RN SHETTY TRUST ®

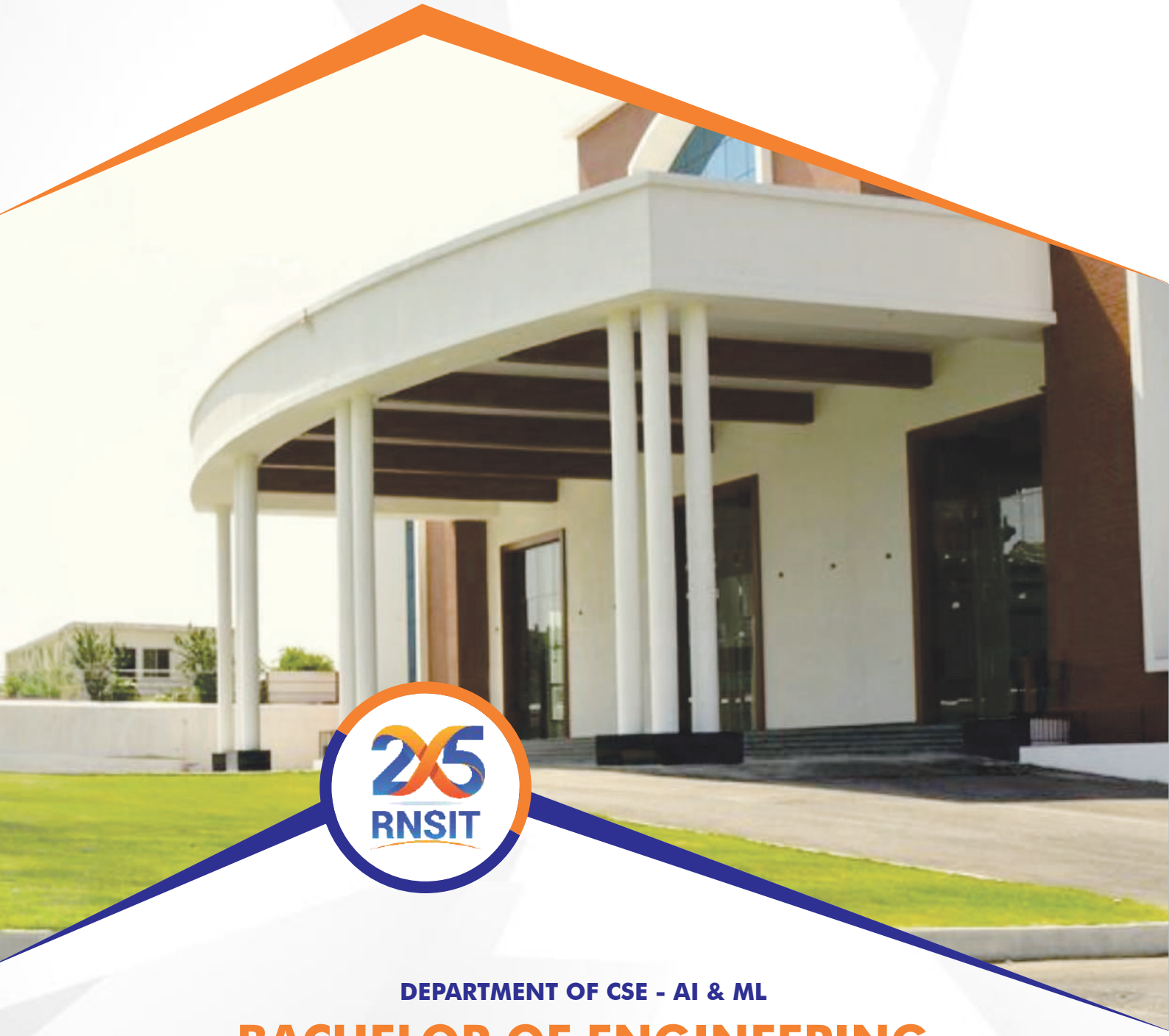
RNS INSTITUTE OF TECHNOLOGY

Autonomous Institution affiliated to Visvesvaraya Technological University, Belagavi
Approved By AICTE, New Delhi. Accredited by NAAC 'A+' Grade
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Dr. R N Shetty
Founder

ESTD.: 2001
An Institute with a Difference



25 RNSIT

DEPARTMENT OF CSE - AI & ML

BACHELOR OF ENGINEERING

Scheme and Syllabus of III & IV Semesters

2025 SCHEME

www.rnsit.ac.in

Scheme and Syllabus
Batch 2025 – 2029

(As per NEP-2020)
(Effective from the academic year 2025 – 26)

About RNSIT

RNS Institute of Technology, familiar as RNSIT was established in the year 2001. It is the brainchild of Dr. R. N. Shetty, a well-known industrialist, and a great philanthropist. The institution was established with the sole purpose of imparting quality education in Engineering, Technology and Management. Being one of the premier engineering colleges in the country RNSIT is marching towards placing itself on the global map by excelling in academics and placements.

Lush green campus, state of the art infrastructure, well equipped laboratories, hundreds of activities, numerous new initiatives, consistent VTU ranks, path breaking placements, cultural extravaganza, Sports events, 5600+ students and 300+ faculty – with all these RNSIT has become dream destination for engineering aspirants across the country.

Vision

Building RNSIT into a World Class Institution

Mission

To impart high quality education in Engineering, Technology and Management with a difference, enabling students to excel in their career by

- Attracting quality Students and preparing them with a strong foundation in fundamentals so as to achieve distinctions in various walks of life leading to outstanding contributions
- Imparting value based, need based, choice based and skill based professional education to the aspiring youth and carving them into disciplined, World class Professionals with social responsibility.
- Promoting excellence in Teaching, Research and Consultancy that galvanizes academic consciousness among Faculty and Students
- Exposing Students to emerging frontiers of knowledge in various domains and make them suitable for Industry, Entrepreneurship, Higher studies, and Research & Development
- Providing freedom of action and choice for all the Stakeholders with better visibility

About CSE (AI & ML)

The Department of Artificial Intelligence and Machine learning Engineering at RNSIT was established in the year 2020, aiding learning in the booming field of AI. The Department provides an excellent learning ambience which encourages the students to do deep research in this field.

RNSIT has established a very supportive learning culture along with excellent infrastructure which meets all the requirements of the students to have a blissful experience in their learning journey. AI & ML, being the most trending topic in the industry is turning heads and attracting more people into this field. The department has conducted and hosted many insightful webinars, seminars, workshops, certification courses, expert talks, etc. which broaden the students' knowledge. The department integrates Traditional Teaching with Coursera, NASSCOM, IBM Cognitive Class and Infosys Springboard which enables students to get the most out of their study time. Student development programs are organised to train students on current industry requirements like AI, Machine Learning, Data Science, IOT, Python Programming, Cloud Computing, Android Development, Web Technologies etc.

Artificial Intelligence and Machine Learning are as much a part of our lives as smart phones now. Every walk of life, every job now has AI & ML intertwined with it. Every global company that needs engineers also needs them to have considerable skills in AI & ML. At AI & ML RNSIT, the students are prepared for the future where AI & ML hold the key to success. The department has an ecosystem which enables teaching, nurturing and training the AI & ML graduates to be formidable engineers who can identify, define, and solve problems using the state-of-the-art technology to develop the society as well as the world into a seamlessly connected ecosystem.

Vision

Empowering AI & ML Engineers to seamlessly integrate Society and Technology

Mission

- To Inculcate, strong mathematical foundations as applied to AI & ML domain.
- To Equip AI & ML graduates with skills to meet Industrial and Societal challenges.
- To Foster ethical values& engineering norms and standards in AI & ML graduates.

Program Educational Objectives

The graduates of AI &ML program will be enabled to

- **PEO1**: Possess knowledge and skills in applied mathematics, AI, ML and their applications in problem solving.
- **PEO2**: Work in competitive environment in IT and ITES profiles across the globe maintaining high moral and ethical process.
- **PEO3**: Grow to their best potential as AI & ML engineers, Data scientists and Data Analysis.

Program Outcomes (POs)

1. **PO1: Engineering Knowledge**: Apply knowledge of mathematics, natural science, computing, engineering fundamentals and an engineering specialization as specified WK1 to WK4 respectively to develop to the solution of complex engineering problems.
2. **PO2: Problem Analysis**: Identify, formulate, review research literature and analyze complex engineering problems reaching substantiated conclusions with consideration for sustainable development. (WK1 to WK4)
3. **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)
4. **PO4: Conduct Investigations of Complex Problems**: Conduct investigations of complex engineering problems using research-based knowledge including design of experiments, modelling, analysis and interpretation of data to provide valid conclusions (WK8)
5. **PO5: Engineering Tool Usage**: Create, select and apply appropriate techniques, resources and modern engineering & IT tools, including prediction and modelling recognizing their limitations to solve complex engineering problems. (WK2 and WK6)
6. **PO6: The Engineer and The World**: Analyze and evaluate societal and environmen tal aspects while solving complex engineering problems for its impact on sustainability with reference to economy, health, safety, legal framework, culture and environment. (WK1, WK5, and WK7).
7. **PO7: Ethics**: Apply ethical principles and commit to professional ethics, human values, diversity and inclusion; adhere to national & international laws. (WK9)
8. **PO8: Individual and Collaborative Teamwork**: Function effectively as an individual, and as a member or leader in diverse/multi-disciplinary teams.
9. **PO9: Communication**: Communicate effectively and inclusively within the engineering community and society at large, such as being able to comprehend and write effective

reports and design documentation, make effective presentations considering cultural, language, and learning differences. (WK8)

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

Program Specific Outcomes (PSOs)

The graduates of AI &ML program will be able to

- **PSO1:** Apply their knowledge and skills in various walks of industry and society to solve emerging problems.
- **PSO2:** Become successful AI & ML engineers and responsible citizens of the country.
- **PSO3:** Contribute in solving the global IT as well as other industry needs of the hour using state of the art technologies with ease.

Knowledge and Attitude Profile (WK)

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

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

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

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

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

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

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

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

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

B.E. in Computer Science and Engineering(AI & ML): Autonomous Scheme and Syllabus

3rd Semester

SL. NO	Course	Course Code	COURSE TITLE	TEACHING DEPARTMENT AND QUESTION PAPER SETTING BOARD (PSB)	TEACHING & LEARNING SCHEME						EXAMINATION			
					CI		LI	TW & SL	# TH/S	Duration in Hours	CIE MARKS	SEE MARKS	TOTAL MARKS	CREDITS
					L	T	P							
1	ASC	25BCSTH301	STATISTICS AND PROBABILITY DISTRIBUTIONS	TD/PSB:MATHEMATICS / CS ALLIED	45	30	0	45	120	3	50	50	100	**4**
2	IPCC	25BCIIC302	FUNDAMENTALS OF DATA SCIENCE & MACHINE LEARNING	CSE(AI & ML)	45	0	30	45	120	3	50	50	100	**4**
3	PCC	25BCSTH303	LOGIC DESIGN AND COMPUTER ORGANIZATION	CSE	45	30	0	45	120	3	50	50	100	**4**
4	PCC	25BCSTH304	DATA STRUCTURES AND APPLICATIONS	CSE	45	0	0	45	90	3	50	50	100	**3**
5	PCC	25BCSTH305	OPERATING SYSTEMS	CSE	45	0	0	45	90	3	50	50	100	**3**
6	PCCL	25BCSLB306	DATA STRUCTURES LABORATORY	CSE	0	0	30	00	30	3	50	50	100	**1**
7	AEC	25BCXAE307	(BUCKET LIST B)	CSE	0	0	30	00	30	3	50	50	100	**1**
8	SDC	25BCBPR308	COMMUNITY PROJECT (PROJECT-BASED LEARNING) / SOCIETAL PROJECT	CSE	0	0	0	30	30	3	50	50	100	**1**
9	NCMC	25BNSSP309	NATIONAL SERVICE SCHEME	NSS COORDINATOR	0	0	0	30	30	–	100	—	100	**PP**
		25BPEDU309	PHYSICAL EDUCATION	Physical Education Director										
		25BYOGA309	YOGA	YOGA TEACHER										
		25BMUSK309	MUSIC	MUSIC TEACHER										
TOTAL									**660**		**500**	**400**	**900**	**21**
10	NCMC	25BMADP310	ADDITIONAL MATHEMATICS-I	TD - MATHS DEPT	14	0	0	14	28	3	100	—	100	**PP**
TOTAL									**688**		**600**	**400**	**1000**	**21**

 # TH/S - TOTAL HOURS PER SEMESTER, TW & SL - TERM WORK & SELF LEARNING

SL. No	Course	Course Code	Course Title	TEACHING DEPARTMENT AND QUESTION PAPER SETTING BOARD (PSB)	Teaching & Learning Scheme					Examination				Credits
					CI		LI	TW&SL	#TH/S	Duration in hours	CIE MARKS	SEE MARKS	TOTAL MARKS	
					L	T	P	SL						
11	SKLAB	25BCISL00X	SKILL LAB (BUCKET LIST SDL)	CS ALLIED	0	0	30	0	30	3	50	50	100	1

AEC — 25BCXAE307X — BUCKET LIST B	
25BCSAE307A	PROJECT MANAGEMENT WITH GIT
25BCIAE307B	DATA ANALYTICS WITH R & EXCEL
25BCIAE307C	AI TOOLS & APPLICATIONS
25BCIAE307D	FUNDAMENTALS OF FULL STACK DEVELOPMENT USING MERN

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B.E. in Computer Science and Engineering (AI & ML): Autonomous Scheme and Syllabus
4th Semester

