Q&A

Course Outcomes: At the end of the course, the students will be able to	
CO1	Demonstrate different actions performed through Version control tools like Git
CO2	Perform Continuous Integration and Continuous Testing and Continuous Deployment using Jenkins by building and automating test cases using Maven & Gradle.
CO3	Experiment with configuration management using Ansible.
CO4	Demonstrate Cloud-based DevOps tools using Azure DevOps.

ASSESSMENT DETAILS BOTH (CIE AND SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks).

A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

CONTINUOUS INTERNAL EVALUATION (CIE)

Component	Scale down to	Total Marks
Conduction of experiments and Record Writing (Each Experiment evaluated for 10 marks)	20	20
Internal Lab Test 1(After 6 experiments) Exam conduction for 50 marks	15	15
Internal Lab Test 2 (After 6 experiments) Exam conduction for 50 marks	15	15
	CIE	**50**

SEMESTER END EXAMINATION (SEE)

1. SEE marks for the practical course are 50 Marks. Practical examinations are to be conducted between the schedules mentioned in the academic calendar of the Institution.
2. All laboratory experiments are to be included for practical examination.
3. Students can pick one question (experiment) from the questions lot prepared by the examiners.
4. Evaluation of test write-up, conduction procedure, result and viva will be conducted jointly by examiners.
5. Rubrics suggested for SEE, writeup-20%, Conduction procedure and result in -60%, Viva-voce 20% of maximum marks. SEE for practical shall be evaluated for 100 marks and scored marks shall be scaled down to 50 marks.
6. Change of experiment is allowed only once and 15% of Marks allotted to the procedure part are to be made zero. The minimum duration of SEE is 03 hours.

CO-PO Mapping

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	2	2	-	3	-	-	-	2	2	2
CO2	2	2	3	2	3	-	-	-	2	2	2
CO3	2	2	2	2	3	-	-	-	2	2	2
CO4	2	2	3	2	3	-	-	-	2	2	2

Level 3 - High, Level 2 - Moderate, Level 1 - Low

SEMESTER-IV					
DATA SCIENCE LABORATORY **Category: AEC/SEC-IV**					
Course Code	:	B24IC483	CIE	:	50 Marks
Teaching Hours L : T : P	:	0 : 0: 2	SEE	:	50 Marks
Total Hours	:	15(P)	Total	:	100 Marks
Credits	:	1	SEE Duration	:	3 Hrs

Course Objectives	
1.	To understand the python libraries for data science
2.	To understand the basic Statistical and Probability measures for data science
3.	To learn descriptive analytics on the benchmark data sets.
4.	To apply correlation and regression analytics on standard data sets.
5.	To present and interpret data using visualization packages in Python.

Sl. No	**Suggested Experiments**
1.	Download, install and explore the features of NumPy, SciPy, Jupyter, Statsmodels and Pandas packages
2.	Working with Numpy arrays
3.	Working with Pandas data frames
4.	Reading data from text files, Excel and the web and exploring various commands for doing descriptive analytics on the Iris data set.
5.	Use the diabetes data set from UCI and Pima Indians Diabetes data set for performing the following: a. Univariate analysis: Frequency, Mean, Median, Mode, Variance, Standard Deviation, Skewness and Kurtosis. b. Bivariate analysis: Linear and logistic regression modeling c. Multiple Regression analysis d. Also compare the results of the above analysis for the two data sets.
6.	Apply and explore various plotting functions on UCI data sets. a. Normal curves b. Density and contour plots c. Correlation and scatter plots d. Histograms e. Three dimensional plotting
7.	Visualizing Geographic Data with Basemap

Note:
Tools: Python, Numpy, Scipy, Matplotlib, Pandas, statmodels, seaborn, plotly, bokeh Note: Example data sets like: UCI, Iris, Pima Indians Diabetes etc.

Course Outcomes: At the end of the course, the students will be able to	
CO1	Make use of the python libraries for data science
CO2	Make use of the basic Statistical and Probability measures for data science.
CO3	Perform descriptive analytics on the benchmark data sets.
CO4	Perform correlation and regression analytics on standard data sets
CO5	Present and interpret data using visualization packages in Python.

ASSESSMENT DETAILS BOTH (CIE AND SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks).