SL. NO	Course	Course code	COURSE TITLE	TEACHING DEPARTMENT AND QUESTION PAPER SETTING BOARD (PSB)	TEACHING & LEARNING SCHEME						EXAMINATION			
					CI		LI	TW & SL	# TH/S	Duration in hours	CIE MARKS	SEE MARKS	TOTAL MARKS	CREDITS
					L	T	P							
1	ASC	25BAITH401	DISCRETE MATHEMATICS AND OPTIMIZATION TECHNIQUES	TD: CS ALLIED/MATHS PSB: CS ALLIED	45	30	0	45	120	3	50	50	100	**4**
2	IPCC	25BCSIC402	DATABASE MANAGEMENT SYSTEMS	CSE	45	0	30	45	120	3	50	50	100	**4**
3	PCC	25BCSTH403	DESIGN AND ANALYSIS OF ALGORITHMS	CSE	45	30	0	45	120	3	50	50	100	**4**
4	PCC	25BCSTH404	ARTIFICIAL INTELLIGENCE & MACHINE LEARNING	CSE	45	30	0	45	120	3	50	50	100	**4**
5	PCCL	25BCSLB405	DESIGN AND ANALYSIS OF ALGORITHMS LABORATORY	CSE	0	0	30	00	30	3	50	50	100	**1**
6	AEC	25BCXAE406X	(BUCKET LIST C)	CSE	0	0	30	00	30	3	50	50	100	**1**
7	BSC	25BFETH407	BIOLOGY FOR ENGINEERS	TD: chemistry / biotech / cs allied; PSB: CS allied	30	0	0	30	60	2	50	50	100	**2**
8	SDC	25BESPR408	ENVIRONMENTAL SCIENCE PROJECT	RESPECTIVE ENGINEERING DEPT.	0	0	0	30	30	3	50	50	100	**1**
9	NCMC	25BNSSP409	NATIONAL SERVICE SCHEME (NSS)	Campus: NSS COORDINATOR	0	0	0	30	30	–	100	—	100	**PP**
		25BPEDU409	PHYSICAL EDUCATION	Campus: Physical Education Director										
		25BYOGA409	YOGA	Campus: YOGA TEACHER										
		25BMUSK409	MUSIC	Campus: MUSIC TEACHER										
TOTAL									**660**		**500**	**400**	**900**	**21**
10	NCMC	25BMADP410	ADDITIONAL MATHEMATICS-II	TD - MATHS DEPT	14	0	0	14	28	3	100	—	100	**PP**
TOTAL									**688**		**600**	**400**	**1000**	**21**

 # TH/S - TOTAL HOURS PER SEMESTER, TW & SL - TERM WORK & SELF LEARNING

SL. No	Course	Course Code	Course Title	TEACHING DEPARTMENT AND QUESTION PAPER SETTING BOARD (PSB)	Teaching & Learning Scheme					Examination				Credits
					CI		LI	TW&SL	#TH/S	Duration in hours	CIE MARKS	SEE MARKS	TOTAL MARKS	
					L	T	P	SL						
11	SKLAB	25BCISL00X	SKILL LAB	CS ALLIED	0	0	30	0	30	3	50	50	100	1

AEC - 25BCXAE406X - BUCKET LIST C	
25BCSAE406A	INTRODUCTION TO UNIX
25BCIAE406B	SCALA
25BCIAE406C	JULIA
25BCIAE406D	NOSQL USING MONGODB
25BCIAE406E	OBJECT ORIENTED PROGRAMMING
25BCIAE406F	REDIS
25BCIAE406G	CASSANDRA

TH/S- Total Hours per Semester, TW & SL- Term Work & Self Learning.
** The course 1BXXL406x – Ability Enhancement Course Laboratory can be offered either as a single compulsory course. Alternatively, the Ability Enhancement Course Laboratory course can be offered with multiple elective options under the course codes 1BXXL406x (where x = A, B, C, D).

III SEMESTER SUBJECTS

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B.E. (Computer Science and Engineering (AI & ML))
Outcome Based Education (OBE) and Choice Based Credit System (CBCS)
SEMESTER – III

Course Title	STATISTICS AND PROBABILITY DISTRIBUTIONS (CSE ALLIED BRANCHES)		
Course Code	25BCSTH301	CIE MARKS	50
(L : T : P) + SL	(3:2:0)+(45 Hours/Sem)	SEE MARKS	50
Credits	4	EXAM HOURS	3

COURSE LEARNING OBJECTIVES

The purpose of the course is to facilitate the learner to:

1. Apply curve fitting, correlation, regression analysis, and sampling techniques to solve engineering and data analysis problems.
2. Analyse probability concepts and probability distributions to model and interpret uncertainty in engineering systems.
3. Familiarize with the fundamental concepts of probability theory and probability distributions to build a strong foundation for engineering and data analysis applications.
4. Solve engineering problems involving random phenomena using stochastic processes and probabilistic modelling techniques.

Module-1	9 Hours
Curve Fitting, Correlation and Regression Analysis: Curve fitting by the method of least squares—fitting curves of the form $y = ax + b$, $y = ax^b$ and $y = ax^2 + bx + c$. Correlation and regression: Karl Pearson's coefficient of correlation and rank correlation problems. Regression analysis, lines of regression problems. **Textbook 1: Chapter 24 (24.3 - 24.6(1), 24.8), Chapter 25 (25.12 - 25.14, 25.16)**	
Module-2	**9 Hours**
Sampling Theory: Introduction to sampling theory, standard error, Type-I and Type-II errors. Test of hypothesis for means- Z test, student's t- test, chi-square test of goodness of fit. **Textbook 1: Chapter 27 (27.1 - 27.8, 27.12 - 27.18)**	
Module-3	**9 Hours**
Probability Theory: Definition of Probability, Mutually exclusive and Independent events, Addition law of Probability, Independent events- Multiplication law of probability, Conditional Probability, Bayes' Theorem and Problems. **Textbook 1: Chapter 26 (26.1 - 26.6)**	

Module-4	9 Hours
Probability Distribution: Random variable, discrete and continuous probability distribution, expectation, mean and variance Binomial distribution, Poisson distribution, Normal distribution, Exponential distribution, (Derivation for Mean and Standard Deviation of Binomial and Poisson Distribution only). **Textbook 1: Chapter 26 (26.7 - 26.10, 26.14 – 26.17, 26.19(6))**	
Module-5	**9 Hours**
Stochastic Process: Joint Probability Distribution (Discrete Random Variable only), Stochastic process, probability vector, stochastic matrices, fixed points, regular stochastic matrices, Markov chains (Finite, discrete only), higher transition probability. **Textbook 2: Chapter 31**	

COURSE OUTCOMES

After successfully completing the course, the student will be able to:

CO1	Employ correlation and regression methodologies to model complex relationships.
CO2	Integrate statistical tools and inferential methods to analyse engineering systems and make data-driven decisions with quantified confidence.
CO3	Develop probabilistic models using discrete and continuous distributions to quantify uncertainty.
CO4	Apply probabilistic models and statistical reasoning to analyse random phenomena.
CO5	Compute joint probability distributions, determine state transition probabilities in Markov chainsand apply stochastic modelling methods for decision-making and forecasting.

ASSESSMENT AND EVALUATION REGULATIONS OF ASC

Assessment Type	Maximum Marks	Minimum Passing Marks	Evaluation Details
CIE – IA Tests (A)	30	-	Two tests each of 50 marks shall be conducted. Average of Two Internal Assessment Tests shall be scaled down to 30 marks.
Continuous and Comprehensive Evaluation (B)	20	-	Any two Assessment methods as per 24RNBE4.2 (*if it is project based, one assignment shall be given), scaled to 20 marks.

Total CIE Theory (A+B)	50	20	CIE Evaluation is done for a maximum of 50 marks.
SEE (C)	50	18	SEE is a theory exam conducted for 100 marks and scaled down to 50 marks. Exam duration shall be for 3 hours.
CIE + SEE (A+B+C)	100	40	Final marks shall be the sum of marks scored in Components A, B and C.
The minimum marks to be secured in CIE is 20 (40%) out of allotted 50 marks to appear for SEE.			

Textbooks:

1. B. S. Grewal, Higher Engineering Mathematics, 42nd Edition, Khanna Publishers, 2017.
2. B. V. Ramana, Higher Engineering Mathematics, Tata McGraw-Hill, 2006.
3. Montgomery, D. C. & Runger, G. C., Applied Statistics and Probability for Engi-neers, 7th Edition, Hoboken, NJ: John Wiley & Sons, 2018.

Reference Books:

1. Gupta, S. C., Fundamentals of Statistics, Himalaya Publishing House, 8th Edition, 2023.
2. Kreyszig, Advanced Engineering Mathematics, John Wiley & Sons, 10th Edition, 2018.
3. N. P. Bali and Manish Goyal, A Textbook of Engineering Mathematics, Laxmi Publications, 10th Edition, 2022.
4. Srimanta Pal & Subodh C. Bhunia, Engineering Mathematics, Oxford University Press, 3rd Edition, 2016.
5. J. K. Blitzstein and J. Hwang, Introduction to Probability, 2nd Edition, Boca Ra-ton, FL, USA: CRC Press, 2019.

Web Links:

1. http://academicearth.org/
2. VTU e-Shikshana Program
3. VTU EDUSAT Program

4. https://nptel.ac.in/courses/111105160
5. https://nptel.ac.in/courses/127106019
6. https://sl1nk.com/rb8fcyk
7. https://sl1nk.com/ooolb6f

Activity-Based Learning:

1. Programming Assignment
2. Tool/Software Exploration
3. Problem-Based Learning (PBL)
4. Assignments

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B.E. (Computer Science and Engineering (AI & ML))
Outcome Based Education (OBE) and Choice Based Credit System (CBCS)
SEMESTER – III

Course Title	FUNDAMENTALS OF DATA SCIENCE & MACHINE LEARNING		
Course Code	25BCIIC302	CIE MARKS	50
(L: T: P) + SL	(3:0:2) + 45 Hours / Sem	SEE MARKS	50
Credits:	4	EXAM HOURS	3

COURSE LEARNING OBJECTIVES:

The objectives of the course are to facilitate the learners to:

1. Understand the fundamentals of Data Science, its process, tools, and apply Python basics with pandas and NumPy for dataset manipulation.
2. Apply statistical and probability concepts, including sampling, distributions, Bayes' theorem, and perform Exploratory Data Analysis (EDA) using Python.
3. Introduce the fundamental concepts and techniques of machine learning.
4. Understand the types of machine learning and the challenges faced in real world applications.
5. Familiarize the machine learning algorithms such as regression.

Module-1 **9 Hours**

Introduction to Data Science: Importance of Data Science, Need for Data Science, What Is Data Science, Data Science Process, Business Intelligence and Data Science, Prerequisites for a Data Scientist, Components of Data Science, Tools and Skills Needed Data Science Tool Python-1: Basics of Python for Data Science, Python Identifiers, Variables, Data types, **Data structures, Python Libraries:** Data Frame Manipulation with pandas and NumPy, pandas, Load and examine the dataset, Data Frame Indexing, Data frame operations, NumPy, Creation of the NumPy arrays.

Textbook 1: Chapter 1, Chapter 7.1, 7.2

Module-2 **9 Hours**

Statistics and Probability: Data Types, Variable Types, Statistics, Sampling Techniques and Probability, Information Gain and Entropy, Probability Theory, Probability Types, Probability Distribution Functions, Bayes' Theorem, Inferential Statistics

Data Science Tool Python-2: Exploration Data Analysis with python: Objectives of EDA

Textbook 1: Chapter 2, Chapter 7.3

Module-3 **9 Hours**

Data Science Methodology: Analytics for Data Science, Examples of Data Analytics, Data Analytics Life Cycle: Data Discovery, Data Preparation, Model Planning, Model Building, Communicate Results, operationalization

Data Science Tool Python-2: Time Series Data

Textbook 1: Chapter 4, Chapter 7.4

Module-4 **9 Hours**

Introduction to Machine Learning: Need for Machine Learning, Machine Learning Explained, Machine Learning in Relation to other Fields, Types of Machine Learning, Challenges of Machine Learning, Machine Learning Process, Machine Learning Applications.

Basic Learning Theory: Design of Learning System, Introduction to Concept of Learning, Modelling in Machine Learning.

Text Book 2:Chapter 1 (1.1-1.7), Chapter 3 (3.3-3.4, 3.6)

Module-5	9 Hours
Similarity-based Learning: Nearest-Neighbour Learning, Weighted K-Nearest-Neighbor Algorithm, Nearest Centroid Classifier, Locally Weighted Regression (LWR). **Regression Analysis:** Introduction to Regression, Introduction to Linear Regression, Multiple Linear Regression, Polynomial Regression, Logistic Regression. **Textbook 2: Chapter 4 (4.2-4.5), Chapter 5 (5.1-5.3, 5.5-5.7)**	

PRACTICAL COMPONENT OF IPCC

Sl.No	Experiments
1	a. Write a Python program to import a structured dataset representing organizational sales performance over multiple time periods. Ensure the dataset is loaded correctly and display its basic information. b. Write a Python program to create a Data Frame from the imported dataset and perform data exploration. Compute summary statistics, examine the dataset's structure, and identify key characteristics to understand the sales data.
2	a. Write a Python program to compute Key Performance Indicators (KPIs) for organizational sales data, including Monthly average sales, Identification of peak performing and underperforming months b. Write a Python program to calculate the percentage growth rate in sales across consecutive months using the same sales dataset, and interpret the results to understand sales trends and support data-driven decision-making.
3	a. Choose a dataset from Kaggle (e.g., Titanic, Customer Churn, or House Prices). Load the dataset in Python, inspect its structure, understand the features, and perform preliminary exploration to identify data types, missing values, and basic statistics. b. Using a selected Kaggle dataset, write a Python program to determine the total number of records (rows) and features (columns), and identify the data type of each feature, classifying it as numerical or categorical.
4	a. Write a Python program to load a sample dataset (e.g., CSV or Excel file) and display the data types of all columns. Analyze the output to determine which columns are numerical, categorical, or object type, which will help in selecting appropriate data processing and analysis techniques. b. Write a Python program to load a dataset, detect any missing values in each column, and calculate summary statistics (mean, median, standard deviation, minimum, maximum) for numerical features. Analyze the results to understand data quality and distribution before further processing.

5	a. Write a Python program to compute the mean and median of a given set of students' marks. Analyze the results and comment on any differences observed between the mean and median values, highlighting possible skewness in the dataset. b. Write a Python program to determine the skewness of a dataset containing students' marks. Use the calculated skewness to explain whether the data is positively skewed, negatively skewed, or symmetric, and discuss the implications for data interpretation.
6	To explore a dataset using Pandas by performing statistical operations, descriptive analysis, and univariate/bivariate statistical measures.
7	To preprocess a dataset using Label Encoding, Scaling, Binarization, duplicate removal, and missing value handling techniques.
8	To perform data visualization on synthetic and Iris datasets using Seaborn plots such as bar plots, box plots, distribution plots, violin plots, count plots, strip plots, joint plots, and pair plots.
9	To implement the k-Nearest Neighbour classification algorithm and evaluate its performance using confusion matrices.
10	To perform linear and multiple regression analysis on given and randomly generated datasets for predictive modelling.

COURSE OUTCOMES:

After completing the course, the student will be able to:

CO1	Describe the machine learning techniques, their types and data analysis framework.
CO2	Apply mathematical concepts for feature engineering and perform dimensionality reduction to enhance model performance.
CO3	Develop similarity-based learning models and regression models for solving classification and prediction tasks.
CO4	Build probabilistic learning models and design neural network models using perceptron's and multilayer architectures
CO5	Utilize clustering algorithms to identify patterns in data and implement reinforcement learning techniques

ASSESSMENT AND EVALUATION REGULATIONS

Assessment Component	Maximum Marks	Minimum Passing Marks	Evaluation Details
CIE – IA Tests (A)	20	–	Two tests, each for 50 marks, shall be conducted. The average of the two Internal Assessment Tests shall be scaled down to 20 marks.

Continuous and Comprehensive Evaluation (B)	10	–	Any one assessment method as per 24RNBE4.2, scaled to 10 marks.
Total CIE Theory (A+B)	30	12	Marks of Tests and Assignments are awarded for a maximum of 30 marks.
CIE Practical	12	–	Marks awarded for weekly conduction of experiments and submission of laboratory records, scaled to 12 marks.
CIE Practical Test	8	–	Average of marks of two tests, each conducted for 100 marks covering all experiments, scaled to 8 marks.
Total CIE Practical (C)	20	8	Marks of experiments, record, and test awarded for a maximum of 20 marks.
CIE: Theory + Practical (A+B+C)	50	20	CIE evaluation is done for a maximum of 50 marks.
SEE (D)	50	18	SEE is a theory exam conducted for 100 marks and scaled down to 50 marks. Exam duration shall be 3 hours.
CIE + SEE (A+B+C+D)	100	40	Final marks shall be the sum of marks scored in Components A, B, C, and D.

Textbook:

1. Sanjeev J. Wagh, Manisha S. Bhende, and Anuradha D. Thakare, "Fundamentals of Data Science", 1st Edition, 2021, CRC press.
2. Sridhar, S., and M. Vijayalakshmi. Machine Learning. 1st ed., Oxford University Press, 2021. ISBN: 9780190127275.

Reference Books:

1. An Introduction to Statistical Learning: with Applications in R, Gareth James, Daniela Witten, Trevor Hastie, Robert Tibshirani, Springer, 1st edition, 2013
2. T M. Mitchell, Machine Learning. New York: McGraw-Hill, 1997. ISBN: 9780070428072.
3. Rama Satish KV, Machine Learning in Data Science ,Edition First 2023, Scientific International Publishing House ISBN: 9789357576390

Web links and Video Lectures(e-Resources):

- https://www.udemy.com/course/data-science-for-thebeginner/?couponCode=PMNVD2025
- https://www.oreilly.com/library/view/doing-datascience/9781449363871/toc01.html
- https://docs.python.org/3/tutorial/
- nptel.ac.in/courses/106106212
- Machine Learning Tutorials: https://www.geeksforgeeks.org/machine-learning/
- Machine Learning Tutorials: https://www.tutorialspoint.com/machine_learning/index.htm
- Introduction to Machine Learning: https://onlinecourses.nptel.ac.in/noc22_cs29/preview

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

- Quizzes
- Assignments
- NPTEL Swayam Course / Infosys Spring Board Courses
- Mini Projects

Self-Study Components:

1. Ensemble Learning
2. Optimization Techniques
3. Introduction to Deep Learning
4. Simple Real-World Use Cases:
    - Spam detection
    - Movie recommendation
    - Student marks prediction

B.E. (Computer Science and Engineering (AI & ML))
Outcome Based Education (OBE) and Choice Based Credit System (CBCS)
SEMESTER – III

Course Title	LOGIC DESIGN AND COMPUTER ORGANIZATION		
Course Code	25BCSTH303	CIE MARKS	50
(L : T : P) + SL	(3:2:0)+(45 Hours/Sem)	SEE MARKS	50
Credits	4	EXAM HOURS	3

COURSE LEARNING OBJECTIVES

After completing this course, the learner will be able to:

1. Simplify digital circuits by applying the principles of Boolean algebra, fundamental logic gates and advanced gate-level minimization techniques.
2. Design, synthesize and analyze basic combinational and sequential digital circuits, including arithmetic units, data routers, latches, flip-flops and registers.
3. Comprehend basic computer architecture by evaluating functional unit interactions, bus structures, instruction sequencing and performance metrics.
4. Formulate efficient input/output strategies and memory hierarchies by analyzing interrupt handling, Direct Memory Access (DMA) and cache mapping operations.
5. Examine internal processing unit dynamics by tracking the step-by-step execution of complete instructions alongside basic pipelining concepts.

Module-1	9 Hours

Digital Systems and Binary Numbers: Binary Logic.

Boolean Algebra and Logic Gates: Axiomatic Definition of Boolean Algebra, Basic Theorems and Properties of Boolean Algebra, Boolean Functions, Digital Logic Gates.

Gate Level Minimization: Introduction, The Map Method, Four-Variable Map, Don't-Care Conditions, NAND and NOR Implementation, Exclusive-OR Function.
Textbook 1: Chapter 1 (1.9), Chapter 2 (2.3 - 2.5, 2.8), Chapter 3 (3.1, 3.2, 3.3, 3.5, 3.6, 3.8)

Module-2	9 Hours

Combinational Logic: Introduction, Combinational Circuits, Design Procedure, Binary Adder-Subtractor, Decimal Adder, Decoders, Encoders, Multiplexers.

Synchronous Sequential Logic: Introduction, Sequential Circuits, Storage Elements: Latches, Storage Elements: Flip- Flops.

Registers and Counters: Registers, Shift Registers, Ripple Counters, Synchronous Counters.

Chapter 4 (4.1, 4.2, 4.4, 4.5, 4.6, 4.9, 4.10, 4.11) Chapter-5 (5.1 - 5.4), Chapter 6 (6.1 - 6.4)

Module-3	9 Hours
Basic Structure of Computers: Functional Units, Basic Operational Concepts, Bus structures, Performance. **Machine Instructions and Programs:** Memory Locations and Addresses, Memory Operations, Instruction and Instruction Sequencing, Addressing Modes. **Textbook 2: Chapter-1 (1.2 - 1.4, 1.6(1.6.1 - 1.6.2, 1.6.4, 1.6.7)), Chapter-2 (2.2 - 2.5)**	
Module-4	**9 Hours**
Input/output Organization: Accessing I/O Devices, Interrupts, Direct Memory Access. **The Memory System:** Semiconductor RAM memories, Read Only Memories, Cache Memories, Virtual Memories, Memory Management Requirements. **Textbook 2 : Chapter 4(4.1, 4.2.(4.2.1 - 4.2.3), 4.4), Chapter 5(5.2 - 5.3, 5.5(5.5.1), 5.7, 5.8)**	
Module-5	**9 Hours**
Basic Processing Unit: Some Fundamental Concepts, Execution of a Complete Instruc-tion. **Pipelining:** Basic Concepts, Data Hazards. **Textbook 2: Chapter 7 (7.1 - 7.2), Chapter 8 (8.1 - 8.2)**	

COURSE OUTCOMES

After successfully completing the course, the student will be able to:

CO1	Apply Optimize digital circuits utilizing Boolean theorems, Karnaugh maps (K-maps)and universal gate implementations (NAND/NOR).
CO2	Design Construct functional combinational and sequential logic components to fulfill specific arithmetic, data transfer and data storage requirements.
CO3	Analyze Deconstruct computer architectures by mapping operational functional units, identifying addressing modes and parsing instruction sequencing.
CO4	Evaluate Implement optimized I/O management and memory architectures through structured interrupts, Direct Memory Access (DMA) controllers and multi-level cache memory mapping.
CO5	Demonstrate Apply practical engineering knowledge to trace instruction executions within a basic processor and operate physical and virtual memory configurations.

ASSESSMENT AND EVALUATION REGULATIONS OF PCC

Assessment Type	Maximum Marks	Minimum Passing Marks	Evaluation Details
CIE – IA Tests (A)	30	-	Two tests each of 50 marks shall be conducted. Average of the two Internal Assessment Tests shall be scaled down to 20 marks.
Continuous and Comprehensive Evaluation (B)	20	-	Any one assessment method as per 24RNBE4.2, scaled to 20 marks.
Total CIE Theory (A+B)	50	20	Marks of tests and assignments awarded for a maximum of 30.
SEE (C)	50	18	SEE is a theory exam conducted for 100 marks and scaled down to 50 marks. Exam duration shall be for 3 hours.
CIE+SEE (A+B+C)	100	40	Final marks shall be the sum of marks scored in Components A, B and C
The minimum marks to be secured in CIE is 20 (40%) out of allotted 50 marks to appear for SEE. with minimum 40% scored in every component of CIE.			

Textbooks:

1. M. Morris Mano and Michael D. Ciletti, Digital Design with an Introduction to Verilog Design, 5th Edition, Pearson Education, 2013.
2. Carl V. Hamacher, Zvonko G. Vranesicand Safwat G. Zaky, Computer Organization, 5th Edition, Tata McGraw–Hill, 2002.

Reference Books:

1. Stephen Brown and Zvonko Vranesic, Fundamentals of Digital Logic with Verilog Design, 3rd Edition, McGraw-Hill Education, 2013.
2. William Stallings, Computer Organization and Architecture: Designing for Performance, 11th Edition, Pearson Education, 2022.
3. John L. Hennessy, David A. Patterson and Christos Kozyrakis, Computer Archi-tecture: A Quantitative Approach, 7th Edition, Morgan Kaufmann, 2025.

Web Links:

1. https://onlinecourses.nptel.ac.in/
2. https://www.coursera.org/
3. https://www.coursera.org/
4. https://matlabacademy.mathworks.com/?page=1 &sort=featured
5. https://in.mathworks.com/products/simulink.html

Self Study Topics:

1. Analyze Hardware Accelerators and Parallel Architectures.
2. Compare Modern Memory Hierarchies and Performance Bottlenecks.
3. Study Edge Computing and Embedded Hardware Deployment.

Experimental Learning	
1	Realization and Minimization of Combinational Logic: MATLAB Execution: Use the Simulink Library ,Logic and Bit Operations. Drag and drop fundamental logic gates (AND, OR, NOT, XOR) into a canvas.
2	Design of Arithmetic Circuits (Adder/Subtractor): MATLAB Execution: Build a 1-bit Full Adder subsystem in Simulink out of standard gates. Cascade four of these subsystems to create a structural 4-bit Binary Adder-Subtractor.
3	Data Routing Blocks (Multiplexers and Decoders): MATLAB Execution: Build an 8x1 Multiplexer subsystem using native conditional blocks or dis-crete logic gates. Alternatively, utilize MATLAB's Truth Table block inside Simulink.
4	Sequential Logic & Counter Design: MATLAB Execution: Open Simulink Stateflow or use the standard memory/flip-flop delay blocks (D Flip-Flop or Memory block).
5	Memory Mapping & Cache Performance Analysis: MATLAB Execution: Write a native MATLAB App / Script (.m file) that simulates CPU interactions with Cache memory.
6	Basic Processing Unit Instruction Execution Simulation: MATLAB Execution: Build a mini-datapath model inside Simulink using Simulink Buses and Reg-isters (Unit Delay blocks) acting as the accumulator, program counter (PC) and ALU.

Activity Based Learning:

1. Skill-based certifications through NPTEL, NVIDIA Deep Learning Institute and Coursera.
2. Case studies on real-world AI systems used in industry.

B.E. (Computer Science and Engineering (AI & ML))
Outcome Based Education (OBE) and Choice Based Credit System (CBCS)
SEMESTER – III

Course Title	DATA STRUCTURES AND APPLICATIONS		
Course Code	25BCSTH304	CIE MARKS	50
(L : T : P) + SL	(3:0:0)+(45 Hours/Sem)	SEE MARKS	50
Credits	3	EXAM HOURS	3

COURSE LEARNING OBJECTIVES

The purpose of the course is to facilitate the learner to:

1. Explain the fundamental concepts, classifications and operations of data structures.
2. Implement arrays, pointers and strings for efficient data representation and manipulation.
3. Apply linear data structures such as stacks, queues and linked lists to solve problems.
4. Construct and traverse non-linear data structures including trees and graphs.
5. Utilize advanced data structures such as hashing and balanced trees to design optimized solutions.

Module-1	9 Hours

Introduction to Data Structures and Algorithms: Basic terminology, classification of data structures, operations on data structures.

Basic Concepts: Pointers and dynamic memory allocation.

Arrays and Structures: Arrays, dynamically allocated arrays, structures and unions, polynomials, sparse matrices, representation of multidimensional arrays, strings.

Searching and Sorting: Insertion sort, radix sort.
Textbook 2: Chapter 2 (2.1 - 2.3), Chapter 14 (14.8, 14.12)
Textbook 1: Chapter 1 (1.2), Chapter 2 (2.1 - 2.7)

Module-2	9 Hours

Stacks and Queues: Stacks, stacks using dynamic arrays, queues, circular queues using dynamic arrays, evaluation of expressions, multiple stacks and queues.