A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

CONTINUOUS INTERNAL EVALUATION (CIE)

Component	Scale down to	Total Marks
Conduction of experiments and Record Writing (Each Experiment evaluated for 10 marks)	20	20
Internal Lab Test 1(After 6 experiments) Exam conduction for 50 marks	15	15
Internal Lab Test 2 (After 6 experiments) Exam conduction for 50 marks	15	15
	CIE	**50**

SEMESTER END EXAMINATION (SEE)

1. SEE marks for the practical course are 50 Marks. Practical examinations are to be conducted between the schedules mentioned in the academic calendar of the Institution.
2. All laboratory experiments are to be included for practical examination.
3. Students can pick one question (experiment) from the questions lot prepared by the examiners.
4. Evaluation of test write-up, conduction procedure, result and viva will be conducted jointly by examiners.
5. Rubrics suggested for SEE, writeup-20%, Conduction procedure and result in -60%, Viva-voce 20% of maximum marks. SEE for practical shall be evaluated for 100 marks and scored marks shall be scaled down to 50 marks.
6. Change of experiment is allowed only once and 15% of Marks allotted to the procedure part are to be made zero. The minimum duration of SEE is 03 hours.

CO-PO Mapping

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	3	1	1	1	-	-	-	2	1	3
CO2	3	1	2	3	2	-	-	-	1	2	3
CO3	1	1	3	1	3	-	-	-	3	3	1
CO4	1	1	1	2	3	-	-	-	2	3	3
CO5	1	3	3	2	2	-	-	-	1	3	1

Level 3 - High, Level 2 - Moderate, Level 1 - Low

SEMESTER-IV					
EMBEDDED SYSTEM AND IOT **Category: AEC/SEC-IV**					
Course Code	:	B24IC484	CIE	:	50 Marks
Teaching Hours L : T : P	:	0 : 0: 2	SEE	:	50 Marks
Total Hours	:	15(P)	Total	:	100 Marks
Credits	:	1	SEE Duration	:	3 Hrs

Course Objectives	
1.	To learn the internal architecture and programming of an embedded processor.
2.	To introduce interfacing, I/O devices to the processor.
3.	To introduce the evolution of the Internet of Things (IoT).
4.	To build a small low-cost embedded IoT system using Arduino/Raspberry Pi/ open platform.
5.	To apply the concept of the Internet of Things in real-world scenario.

Sl. No	**Suggested Experiments**
1.	Write 8051 Assembly Language experiments using simulator
2.	Test data transfer between registers and memory
3.	Perform ALU operations
4.	Write Basic and arithmetic Programs Using Embedded C
5.	Introduction to Arduino platform and programming
6.	Explore different communication methods with IoT devices (Zigbee, GSM, Bluetooth)
7.	Introduction to Raspberry PI platform and python programming
8.	Interfacing sensors with Raspberry PI
9.	Communicate between Arduino and Raspberry PI using any wireless medium
10.	Setup a cloud platform to log the data
11.	Log Data using Raspberry PI and upload to the cloud platform
12.	Design an IOT based system

Course Outcomes: At the end of the course, the students will be able to	
CO1	Explain the architecture of embedded processors.
CO2	Write embedded C programs.
CO3	Design simple embedded applications.
CO4	Compare the communication models in IOT
CO5	Design IoT applications using Arduino/Raspberry Pi /open platform

ASSESSMENT DETAILS BOTH (CIE AND SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks).

A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

CONTINUOUS INTERNAL EVALUATION (CIE)

Component	Scale down to	Total Marks
Conduction of experiments and Record Writing (Each Experiment evaluated for 10 marks)	20	20
Internal Lab Test 1(After 6 experiments) Exam conduction for 50 marks	15	15
Internal Lab Test 2 (After 6 experiments) Exam conduction for 50 marks	15	15
	CIE	**50**

SEMESTER END EXAMINATION (SEE)

1. SEE marks for the practical course are 50 Marks. Practical examinations are to be conducted between the schedules mentioned in the academic calendar of the Institution.
2. All laboratory experiments are to be included for practical examination.
3. Students can pick one question (experiment) from the questions lot prepared by the examiners.
4. Evaluation of test write-up, conduction procedure, result and viva will be conducted jointly by examiners.
5. Rubrics suggested for SEE, writeup-20%, Conduction procedure and result in -60%, Viva-voce 20% of maximum marks. SEE for practical shall be evaluated for 100 marks and scored marks shall be scaled down to 50 marks.
6. Change of experiment is allowed only once and 15% of Marks allotted to the procedure part are to be made zero. The minimum duration of SEE is 03 hours.