Stacks: Applications of stacks.
Textbook 1: Chapter 3 (3.1 - 3.4, 3.6, 3.7)
Textbook 2: Chapter 7 (7.7.4)

Module-3	9 Hours

Linked Lists: Singly linked lists and chains, representing chains in C, linked stacks and queues, polynomials, additional list operations, sparse matrices, doubly linked lists.
Textbook 1: Chapter 4 (4.1 - 4.5, 4.7, 4.8)

Module-4	9 Hours
Trees: Introduction, binary trees, binary tree traversals, threaded binary trees, binary search trees, selection trees, forests. **Textbook 1: Chapter 5 (5.1 - 5.3, 5.5, 5.7 - 5.9)**	
Module-5	**9 Hours**
Graphs: Graph abstract data types, elementary graph operations. **Hashing:** Introduction, static hashing, dynamic hashing. **Multiway Search Trees:** B-trees, B+ trees. **Textbook 1: Chapter 6 (6.1, 6.2), Chapter 8 (8.1 - 8.3), Chapter 11 (11.2, 11.3)**	

COURSE OUTCOMES

After successfully completing the course, the student will be able to:

CO1	Identify fundamental data structures and describe operations using arrays, pointers, and strings.
CO2	Illustrate how stacks and queues evaluate expressions and solve linear data structure problems.
CO3	Construct memory-efficient programs using singly and doubly linked lists.
CO4	Examine tree-based structures to model hierarchical relationships.
CO5	Compare graphs, balanced trees, and hashing techniques to address real-world computational problems.

ASSESSMENT AND EVALUATION REGULATIONS OF PCC

Assessment Type	Maximum Marks	Minimum Passing Marks	Evaluation Details
CIE – IA Tests (A)	30	-	Two tests each of 50 marks shall be conducted. Average of two Internal Assessment Tests shall be scaled down to 30 marks.
Continuous and Comprehensive Evaluation (B)	20	-	Any two assessment methods as per 24RNBE4.2 (if it is project based, one assignment shall be given), scaled to 20 marks.
Total CIE (A+B)	50	20	CIE evaluation is done for a maximum of 50 marks.
SEE (C)	50	18	SEE is a theory exam conducted for 100 marks and scaled down to 50 marks. Exam duration shall be for 3 hours.

CIE + SEE (A+B+C)	100	40	Final marks shall be the sum of marks scored in components A, B and C.
The minimum marks to be secured in CIE are 20 (40%) out of allotted 50 marks to appear for SEE, with a minimum of 40% scored in every component of CIE.			

Textbooks:

1. Ellis Horowitz, Sartaj Sahni and Susan Anderson-Freed, Fundamentals of Data Structures in C, 2nd Edition, Universities Press, 2014.
2. Reema Thareja, Data Structures Using C, 2nd Edition, Oxford Press, 2014.

Reference Books:

1. Seymour Lipschutz, Data Structures Schaum's Outlines, Revised 1st Edition, Mc-Graw Hill, 2014.
2. Gilberg and Forouzan, Data Structures: A Pseudo-code Approach with C, 2nd Edition, Cengage Learning, 2014.
3. Jean-Paul Tremblay and Paul G. Sorenson, An Introduction to Data Structures with Applications, 2nd Edition, McGraw Hill, 2013.
4. A. M. Tanenbaum, Data Structures Using C, PHI, 1989.

Web Links:

1. https://youtu.be/S47aSEqm_0I?si=34alu47wCWGdsxwN
2. https://ds2-iiith.vlabs.ac.in/exp/selection-sort/index.html
3. https://ds1-iiith.vlabs.ac.in/exp/stacks-queues/index.html
4. https://ds1-iiith.vlabs.ac.in/exp/linked-list/basics/overview.html
5. https://ds1-iiith.vlabs.ac.in/List%20of%20experiments.html
6. https://ds1-iiith.vlabs.ac.in/exp/tree-traversal/index.html
7. https://ds1-iiith.vlabs.ac.in/exp/tree-traversal/depth-first-traversal/ dft-practice.html
8. https://onlinecourses-archive.nptel.ac.in/noc18_cs25/preview

Self Study Topics:

1. Recursion
2. AVL Trees
3. Red-Black Trees

B.E. (Computer Science and Engineering (AI & ML))
Outcome Based Education (OBE) and Choice Based Credit System (CBCS)
SEMESTER – III

Course Title	OPERATING SYSTEMS		
Course Code	25BCSTH305	CIE MARKS	50
(L : T : P) + SL	(3:0:0)+(45 Hours/Sem)	SEE MARKS	50
Credits	3	EXAM HOURS	3

COURSE LEARNING OBJECTIVES

The purpose of the course is to facilitate the learner to:

1. Understand the fundamental concepts and architecture of operating systems, including system structure, services, and system calls.
2. Analyse and apply concepts of processes, threads, and CPU scheduling, along with inter-process communication and synchronization techniques.
3. Explain and evaluate memory management strategies, including paging, segmentation, and virtual memory techniques.
4. Demonstrate knowledge of file systems, storage structures, and protection mechanisms, and use relevant system-level commands and APIs for managing operating system resources.

Module-1	9 Hours
Introduction to Operating Systems: What operating systems do, Computer system organization, Computer system architecture, Operating system structure, Operating system operations. **System Structures:** User–Operating System interface, System calls, Types of system calls, System programs, Operating system design and implementation, Operating system structure. **Textbook 1 : Chapter 1 (1.1–1.5), Chapter 2 (2.2–2.7)**	
Module-2	**9 Hours**
Process Management: Process concept, Process scheduling, Operations on processes, Inter-process communication. **Multi-threaded Programming:** Overview, Multithreading models, Thread libraries, Threading issues. **Process Scheduling:** Basic concepts, Scheduling criteria, Scheduling algorithms, Multiple-processor scheduling. **Textbook 1 : Chapter 3 (3.1–3.4), Chapter 4 (4.1–4.4), Chapter 5 (5.1–5.3, 5.5)**	
Module-3	**9 Hours**

Synchronization: Background, The critical section problem, Peterson's Solution, Synchronization hardware, Semaphores, Classic problems of synchronization.

Deadlocks: System model, Deadlock characterization, Methods for handling deadlocks, Deadlock prevention, Deadlock avoidance, Deadlock detection and recovery from deadlock.

Textbook 1 : Chapter 6 (6.1–6.6), Chapter 7 (7.1–7.7)

Module-4	**9 Hours**

Memory Management Strategies: Memory management strategies: Background, Swapping, Contiguous memory allocation, Paging, Structure of page table, Segmenta-tion.

Virtual Memory Management: Background, Demand paging, Copy-on-write, Page replacement, Allocation of frames, Thrashing.

Textbook 1 : Chapter 8 (8.1–8.6), Chapter 9 (9.1–9.6)

Module-5	**9 Hours**

File System: File concept, Access methods, Directory and disk structure.

Implementing File System: File system structure, File system implementation, Di-rectory implementation, Allocation methods, Free space management.

Secondary Storage Structure: Overview of mass storage structure, Disk structure, Disk attachment, Disk scheduling.

System Protection: Goals of protection, Principles of protection, Domain of protection, Access matrix.

Textbook 1 : Chapter 10 (10.1–10.3), Chapter 11 (11.1–11.5), Chapter 12 (12.1–12.4), Chapter 14 (14.1–14.4)

COURSE OUTCOMES

After successfully completing the course, the student will be able to:

CO1	Interpret the fundamental concepts, architecture, services, and design principles of operating systems.
CO2	Analyze process management techniques and resource allocation strategies for efficient system operation.
CO3	Apply synchronization and coordination mechanisms to manage concurrent processes and system resources effectively.
CO4	Analyze memory management strategies to optimize resource utilization and system performance.
CO5	Examine storage management, file systems, and security mechanisms in operating systems.

ASSESSMENT AND EVALUATION REGULATIONS OF PCC

Assessment Type	Maximum Marks	Minimum Passing Marks	Evaluation Details
CIE – IA Tests (A)	30	-	Two tests each of 50 marks shall be conducted. Average of two Internal Assessment Tests shall be scaled down to 30 marks.
Continuous and Comprehensive Evaluation (B)	20	-	Any one assessment method as per 24RNBE4.2, scaled to 10 marks.
Total CIE Theory (A+B)	50	20	CIE Evaluation is done for a maximum of 50 marks.
SEE (C)	50	18	SEE is a theory exam conducted for 100 marks and scaled down to 50 marks. Exam duration shall be for 3 hours.
CIE + SEE (A+B+C)	100	40	Final marks shall be the sum of marks scored in components A, B,and C,
The minimum marks to be secured in CIE is 20 (40%) out of allotted 50 marks to appear for SEE.			

Textbooks:

1. Abraham Silberschatz, Peter Baer Galvin, Greg Gagne, Operating System Concepts, 8th Edition, Wiley-India, 2015.

Reference Books:

1. P.C.P. Bhatt, An Introduction to Operating Systems: Concepts and Practice, 4th Edition, PHI (EEE), 2014.
2. William Stallings, Operating Systems: Internals and Design Principles, 6th Edition, Pearson.
3. A.S. Tanenbaum and H. Bos, Modern Operating Systems, 4th Edition, Prentice-Hall of India, New Delhi, 2014.

Web Links:

1. https://pages.cs.wisc.edu/~remzi/OSTEP/
2. https://www.geeksforgeeks.org/operating-systems/
3. https://www.tutorialspoint.com/operating_system/index.htm
4. https://www.scaler.com/topics/operating-system/

5. https://www.youtube.com/watch?v=yKl1uBHPdp30
6. https://www.youtube.com/watch?app=desktop&t=1s&v=dOiA2nNJpc0

Self Study Topics:

1. **Virtual Machines:** Study the concept of virtualization, including the architecture and functionality of virtual machines (VMs), and understand how VMs help in efficient resource utilization and system isolation.
2. **Basic Linux Commands:** Gain hands-on experience with essential Linux terminal commands used for file management, user permissions, process control, and system monitoring.
3. **Multithreading Demonstration using Programming Languages:** Implement and compare multithreading concepts using:
   a. Java using the Thread class and Runnable interface.
   b. Python using the threading module.
4. **C Programming using POSIX Threads (pthreads):** Implement multithreading using POSIX threads (pthreads).
5. **Overview of Different Operating Systems:** Compare the architecture, scheduling, memory management, and file systems of Linux, Windows, Unix, Android, macOS, iOS, RTOS, Chrome OS, Solaris, Haiku OS, and TinyOS.

B.E. (Computer Science and Engineering (AI & ML))
Outcome Based Education (OBE) and Choice Based Credit System (CBCS)
SEMESTER – III

Course Title	DATA STRUCTURES LABORATORY		
Course Code	25BCSLB306	CIE MARKS	50
(L : T : P)	(0:0:2)	SEE MARKS	50
Credits	1	EXAM HOURS	3

COURSE LEARNING OBJECTIVES

The purpose of the course is to facilitate the learner to:

1. Understand and implement dynamic memory management techniques in C.
2. Apply linear data structures (stacks, queues, linked lists) to solve computational problems.
3. Analyze and utilize non-linear data structures such as trees and graphs for applications.
4. Design practical solutions to real-world problems using suitable data structures.

Program 1 – Weekly Planner

A student needs a simple Weekly Planner System to keep track of their weekly schedule. For each day, the planner should store: name of the day (e.g., Monday, Tuesday. . .), date of the day (numeric format) and the activity planned for that day (e.g., class, event, meeting).

Develop a C program to implement this weekly planner using the following functions.

a. create() to initialize the weekly planner.

b. read() to input the details (day name, date, activity) from the user.

c. display() to generate and print the Weekly Activity Report on screen.

Program 2 – Pattern Matching

A publishing company is developing a simple tool to edit documents by replacing certain words or phrases. Design a C program that performs find-and-replace operations on text without using built-in string functions.

a. Read a main string (STR), a pattern string (PAT)and a replacement string (REP) from the user.

b. Search the main string for all occurrences of PAT.

c. Replace every occurrence of PAT in STR with REP.

d. If PAT does not exist in STR, display an appropriate message.

Program 3- Parcel Storage System

A courier office needs a simple Parcel Storage System to manage parcels efficiently. Each parcel is assigned an integer ID for identification. Design a C program that supports the following operations:

a. push() – Add a parcel ID onto the stack when a new parcel arrives.

b. pop() – Remove the last parcel ID from the stack when a parcel is taken out.

c. display() – Show all parcel IDs currently stored in the stack.

d. Display suitable messages when the stack is full (overflow) or empty (underflow).

Program 4 - Calculator Application

In modern calculators, mathematical expressions are usually entered in infix notation, where operators are written between operands (e.g., 3 + 4 * 2). However, calculators and computer systems evaluate these expressions more efficiently in postfix notation, where operators follow operands (e.g., 3 4 2 * +).

To simulate this process, develop a C program that converts any valid infix expression into its equivalent postfix expression. The program should support alphanumeric operands and the following operators: -, +, *, /, %, ^.

Program 5 - Call Center Help Desk

A call center assigns a ticket number to every incoming call. Since only a limited number of calls can be handled at a time, the calls are placed in a queue. When a representative becomes free, the next call in the queue is served.

Design and implement a C program to simulate this system using a circular queue. The program should support the following operations:

a. Add a new call to the queue (enqueue)

b. Serve the next call (dequeue)

c. Display all waiting calls

The program must also handle queue overflow and underflow conditions properly.

Program 6 - Student Information Management System

A university wants to maintain a dynamic record of its students for academic and administrative purposes. Each student record contains the following details: USN, Name, Programme, Semesterand Phone Number. Since the number of students may vary frequently due to admissions and withdrawals, a singly linked list (SLL) is chosen for efficient memory usage and flexible data management.

To simulate this system, develop a menu-driven C program that performs the following operations on the student database:

a. Create a Singly Linked List of N student records using front insertion.

b. Display all student records and count the number of nodes in the list.

c. Insert or delete a student record at the end of the list.

d. Insert or delete a student record at the front of the list (demonstrating stack operations).

Program 7 - Employee Record Management System

A company maintains details of its employees for administrative and payroll purposes. Each employee record contains the following fields: SSN, Name, Department, Designation, Salaryand Phone Number. Since employees may frequently join, leave, or change positions, a Doubly Linked List (DLL) provides a flexible way to manage these records efficiently in both directions.

To simulate this process, design and implement a menu-driven C program that performs the following operations on the employee database:

a. Create a Doubly Linked List of N employee records using end insertion.

b. Display all employee records and count the total number of nodes.

c. Insert or delete an employee record at the end of the list.

d. Insert or delete an employee record at the front of the list.

e. Demonstrate how the DLL can be used as a Double Ended Queue (Deque).

Program 8 – Library Book Management System

Design and implement a menu-driven C program to manage a Library Book Database using a Binary Search Tree (BST). Each record should store the following details: ISBN Number and Book Title.

The program should support the following operations:

a. Insert a new book into the BST

b. Traverse the BST using Inorder, Preorderand Postorder

c. Search for a book by its ISBN number and print the title.

Program 9 - City Connectivity using Graph Traversal

In a city transportation system, each city can be represented as a node and the direct roads between them as edges of a graph. To analyse connectivity, it is important to know which cities can be reached from a given starting city.

Develop a C program to:

a. Represent N cities using an Adjacency Matrix

b. Display all cities reachable from a specified city using DFS or BFS traversal.

Program 10 - Collision Handling in Vehicle Registration System

In a vehicle registration system, each vehicle is assigned a unique 4-digit registration number. To support quick storage and retrieval, these records are organized in a hash table with m storage locations.

Develop a C program to:
1. Store vehicle registration numbers in the hash table using linear probing and quadratic probing for collision handling. 2. Display the final state of the hash table after all insertions.

COURSE OUTCOMES

After successfully completing the course, the student will be able to:

CO1	Demonstrate the working of basic operations on fundamental data structures.
CO2	Develop programs that use linear and non-linear data structures for problem solving.
CO3	Apply dynamic allocation techniques for efficient resource utilization.
CO4	Design practical solutions to real-world problems using appropriate data structures.

ASSESSMENT AND EVALUATION REGULATIONS OF PCCL

Assessment Type	Maximum Marks	Minimum Passing Marks	Evaluation Details
CIE Practical (A)	30	-	Marks awarded for Weekly Conduction of Experiments and Submission of Laboratory records, scaled to 30 marks.
CIE Practical Test (B)	20	-	Average of marks of Two tests, each conducted for 100 marks covering all experiments, scaled to 20.
Total CIE Practical (A+B)	50	20	Sum of Marks of Experiments, Record and Test shall be CIE marks awarded for a maximum of 50.
SEE (C)	50	20	SEE is a lab exam, conducted for 100 marks and scaled down to 50 marks. Exam duration shall be for 3 hours.
CIE + SEE (A+B+C)	100	40	Final marks shall be the sum of marks scored in Components A, B and C.
The minimum marks to be secured in CIE is 20 (40%) out of allotted 50 marks to appear for SEE.			

B.E. (Computer Science and Engineering (AI & ML))
Outcome Based Education (OBE) and Choice Based Credit System (CBCS)
SEMESTER – III

Course Title	PROJECT MANAGEMENT WITH GIT		
Course Code	25BCSAE307A	CIE MARKS	50
(L : T : P)	(0:0:2)	SEE MARKS	50
Credits	1	EXAM HOURS	3

COURSE LEARNING OBJECTIVES

The purpose of the course is to facilitate the learner to:

1. To familiarise with basic commands of Git.
2. To create and manage branches.
3. To understand how to collaborate and work with Remote Repositories.
4. To familiarise with various controlling commands.

Sl. No.	EXPERIMENTS
1	**Setting Up and Basic Commands** Initialize a new Git repository in a directory. Create a new file and add it to the staging area and commit the changes with an appropriate commit message.
2	**Creating and Managing Branches** Create a new branch named feature-branch. Switch to the master branch. Merge the feature-branch into master.
3	**Creating and Managing Branches** Write the commands to stash your changes, switch branchesand then apply the stashed changes.
4	**Collaboration and Remote Repositories** Clone a remote Git repository to your local machine.
5	**Collaboration and Remote Repositories** Fetch the latest changes from a remote repository and rebase your local branch onto the updated remote branch.
6	**Collaboration and Remote Repositories** Write the command to merge feature-branch into master while providing a custom commit message for the merge.
7	**Git Tags and Releases** Write the command to create a lightweight Git tag named v1.0 for a commit in your local repository.
8	**Advanced GIT Operations** Write the command to cherry-pick a range of commits from source-branch to the current branch.
9	**Analysing and Changing Git History** Given a commit ID, how would you use Git to view the details of that specific commit, including the author, dateand commit message?.

10	**Analysing and Changing Git History** Write the command to list all com-mits made by the author JohnDoe between 2023-01-01 and 2023-12-31.
11	**Analysing and Changing Git History** Write the command to display the last five commits in the repository's history.
12	**Analysing and Changing Git History** Write the command to undo the changes introduced by the commit with the ID abc123.

COURSE OUTCOMES

After successfully completing the course, the student will be able to:

CO1	Use the basics commands related to git repository, Create and manage the branches.
CO2	Apply commands related to Collaboration and Remote Repositories.
CO3	Use the commands related to Git Tags, Releases and advanced git operations.
CO4	Analyse and change the git history.

ASSESSMENT AND EVALUATION REGULATIONS OF AEC

Assessment Type	Maximum Marks	Minimum Passing Marks	Evaluation Details
CIE – CIE Practical (A)	30	-	Marks awarded for weekly Conduction of Experiments and Submission of Laboratory records, scaled to 30 marks.
CIE Practical Test (B)	20	-	Average of marks of Two tests. each conducted for 100 marks covering all experiments , scaled to 20.
Total CIE Practical (A+B)	50	20	Sum of Marks of Experiments, Record and Test shall be CIE marks awarded for a maximum of 50.
SEE (C)	50	20	SEE is a lab exam, conducted for 100 marks and scaled down to 50 marks. Exam duration shall be 3 hours.
CIE + SEE (A+B+C)	100	40	Final marks shall be the sum of marks scored in Components A, B and C.
The minimum marks to be secured in CIE is 20 (40%) out of allotted 50 marks to appear for SEE.			

Web Links:

1. Version Control with Git, 3rd Edition, by Prem Kumar Ponuthorai, Jon Loeliger. Released October 2022. Publisher(s): O'Reilly Media, Inc.
2. Pro Git book, written by Scott Chacon and Ben Straub, published by Apress. https://git-scm.com/book/en/v2
3. https://infyspringboard.onwingspan.com/.../overview
4. https://infyspringboard.onwingspan.com/.../overview

B.E. (Computer Science and Engineering (AI & ML))
Outcome Based Education (OBE) and Choice Based Credit System (CBCS)
SEMESTER – III

Course Title	**DATA ANALYTICS WITH R & EXCEL**		
Course Code	**25BCIAE307B**	**CIE MARKS**	**50**
L: T: P	**0:0:2**	**SEE MARKS**	**50**
Credits:	**1**	**EXAM HOURS**	**3**

Course Learning Objectives:
The purpose of the course is to facilitate the learner to:

1. Apply analysis techniques to datasets in Excel.
2. Learn how to use Pivot Tables and Pivot Charts to streamline your workflow in Excel.
3. Understand and identify the principles of data analysis.
4. Apply the Graphical Packages of R for visualization
5. Build presentation ready dashboards in R.

Exp#	Experiment Title
1	Introduction to R Programming: Data Types, Operations, and Basic Data Structures Demonstrate the steps for installation of R and R Studio. Perform the following: Assign different type of values to variables and display the type of variable. Assign different types such as Double, Integer, Logical, Complex and Character and understand the difference between each data type. Demonstrate Arithmetic and Logical Operations with simple examples. Demonstrate generation of sequences and creation of vectors. Demonstrate Creation of Matrices Demonstrate the Creation of Matrices from Vectors using Binding Function. Demonstrate element extraction from vectors, matrices and arrays.
2	Matrix Operations in R: Implementation of Basic Arithmetic and Transpose on 3x3 Matrices Develop a program to create two 3 X 3 matrices A and B and perform the following operations Transpose of the matrix Addition Subtraction Multiplication Division
3	Prime Number Generation in R Using Sieve of Eratosthenes with Functions Develop an R Program using functions to find all the prime numbers up to a specified number by the method of Sieve of Eratosthenes.
4	String Manipulation in R: Exploring Text Processing Functions Implement different String Manipulation functions in R.

<table>
<tr><td>5</td><td>Data Frame Creation, Sub-setting, and Merging in R for Inventory Analysis Develop R program to create a Data Frame with following details and do the following operations.
Subset the Data frame and display the details of only those items whose price is greater than or equal to 350.
Subset the Data frame and display only the items where the category is either “Office Supplies” or “Desktop Supplies”.</td></tr>
<tr><td></td><td>c. Create another Data Frame called “item-details” with three different fields itemCode, ItemQtyonHand and ItemReorderLvl and merge the two frames
<table>
<tr><td>ItemCode</td><td>ItemCategory</td><td>itemPrice</td></tr>
<tr><td>1001</td><td>Electronics</td><td>700</td></tr>
<tr><td>1002</td><td>Desktop Supplies</td><td>300</td></tr>
<tr><td>1003</td><td>Office Supplies</td><td>350</td></tr>
<tr><td>1004</td><td>USB</td><td>400</td></tr>
<tr><td>1005</td><td>CD Drive</td><td>800</td></tr>
</table></td></tr>
<tr><td>6</td><td>Employee Data Analysis in R: Importing, Filtering, and Exporting CSV Files Design a data frame in R for storing about 20 employee details. Create a CSV file named “input.csv” that defines all the required information about the employee such as id, name, salary, start_date, dept. Import into R and do the following analysis.
Find the total number rows & columns
Find the maximum salary
Retrieve the details of the employee with maximum salary
Retrieve all the employees working in the IT Department.
Retrieve the employees in the IT Department whose salary is greater than 20000 and write these details into another file “output.csv”.</td></tr>
<tr><td>7</td><td>Getting Started with Excel: Create a sample Excel sheet and explore different tabs in the Ribbon and their functionalities.</td></tr>
<tr><td>8</td><td>Working with Data: Importing data, Data Entry & Manipulation, Sorting & Filtering.
APPLICATION: Create worksheet for Tracking Project Budgets: Sheet should contain Project ID, Project Name, Department, Project Manager, Allocated Budget, Resources Cost, Equipment Cost, Travel & Miscellaneous Cost, Total Expenses (calculated), Budget Variance (calculated as Allocated Budget – Total Expenses), Project Status (e.g., On Budget / Over Budget using formula logic). Use appropriate formulas to calculate the above scenario. Analyse the data using appropriate chart and report the data.</td></tr>
<tr><td>9</td><td>Working with Data: Data Validation, Pivot Tables & Pivot Charts.
APPLICATION: Create worksheet on Hospital Patient Records Management: data consisting of Patient ID, Name, Gender, age, Date of Admission, Department (e.g., Cardiology, Orthopedics, Pediatrics), Diagnosis, Treatment Type (Inpatient/Outpatient), Number of Days Admitted, Cost Per Day, Total Bill Amount (calculated using a formula), City of Residence, Mode of Payment and other details. Use of formula to segregate
different categories and perform a comparative study using pivot tables and different sort of charts</td></tr>
</table>

10	Data Analysis Process: Conditional Formatting, What-If Analysis, Data Tables, Charts & Graphs. APPLICATION : Create worksheet on Student Performance Management: Sheet should contain Student ID, Student Name, Course Name, Internal Marks, External Marks, Total Marks, Result (Pass/Fail using a formula: Pass if Total Marks ≥ 40), Grade (use nested IF formula to assign grades A, B, C, or F based on Total Marks), Date of Exam. Use appropriate formulas to calculate the above scenario. Analyse the data using appropriate chart and report the data.
11	Cleaning Data with Text Functions: use of UPPER and LOWER, TRIM function, Concatenate. Create a worksheet for Customer Information Management containing the following fields: Customer ID, First Name, Last Name, Full Name, Email Address, City, State, Customer Category. Assume that the data entered contains inconsistent capitalization, extra spaces, and incomplete formatting.
12	Cleaning Data Containing Date and Time Values: use of DATEVALUE function, DATEADD and DATEDIF, TIMEVALUE functions. APPLICATION: Create a worksheet for Employee Attendance Management containing the following fields: Employee ID, Employee Name, Date of Joining (entered in different formats), Attendance Date (entered as text), Check-in Time (entered as text), Check-out Time (entered as text), Years of Service ,Total Working Hours. Use appropriate formulas and functions to clean and analyze the data.

COURSE OUTCOMES

After successfully completing the course, the student will be able to:

CO1	Use advanced functions and productivity tools to assist in developing worksheets.
CO2	Manipulate data lists using Outline and PivotTables.
CO3	Illustrate the basics of Data Preparation with real world examples in R.
CO4	Apply various Statistical Analysis methods for data analytics in R.

ASSESSMENT AND EVALUATION REGULATIONS OF AEC

Assessment Type	Maximum Marks	Minimum Passing Marks	Evaluation Details
CIE Practical (A)	30	-	Marks awarded for Weekly Conduction of Experiments and Submission of Laboratory records, scaled to 30 marks.
CIE Practical Test (B)	20	-	Average of marks of Two tests, each conducted for 100 marks covering all experiments, scaled to 20.
Total CIE Practical (A+B)	50	20	Sum of Marks of Experiments, Record and Test shall be CIE marks awarded for a maximum of 50.
SEE (C)	50	20	SEE is a lab exam, conducted for 100 marks and scaled down to 50 marks. Exam duration shall

			be for 3 hours.
CIE + SEE (A+B+C)	100	40	Final marks shall be the sum of marks scored in Components A, B and C.
The minimum marks to be secured in CIE is 20 (40%) out of allotted 50 marks to appear for SEE.			

B.E. (Computer Science and Engineering (AI & ML))
Outcome Based Education (OBE) and Choice Based Credit System (CBCS)
SEMESTER – III

COURSE TITLE	AI TOOLS & APPLICATIONS		
Course Code	25BCIAE307C	CIE MARKS	50
(L: T: P) +SL	0:0:2	SEE MARKS	50
Credits	1	EXAM HOURS	03

COURSE LEARNING OBJECTIVES:

The purpose of the course is to facilitate the learner to:

1. Use Generative AI tools like ChatGPT, Canva, and Gamma. app for accelerating the creation of content, interactive simulations and assessments, to transform the raw material into structured, ready-to-use assets viz., content documents, presentations or visual handouts effortlessly.
2. Understand Precision Prompting: Scholarly Question Design for Reliable AI Outputs.
3. Use practical methods for leveraging Artificial Intelligence (AI) to enhance the productivity and effectiveness of academic research—specifically in ideation, literature review, and visualization of research connections.
4. Craft Adaptive Architectures for Personalized Learning Pathways using AI tools.

Program 1

Create high quality, structured course content Using Generative AI tools (Use ChatGPT).
Example: Create a lecture on looping statements in Python, World War II, etc.

Program 2

Demonstrate the Canvas mode in ChatGPT
Example 1: Show the Interactive Editing of Documents using prompt-based modifications.

Apply a prompt like: “Make this shorter”, “Add an analogy here”, “Convert this into bullet points”.

Example 2: Write a paragraph on if-else statements, select it, and prompt: “Explain this with a real-life analogy for beginners.”

Program 3

Demonstrate the usage of Notion (knowledge management platform) which is a smart, flexible Google Doc with extra features such as Nested pages, Toggle sections, Visual blocks (tables, images, embeds), Easy rearrangement.

Example : Create or demonstrate how to:

- Paste GPT-generated content into Notion
- Break it into pages or collapsible sections
- Prepare content for sharing or lesson delivery

Program 4

Demonstrate the use of Canva Docs and Canva Magic Tools.

Example: Demonstrate how to take the AI-generated lesson (on looping Statements in Python) and copy it directly into Canva Docs, which is Canva's version of a dynamic document editor. Paste GPT/Notion Content into Canva Docs using Canva Magic Tools. Create a visually enhanced handout or lesson packet that students can download, read on mobile, or print.

After generating the topic breakdown with ChatGPT:

- Use Canva Docs to format each cause as a section
- Add relevant photos from Canva Elements
- Include a "Key Takeaway" block after each section
- Attach a short 2-question quiz at the end

Program 5

Demonstrate the use of Magic Suite-Magic Eraser/Replace, Magic transform, etc.

Example:

a. Demonstrate the Magic Write feature. Say, Right-click on a paragraph, then choose actions like: "Rewrite this", "Make it more concise", "Fix grammar", "Expand this with an example", "Custom prompt" (e.g., "Explain this in simple language")

b. Demonstrate the Magic Eraser / Replace feature which is Primarily used in images. Say, Erase unwanted objects (e.g., a watermark or irrelevant icon), Replace an item in an image (e.g., change a laptop to a chalkboard)

c. Demonstrate the Magic Transform feature which can be used to instantly convert the above created document into multiple formats.

Program 6

Demonstrate the use of Gamma.app-AI-Powered presentation builder.

Show the following Customizations for the document created in above examples.

Feature	**Example**
Slide Title/Text	Edit headings or simplify slide copy
Image Replacement	Use AI to regenerate more suitable visuals
Content Rewrite	Prompt: "Make this slide simpler for high school

students" Layout Editing Rearrange card structure or duplicate/delete cards

Program 7
Generate Questions from Content (CTRL Method). CTRL is a powerful method for precision prompting. Example: Python Conditional Statements • Prompt Example 1: Create 3 Multiple Choice Questions (MCQs) on Conditional Statements in Python for college students who are beginners. Keep the tone formal and straightforward. • Prompt Example 2: Generate 2 Match-the-columns questions on Python Conditional Statements. Keep the questions beginner-friendly and formal. • Demo Examples: • Using PDF as Content Source: ✓ I've uploaded a PDF on "Introduction to Sociology" (provide link). Generate 5 MCQs for undergraduate students. Maintain academic tone, moderate complexity. • Using Web Link: ✓ Use the content from the following web link (provide actual URL here) and create 3 MCQs on Photosynthesis suitable for high-school biology students.
Program 8
Demonstrate the Parsons Method for Interactive Problem Statements. Parson's Method enhances problem-solving skills by giving students code fragments or sentences they must put in the correct logical order, proven to improve conceptual understanding. **Live Demonstration Prompt:** Generate a Parson's Problem using Python conditional statements for beginner-level students. Provide shuffled code blocks for a simple "if-else" structure.
Program 9
Demonstrate the usage of AI Tools for Creating and Delivering Tests. Tools available are: Quizizz AI, ClassMarker, Formative, Google Forms + AI (Form Presenter) Demonstrate a Use case of AI Tools for Creating and Delivering Tests. Once questions are created (Q7), automate their conversion into online tests for ease of deployment and analysis. Use Quizizz AI for Automated MCQs, grading and analytics.
Program 10
Demonstrate the use of AI-Driven Research Ideation (ChatGPT + Search) Live Demonstration Example: Example Prompt given to ChatGPT: Suggest 3 novel research angles on the topic: 'Impact of Social Media on Mental Health' relevant to Psychology researchers.

Program 11
Deploy Elicit (elicit.com) for Rapid Literature Discovery. To overcome manual search limitations, use Elicit, an AI-driven tool specialized in academic literature discovery. Example: Topic provided: "What is the impact of mindfulness techniques on anxiety among university students?" Analyzing Search Results: Elicit automatically generates a structured table of scholarly papers directly related to your query. It quickly provides: Paper titles, Abstracts (automatically summarized), Methodologies, Participants/sample sizes, Year published, citations count, and study types. The student should Customize Table Columns: say, Click "Columns" àSelect additional details to view: Population studied, Intervantion details, Outcomes measured, Research methods Show the Advanced Filtering techniques: Say Filter results by: Publication date, Study type (e.g., randomized control trials, observational studies), Citations count (to identify influential papers)
Program 12
Using Consensus for Quick Expert Insights (consensus.app). The Consensus AI tool summarizes academic research consensus clearly and visually. Example: Enter your research query.: "Does social media use negatively impact teenagers' mental health?" Understand the Results: "Consensus Meter" summarizing expert agreement, Conduct In-depth Exploration of each summarized statement, do Advanced Filtering (Narrow down by year, relevance, study type, or agreement level.
Program 13
Visualizing Research Connections with Litmaps (app.litmaps.com) Litmaps, a visualization tool that simplifies understanding complex academic citation networks visually Example: Enter your core research paper or DOI (Digital Object Identifier). Explore the Visual Citation Map (Connected papers represented visually, indicating citation relationships clearly. Papers connected via arrows showing who cites whom). Interactivity and Exploration: Click on any paper node to: Quickly see its abstract, authors, citations. Explore further connections expanding research context. Refine the Map: Filter the visualizations by: Year, Citations, Keywords, Publication type
Program 14
Explore how Generative AI can be applied in education to enable personalised learning experiences and support learners across various tasks. Use AI Tools such as Khanmigo, QuestionWell (For generating questions aligned to standards) or Diffit (For creating differentiated instructional materials). Example Prompt 1: "Act as a backend software development interviewer. Ask questions about JavaScript, React, Node.js, SQL, AWS, and System Design. Provide feedback based on a rubric." Example Prompt 2: "Act as a Python Developer. Create a learning plan for someone transitioning from another programming language. Ask clarification questions before proceeding." Example Prompt 3: "Provide constructive feedback on the student's answer based on the rubric. Mention 2 strengths, 2 areas for improvement, and suggestions. Use a positive tone." Tools You Can Explore: Brisk (Chrome extension for Google Docs), MagicSchool.ai (AI assistant for teachers).

COURSE OUTCOMES:

After successfully completing the course, the student will be able to:

CO1	**Apply** Generative AI tools such as ChatGPT, Canva, and Gamma.app to create structured content, simulations, and assessments.
CO2	**Transform** raw information into well-structured academic or professional outputs using AI tools like Canva Docs and Gamma.app.
CO3	**Design** precision prompts to generate reliable scholarly content and evaluation questions using advanced prompting strategies.
CO4	**Utilize** AI-powered platforms (e.g., Elicit, Consensus, Litmaps) to enhance productivity in research ideation, literature review, and visualization.
CO5	**Create** adaptive and personalized learning pathways using AI tools to support differentiated instruction and learner engagement.

ASSESSMENT AND EVALUATION REGULATIONS OF AEC

Assessment Type	Maximum Marks	Minimum Passing Marks	Evaluation Details
CIE Practical (A)	30	-	Marks awarded for Weekly Conduction of Experiments and Submission of Laboratory records, scaled to 30 marks.
CIE Practical Test (B)	20	-	Average of marks of Two tests, each conducted for 100 marks covering all experiments, scaled to 20.
Total CIE Practical (A+B)	50	20	Sum of Marks of Experiments, Record and Test shall be CIE marks awarded for a maximum of 50.
SEE (C)	50	20	SEE is a lab exam, conducted for 100 marks and scaled down to 50 marks. Exam duration shall be for 3 hours.
CIE + SEE (A+B+C)	100	40	Final marks shall be the sum of marks scored in Components A, B and C.
The minimum marks to be secured in CIE is 20 (40%) out of allotted 50 marks to appear for SEE.			

Text Book

1. Sandeep Surapaneni, Introduction to AI for Non-Tech People
   Available at: https://www.scribd.com/document/855410054/AI-for-Beginners-by-Sandeep-Surapaneni

Reference Links:

- OpenAI Prompt Engineering Guide: https://platform.openai.com/docs/guides/prompt-engineering
- Effective Few-shot prompting examples : https://learnprompting.org/docs/basics/few_shot_prompting

- Parsons Problems Explained (Research-backed) : https://computinged.wordpress.com/2017/06/05/parsons-problems-have-same-learning-gains-as-writing-or-fixing-code-with-less-frustration-and-more-fun/
- Example Parsons Problem Online Tool : https://parsons.problemsolving.io/
- Edutopia on AI Writing Feedback : https://www.edutopia.org/article/ai-writing-feedback-students/

Suggested Learning Resources:

Tool	Link
ChatGPT (Canvas)	https://chat.openai.com
Notion	https://notion.so
Canva Docs	https://www.canva.com
Gamma.app	https://gamma.app
Genially	https://www.genial.ly
Quizizz AI	https://quizizz.com
H5P	https://h5p.org
AI Tutor	https://chatgpt.com/share/68358dc1-0748-8006-a2bf-c50023cc280f
Khanmigo	https://www.youtube.com/watch?v=rnIgnS8Susg&t=119s
Elicit	https://elicit.com/
Consensus	https://consensus.app/
Litmaps	https://app.litmaps.com/

B.E. (Computer Science and Engineering (AI&ML))
Outcome Based Education (OBE) and Choice Based Credit System (CBCS)
SEMESTER – III

Course Title	**FUNDAMENTALS OF FULL STACK DEVELOPMENT USING MERN**		
Course Code	**25BCIAE307D**	**CIE MARKS**	**50**
(L: T: P) + SL	**(0:0:2) + 30 Hours/Sem**	**SEE MARKS**	**50**
Credits	**1**	**EXAM HOURS**	**03**

COURSE LEARNING OBJECTIVES

The purpose of the course is to facilitate the learner to:

1. Understand the fundamentals of web technologies and the structure of web applications using HTML, CSS, and JavaScript.
2. Familiarize with the MERN stack architecture and its components including MongoDB, Express.js, React, and Node.js.
3. Develop backend services using Node.js and Express.js, and integrate MongoDB for database operations.
4. Build dynamic and responsive user interfaces using react, managing state and navigation.
5. Design and develop full-stack web applications with advanced features like authentication, payments, and multimedia integration.

Sl. No	Experiments
1	Using MongoDB, create a collection called transactions in database usermanaged (drop if it already exists) and bulk load the data from a json file, transactions.json b. Upsert the record from the new file called transactions_upsert.json in Mongodb.
2	Query MongoDB with Conditions: [Create appropriate collection with necessary documents to answer the query] a. Find any record where Name is Somu b. Find any record where total payment amount (Payment.Total) is 600. c. Find any record where price (Transaction.price) is between 300 to 500. d. Calculate the total transaction amount by adding up Payment. Total in all records.
3	a. Write a program to check request header for cookies. b. Write node.js program to print the a car object properties, delete the second property and get length of the object.
4	a. Read the data of a student containing usn, name, sem, year_of_admission from node js and store it in the mongodb b. For a partial name given in node js, search all the names from mongodb student documents created in Question(a)
5	Implement all CRUD operations on a File System using Node JS
6	Develop the application that sends fruit name and price data from client side to Node.js server using Ajax.
7	Develop an authentication mechanism with email_id and password using HTML and Express JS (POST method)
8	Develop two routes: find_prime_100 and find_cube_100 which prints prime numbers less than 100 and cubes less than 100 using Express JS routing mechanism
9	Develop a React code to build a simple search filter functionality to display a filtered list based on the search query entered by the user.
10	Develop a React code to collect data from rest API.

COURSE OUTCOMES

After successfully completing the course, the student will be able to:

CO1	**Design and develop** responsive web pages using HTML5, CSS3, and basic JavaScript functionality. *(Bloom's Level: L3 – Apply)*
CO2	**Explain** the structure and advantages of the MERN stack and set up the development environment. *(Bloom's Level: L2 – Understand)*
CO3	**Create** RESTful APIs using Node.js, Express.js, and perform CRUD operations on MongoDB with secure authentication.
CO4	**Build** a fully functional frontend using React with routing and state management features. *(Bloom's Level: L3 – Apply)*

ASSESSMENT AND EVALUATION REGULATIONS OF AEC

Assessment Type	Maximum Marks	Minimum Passing Marks	Evaluation Details
CIE Practical (A)	30	-	Marks awarded for Weekly Conduction of Experiments and Submission of Laboratory records, scaled to 30 marks.
CIE Practical Test (B)	20	-	Average of marks of Two tests, each conducted for 100 marks covering all experiments, scaled to 20.
Total CIE Practical (A+B)	50	20	Sum of Marks of Experiments, Record and Test shall be CIE marks awarded for a maximum of 50.
SEE (C)	50	20	SEE is a lab exam, conducted for 100 marks and scaled down to 50 marks. Exam duration shall be for 3 hours.
CIE + SEE (A+B+C)	100	40	Final marks shall be the sum of marks scored in Components A, B and C.
The minimum marks to be secured in CIE is 20 (40%) out of allotted 50 marks to appear for SEE.			

Textbooks

1. Randy Connolly and Richardo Hoar, **"Fundamentals of Web Development",** Pearson, 1st Edition, 2014.
2. Shama Hoque, "Full-Stack React projects", Packt, 2018.

Reference Books

1. Vasan Subramanian Pro MERN Stack: Full Stack Web App Development with Mongo, Express, React, and Node, Apress; 1st ed. edition (1 April 2017)

B.E. (Computer Science and Engineering (AI & ML))
Outcome Based Education (OBE) and Choice Based Credit System (CBCS)
SEMESTER – III

Course Title	**NATIONAL SERVICE SCHEME**		
Course Code	**25BNSSP309**	**CIE MARKS**	**100**
(L : T : P) + SL	**(0:0:0)+(30 Hours/Sem)**	**SEE MARKS**	**–**
Credits	**–**	**EXAM HOURS**	**–**

COURSE LEARNING OBJECTIVES

The purpose of the course is to facilitate the learner to:

1. Identify the needs and problems of the community and participate in problem-solving activities.
2. Develop a sense of social and civic responsibility and utilize knowledge to find practical solutions to individual and community problems.
3. Develop the competencies required for group living and sharing responsibilities, and gain skills in mobilizing community participation to acquire leadership qualities and democratic attitudes.

Module-1
Introduction to NSS, Life Competencies, Youth Leadership and NSS
Module-2
Social connect and responsibilities
Module-3
Activities-1 (Choose from Activity List)
Module-4
Activities-2 (Choose from Activity List)
Module-5
Activities-3 (Choose from Activity List)

COURSE OUTCOMES

After successfully completing the course, the student will be able to:

CO1	Understand the motto and concepts of NSS
CO2	Develop overall personality of volunteers and make them as leaders and responsible citizens of our nation
CO3	Analyze the environmental and societal problems/issues and will be able to design solutions for the same.
CO4	Communicate effectively with the community and with the officials.

ACTIVITY LIST	
Plantation Drive: Adopt a Tree	Developing and managing an efficient garbage disposal system.
Food Preservation and Packaging Awareness	Tourism Promotion: Innovative Ap-proaches.
Facilitating 100% digitized money transactions	Contribution to any national-level initiative of the Government of India, e.g., Digital India, Skill India, Swachh Bharat Internship, etc.

ASSESSMENT AND EVALUATION REGULATIONS OF NCMC

Assessment Type	Maximum Marks	Minimum Passing Marks	Evaluation Details
CIE - IA Tests (A)	60	-	Sum of Two Internal Assessment Tests (MCQs) each conducted for 30 marks.
Continuous and Comprehensive Evaluation (B)	40	-	Any two Assessment methods as per 24RNBE4.2, scaled to 40 marks.
Total CIE (A+B)	100	40	CIE Evaluation is done for a maximum of 100 marks.
The minimum marks to be secured in CIE is 40 (40%) out of allotted 100 marks to Pass.			

Reference Books:

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

Web Links:

1. https://nss.gov.in/
2. https://pledge.mygov.in/

B.E. (Computer Science and Engineering (AI & ML))
Outcome Based Education (OBE) and Choice Based Credit System (CBCS)
SEMESTER – III

Course Title	PHYSICAL EDUCATION		
Course Code	25BPEDU309	CIE MARKS	100
(L : T : P) + SL	(0:0:0)+(30 Hours/Sem)	SEE MARKS	—
Credits	—	EXAM HOURS	—

COURSE LEARNING OBJECTIVES

The purpose of the course is to facilitate the learner to:

1. Understand the fundamental concepts of Physical Education, games and sports skills, Health, Nutrition and Fitness.
2. Familiarization of health-related Exercises, Sports for overall growth and development.
3. Participate in the competition at regional/state / national / international levels.
4. Create consciousness among the students on Health, Fitness and Wellness in developing and maintaining a healthy lifestyle.

Module-1 Title: Athletics-Track Events-110 and 400 Mtrs Hurdles	**3 Hours**
110 Mtrs and 400Mtrs: 1. Hurdling Technique: Lead leg Technique, Trail leg Technique 2. Crouch start (its variations) use of Starting Block.	
Module-2 Title: Athletics -Jump	**3 Hours**
High Jump a) Approach Run b) Take-off c) Bar Clearance (Straddle) d) Landing	
Module-3 Title: Athletics - Throws	**3 Hours**
Discus Throw a) Holding the Discus b) Initial Stance Primary Swing c) Rotation d) Release and Recovery (Rotation in the circle)	

Module-4 Title: Football	3 Hours

i) **Fundamental skills**

a) Kicking: Kicking the ball with inside of the foot, Kicking the ball with Full Instep of the foot, Kicking the ball with Inner Instep of the foot, Kicking the ball with Outer Instep of the foot and Lofted Kick.

b) Trapping: Trapping the Rolling ball and the Bouncing ball with sole of the foot.

c) Dribbling: Dribbling the ball with Instep of the foot, Dribbling the ball with Inner and Outer Instep of the foot.

d) Heading: In standing, running and jumping condition.

e) Throw-in: Standing throw-in and Running throw-in.

f) Tackling: Simple Tackling, Slide Tackling.

g) Goal Keeping: Collection of Ball, Ball clearance—kicking, throwing and deflecting.

h) Game practice with application of Rules and Regulations.

Module-5 Title: Hockey	3 Hours

i) **Fundamental skills**

a) Passing: Short pass, Long pass, Push pass, Hit.

b) Trapping.

c) Dribbling and Dozing.

d) Penalty stroke practice.

e) Penalty corner practice.

f) Tackling: Simple Tackling, Slide Tackling.

g) Goal Keeping: Ball clearance, kicking and deflecting.

h) Game practice with application of Rules and Regulations.

iii. Rules and their interpretation and duties of the officials

COURSE OUTCOMES

After successfully completing the course, the student will be able to:

CO1	Understand and demonstrate fundamental techniques of track events including 110m and 400m hurdles, with proper use of starting blocks and hurdling skills.
CO2	Apply technical knowledge of athletic jumps, particularly high jump, including approach run, take-off, bar clearance and landing techniques.
CO3	Develop skills and perform throwing events, specifically discus throw, with correct techniques such as grip, stance, rotation, release and recovery.
CO4	Demonstrate fundamental skills of football such as kicking, trapping, dribbling, heading, throw-in, tackling and goalkeeping along with understanding rules and officiating.
CO5	Exhibit basic skills and techniques in hockey, including passing, trapping, drib-bling, tackling, penalty strokes/corners and understand rules and duties of officials.

ASSESSMENT AND EVALUATION REGULATIONS OF NCMC

Assessment Type	Maximum Marks	Minimum Passing Marks	Evaluation Details
CIE – IA Tests (A)	60	-	Sum of Two Internal Assessment Tests (MCQs) each conducted for 30 marks.
Project (B)	40	-	——
Total CIE (A+B)	100	40	CIE Evaluation is done for a maximum of 100 marks.
The minimum marks to be secured in CIE is 40 (40%) out of 100 marks allotted to Pass.			

Textbooks:

1. Health and Physical Education by V.K. Sharma
2. Introduction to Physical Education, Fitnessand Sport by Daryl Siedentop
3. Physical Education Activities, Sports and Games: The Origin and Background, Rules of Play, Teaching Hints and Fundamentals by Louis E. Means

Reference Books:

1. Saraswati Health and Physical Education Textbook
2. Foundations of Physical Education, Exercise Science and Sport by Deborah A. Wuest

B.E. (Computer Science and Engineering (AI & ML))
Outcome Based Education (OBE) and Choice Based Credit System (CBCS)
SEMESTER – III

Course Title	**YOGA**		
Course Code	**25BYOGA309**	**CIE MARKS**	**100**
(L : T : P) + SL	**(0:0:0)+(30 Hours/Sem)**	**SEE MARKS**	**—**
Credits	**—**	**EXAM HOURS**	**—**

COURSE LEARNING OBJECTIVES

The purpose of the course is to facilitate the learner to:

1. Physical, Mental and Spiritual objectives of Yoga.
2. Explain the meaning of Yoga.
3. Discuss the importance of Yoga and its scope.
4. Describe the aims and objectives of Yoga.
5. Clarify the misconceptions on Yoga.

Module-1 Title: Suryanamaskara	**3 Hours**

Suryanamaskar 12 count 6 rounds

a) Suryanamaskar prayer.
b) Meaning, need & importance.
c) Benefits of Suryanamaskara.

Module-2 Title: Yoga	**3 Hours**

a) Meaning and definition.
b) Brief introduction of yogic practices for the common man.
c) Rules and regulations.
d) Misconceptions of Yoga.

Module-3 Title: Asanas - Sitting & Standing	**3 Hours**

Need and importance of different Asanas, meaning by name, technique, precautionary measures and benefits of each asana.

Sitting

a) Ardha Ushtrasana.
b) Yogamudra in Padmasana.

Standing

a) Hastapadasana.

b) Utkatasana.

Module-4 Title: Asanas - Supine line **3 Hours**

Need and importance of different Asanas, meaning by name, technique, precautionary measures and benefits of each asana.

Supine line

a) Sarvangasana.

b) Chakraasana.

Module-5 Title: Pranayama **3 Hours**

a) Kapalabhati - Revision of practice 40 strokes/min - 3 rounds.

b) Pranayama:

i) Ujjayi.

ii) Sheetali.

c) Meaning, Need, importance of Pranayama, Different types, Meaning by name, technique, precautionary measures and benefits of each Pranayama.

COURSE OUTCOMES

After successfully completing the course, the student will be able to:

CO1	Explain the meaning, definition, scope and objectives of Yoga and its role in physical, mental and spiritual well-being.
CO2	Demonstrate Suryanamaskara (12 counts, 6 rounds) with correct technique and understand its importance and benefits.
CO3	Apply knowledge of yogic practices, rules and regulations while identifying and correcting common misconceptions of Yoga.
CO4	Perform sitting, standing and supine Asanas with proper technique, precautions and awareness of their benefits.
CO5	Practice Pranayama techniques (Kapalabhati, Ujjayi, Sheetali) to improve breathing control, concentration and overall health.

ASSESSMENT AND EVALUATION REGULATIONS OF NCMC

Assessment Type	Maximum Marks	Minimum Passing Marks	Evaluation Details
CIE – IA Tests (A)	60	—	Sum of Two Internal Assessment Tests (MCQs) each conducted for 30 marks.
Project (B)	40	—	——
Total CIE (A+B)	100	40	CIE Evaluation is done for a maximum of 100 marks.
The minimum marks to be secured in CIE is 40 (40%) out of 100 marks allotted to Pass.			

Textbooks:

1. The Yoga Sutras of Patanjali by Sri Swami Satchidananda.
2. Light on Yoga by B.K.S. Iyengar.

Reference Books:

1. The Heart of Yoga by T.K.V. Desikachar.
2. Asana Pranayama Mudra Bandha by Swami Satyananda Saraswati.

B.E. (Computer Science and Engineering (AI & ML))
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SEMESTER – III

Course Title	MUSIC		
Course Code	25BMUSK309	CIE MARKS	100
(L : T : P) + SL	(0:0:0)+(30 Hours/Sem)	SEE MARKS	—
Credits	—	EXAM HOURS	—

COURSE LEARNING OBJECTIVES

The purpose of the course is to facilitate the learner to:

1. Understand the origin, evolutionand fundamental concepts of Indian classical music.
2. Familiarize themselves with the basic forms of Carnatic and Hindustani music compositions and appreciate their musical structure and significance.
3. Identify and classify the major musical instruments used in Carnatic and Hindustani music and understand their construction and performance characteristics.
4. Recognize the contributions of eminent Indian composers and musicians to the development and preservation of Indian classical music.
5. Develop an appreciation for India's rich musical heritage, fostering creativity, cultural awarenessand lifelong interest in music.

Module-1	3 Hours
Origin of the Indian Music: Evolution of the Indian music system, understanding of Shruthi, Nada, Swara, Laya, Raga, Tala and Mela.	
Module-2	**3 Hours**
Compositions: Introduction to the few types of compositions in Carnatic Music—Geethe, Swarajathi, Varna and Madhyama Kala Kriti.	
Module-3	**3 Hours**
Compositions: Introduction to the few types of compositions in Hindustani Music—Khayal, Drupad, Tarana.	
Module-4	**3 Hours**
Music Instruments: Classification and construction of string instruments, wind instrurnents, percussion instruments in both Carnatic and Hindustani Music.	
Module-5	**3 Hours**
Composers: Biography and contributions of of the following eminent personalities Purandaradasa, Thyagaraja, Mysore Vasudevacharya. Pt. Mallikarjun Mansur, Vidhushi Gangubhai Hangal.	

COURSE OUTCOMES

After successfully completing the course, the student will be able to:

CO1	Explain the origin, evolution and fundamental concepts of Indian classical music.
CO2	DCompare and distinguish the characteristics of selected Carnatic and Hindustani music compositions.
CO3	Classify the major categories of Indian musical instruments and describe their construction and applications in Carnatic and Hindustani music.
CO4	Examine the contributions of eminent Composers/Musicians and appreciate their role in preserving and promoting Indian classical music.

ASSESSMENT AND EVALUATION REGULATIONS OF NCMC

Assessment Type	Maximum Marks	Minimum Passing Marks	Evaluation Details
CIE – IA Tests (A)	60	-	Sum of Two Internal Assessment Tests (MCQs) each conducted for 30 marks.
Project (B)	40	—	Submission of report on a topic related to music.
Total CIE (A+B)	100	40	CIE Evaluation is done for a maximum of 100 marks.
The minimum marks to be secured in CIE is 40 (40%) out of 100 marks allotted to Pass.			

Textbooks:

1. Vidushi Vasantha Madhavi, Theory of Music, Prism Publication, 2007.
2. T Sachidevi and T Sharadha (Thirumalai Sisters), Karnataka Sangeetha Dharpana-Vol. 1 (English), Shreenivaas Prakaashana, 2018.
3. B. Chaitanya Deva, An Introduction to Indian Music, Publications Division, Gov-ernment of India, New Delhi.

Reference Books:

1. Lakshminarayana Subramaniam, Viji Subramanaim, Classical Music of India: A Practical Guige, Tranqueber 2018.
2. R. Rangaramanuja Ayyangar, History of South Indian (Carnatic) Music, Vipanci Charitable Trust; Third edition, 2019.
3. Vamanrao H. Deshpande, Indian Musical Traditions: An Aesthetic Study of the Gharanas in Hindustani Music, Popular Prakashan, Mumbai.

B.E. (Computer Science and Engineering (AI & ML))
Outcome Based Education (OBE) and Choice Based Credit System (CBCS)
SEMESTER – III

Course Title	ADDITIONAL MATHEMATICS-I		
Course Code	25BMADP310	CIE MARKS	100
(L : T : P) + SL	(1:0:0)+(14 Hours/Sem)	SEE MARKS	–
Credits	–	EXAM HOURS	–

COURSE LEARNING OBJECTIVES

The purpose of the course is to facilitate the learner to:

1. Apply the fundamental concepts of complex trigonometry, vector algebra and differential and integral calculus to analyze mathematical and engineering problems.
2. Apply the principles of vector differentiation and solve first-order ordinary differential equations in relevant scientific and engineering contexts.

Module-1	9 Hours
Complex Trigonometry: Complex Numbers: Definitions and properties. Modulus and amplitude of a complex number, Argand's diagram, De-Moivre's theorem (without proof). **Vector Algebra:** Scalars and vectors. Addition, subtraction and multiplication of vec-tors. Dot and Cross products, Problems.	
Module-2	**9 Hours**
Differential Calculus: Review of successive differentiation-illustrative examples. Maclaurin's series expansions-illustrative examples. **Partial Differentiation:** Euler's theorem-problems on first order derivatives only. Total derivatives-differentiation of composite functions. Jacobians of order two-Problems.	
Module-3	**9 Hours**
Vector Differentiation: Differentiation of vector functions. Velocity and acceleration of a particle moving on a space curve. Scalar and vector point functions. Gradient, Divergence, Curl-simple problems. Solenoidal and irrotational vector fields-Problems.	
Module-4	**9 Hours**
Integral Calculus: Review of elementary integral calculus. Reduction formulae for $\sin^n x$, $\cos^n x$ (with proof) and $\sin^m x \cos^n x$ (without proof)and evaluation of these with standard limits-Examples.	
Module-5	**9 Hours**
Ordinary Differential Equations (ODEs): Introduction-solutions of first order and first-degree differential equations: Exact differential equations, Linear differential equa-tions, Equations reducible to exact differential equations and Bernoulli's equation.	

COURSE OUTCOMES

After successfully completing the course, the student will be able to:

CO1	Apply concepts of complex numbers and vector algebra to analyze the problems arising in related areas.
CO2	Apply derivatives and partial derivatives to calculate the rate of change of multivariate functions.
CO3	Solve problems involving position, velocity and acceleration in two and three dimensions using vector-valued functions.
CO4	Apply the fundamental techniques of elementary integration to solve standard integrals.
CO5	Identify and solve first-order ordinary differential equations.

ASSESSMENT AND EVALUATION REGULATIONS OF NCMC

Assessment Type	Maximum Marks	Minimum Passing Marks	Evaluation Details
CIE - IA Tests (A)	60	-	Sum of Two Internal Assessment Tests (MCQs) each conducted for 30 marks.
Continuous and Comprehensive Evaluation (B)	40	-	Any two Assessment methods as per 24RNBE4.2, scaled to 40 marks.
Total CIE (A+B)	100	40	CIE Evaluation is done for a maximum of 100 marks.
The minimum marks to be secured in CIE is 40 (40%) out of allotted 100 marks to Pass.			

Textbook:

1. Higher Engineering Mathematics: B. S. Grewal, Khanna Publishers, 43rd Edition, 2015.

Reference Books:

1. Advanced Engineering Mathematics: E. Kreyszig, John Wiley & Sons, 10th Edition, 2015.
2. Engineering Mathematics: N. P. Bali and Manish Goyal, Laxmi Publishers, 7th Edition, 2007.
3. Engineering Mathematics Vol. I: Rohit Khurana, Cengage Learning, 1st Edition, 2015.

IV SEMESTER SUBJECTS

B.E. (Computer Science and Engineering (AI & ML))
Outcome Based Education (OBE) and Choice Based Credit System (CBCS)
SEMESTER – IV

Course Title:	**DISCRETE MATHEMATICS AND OPTIMIZATION TECHNIQUES**		
Course Code:	**25BAITH401**	**CIE MARKS**	**50**
(L: T: P) +SL	**(45:30:0) + 45 hrs/semester**	**SEE MARKS**	**50**
Credits:	**4**	**EXAM HOURS**	**3**

COURSE LEARNING OBJECTIVES:

The purpose of the course is to facilitate the learner to:

1. Apply the principles of mathematical logic and relations to analyze discrete mathematical problems.
2. Demonstrate the use of counting techniques and the principle of counting in solving combinatorial problems.
3. Familiarize with the fundamental concepts of principles of inclusion and exclusion to build a strong foundation in discrete mathematics.
4. Solve engineering optimization problems using appropriate mathematical and combinatorial techniques

Module 1: Fundamentals of logic	**9 hrs**
Basic connectives and Truth tables, Tautologies, Logical Equivalence: The laws of logic, Logical implications, Rules of inference, Proof and disproof. **Text 1 - Ch: 2.1, 2.2, 2.3, 2.5**	
Module 2: Relations	**9 hrs**
Cartesian Products and Relations, Properties of Relations, Zero-One Matrices and Directed Graphs, Equivalence Relations and Partitions, Partial Orders — Hasse Diagrams, Lattices. **Text 1 - Ch: 5.1, 7.1 – 7.4**	
Module 3: Fundamental Principles of Counting	**9 hrs**
The Rules of Sum and Product, Permutations, Combinations, Binomial and multinomial theorems, Combinations with Repetition. **Text 1 – Ch: 1.1 - 1.4**	
Module 4: The Principle of Inclusion and Exclusion	**9 hrs**
The Principle of Inclusion and Exclusion, Generalizations of the Principle, Derangements – Nothing is in its Right Place, Rook Polynomials, the Second Order Linear Homogeneous Recurrence Relation with Constant Coefficients. **Text 1 - Ch: 8.1 – 8.4, 10.2**	

Module 5: Optimization Techniques	**9 hrs**
Unconstrained optimization: Gradient Descent, Newton's Method, Constrained optimization: Lagrange Multipliers, Applications in Machine Learning: Linear Regression, Parameter estimation, maximum likelihood estimation, overfitting in Linear Regression, Bayesian Linear Regression. **Text 3 - Ch: 9.1-9.4, Text 4 - 6.1, 6.2, 6.4, 6.5**	

COURSE OUTCOMES:

After successfully completing the course, the student will be able to:

CO1	Apply Mathematical logic to validate propositions.
CO2	Implement properties of relations in theoretical algorithms.
CO3	Evaluate combinatorics related problems in the field of Artificial Intelligence.
CO4	Analyse the principle of inclusion and exclusion to solve counting problems involving finite sets.
CO5	Apply optimization techniques to formulate and solve engineering and Artificial Intelligence problems using appropriate analytical and numerical methods.

ASSESSMENT AND EVALUATION REGULATIONS OF ASC

Assessment Type	**Maximum Marks**	**Minimum Passing Marks**	**Evaluation Details**
CIE – IA Tests (A)	30	-	Two tests each of 50 marks shall be conducted. Average of Two Internal Assessment Tests shall be scaled down to 30 marks.
Continuous and Comprehensive Evaluation (B)	20	-	Any two Assessment methods as per 24RNBE4.2 (*if it is project based, one assignment shall be given), scaled to 20 marks.
Total CIE (A+B)	50	20	CIE Evaluation is done for a maximum of 50 marks
SEE (C)	50	18	SEE is a theory exam conducted for 100 marks and scaled down to 50 marks. Exam duration shall be for 3 hours.
CIE + SEE (A+B+C)	100	40	Final marks shall be the sum of marks scored in Components A, B and C.

- The minimum marks to be secured in CIE is 20 (40%) out of allotted 50 marks to appear for SEE.
- If any courses of 3 credits are of Integrated Course type, for such courses the method suggested for 4 credits IPCC shall be followed.

Text Books:

1. **Grimaldi, Ralph P.***Discrete and Combinatorial Mathematics: An Applied Introduction*. 5th ed. Boston, MA: Pearson Addison Wesley, 2004. ISBN: 9780201726343.
2. **Edwin K. P. Chong and Stanislaw H. Żak**, An Introduction to Optimization, 5th ed., Wiley, 2024.
3. **Marc Peter Deisenroth, A. Aldo Faisal, and Cheng Soon Ong,** "Mathematics for Machine Learning", Cambridge University Press, 2020.

Reference Books:

1. Chandrasekharaiah, D. S., *Discrete Mathematical Structures*, 5th Edition, PRISM Books Pvt. Ltd., Bengaluru, 2018.
2. Chandrasekharaiah, D. S.*Graph Theory and Combinatorics*. 4th ed. Bengaluru, India: PRISM Books Pvt. Ltd. ISBN 9788172866983
3. Kenneth H. Rosen: Discrete Mathematics and its Applications, 6th Edition, McGraw Hill, 2007.
4. Basavaraj S Anami and Venakanna S Madalli: Discrete Mathematics – A Concept based approach, Universities Press, 2016

B.E. (Computer Science and Engineering (AI & ML))
Outcome Based Education (OBE) and Choice Based Credit System (CBCS)
SEMESTER – IV

Course Title	**DATABASE MANAGEMENT SYSTEMS**		
Course Code	**25BCSIC402**	**CIE MARKS**	**50**
(L : T : P) + SL	**(3:0:2)+(45 Hours/Sem)**	**SEE MARKS**	**50**
Credits	**4**	**EXAM HOURS**	**3**

COURSE LEARNING OBJECTIVES

The purpose of the course is to facilitate the learner to:

Understand the fundamental concepts, architecture and advantages of Database Man-agement Systems and their role in data handling.

Design and model database schemas using Entity-Relationship (ER) diagrams and map conceptual designs to relational models.

Write efficient SQL queries for data definition, manipulation and retrieval and under-stand NoSQL databases and their applications.

Apply normalization techniques to design well-structured relational database schemas and eliminate redundancy.

Comprehend transaction processing, concurrency control and recovery techniques to ensure data integrity and reliability in database systems.

Module-1	**9 Hours**

Introduction to Databases: 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.

Conceptual Data Modelling using Entities and Relationships: Entity types, En-tity sets and structural constraints, Weak entity types, ER Diagrams, Naming Conven-tions and Design Issues.

Textbook 1: Chapter 1 (1.1 - 1.7), Chapter 2 (2.1 - 2.2, 2.5, 2.6), Chapter 3(3.1 - 3.7)

Module-2	**9 Hours**

Mapping Conceptual Design into a Logical Design: Relational Database Design using ER-to-Relational mapping.

Relational Model: 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, etc.).

Chapter 9 (9.1), Chapter 5 (5.1 - 5.3), Chapter 8 (8.1 - 8.4)

Module-3	9 Hours
SQL: SQL data definition and data types, Schema change statements in SQL, specifying constraints in SQL, retrieval queries in SQL, INSERT, DELETE and UPDATE statements in SQL, Additional features of SQL. **More SQL: Complex Queries, Triggers, Views and Schema Modification:** More complex SQL retrieval queries, Specifying constraints as assertions and action triggers, Views in SQL. **NOSQL Databases and Big Data Storage Systems:** Introduction to NOSQL Sys-tems, The CAP Theorem, Document-Based NOSQL Systems and MongoDB. **Textbook 1: Chapter 6 (6.1 - 6.5), Chapter 7 (7.1 - 7.3), Chapter 24 (24.1 -24.3)**	
Module-4	**9 Hours**
Normalization: Database Design Theory - Introduction to Normalization using Functional and Multivalued Dependencies: Informal design guidelines for relation schema, Functional Dependencies, Normal Forms based on Primary Keys, Second and Third Normal Forms, Boyce-Codd Normal Form. **Relational Database Design Algorithms:** Functional Dependencies: Inference Rules, Equivalence and Minimal Cover, Properties of Relational Decompositions, Algorithms for Relational Database Schema Design, About Nulls, Dangling Tuples. **Textbook 1: Chapter 14 (14.1 - 14.5), Chapter 15 (15.1 - 15.2)**	
Module-5	**9 Hours**
Transaction Processing: Introduction to Transaction Processing, Transaction and System concepts, Desirable properties of Transactions, Characterizing schedules based on recoverability, Characterizing schedules based on Serializability, Transaction support in SQL. **Concurrency Control in Databases:** Two-phase locking techniques for Concurrency control, Concurrency control based on Timestamp ordering. **Textbook 1: Chapter 20 (20.1 - 20.6), Chapter 21 (21.1, 21.2)**	

PRACTICAL COMPONENT OF IPCC

Sl. No.	EXPERIMENTS
1	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, Branch id, No-of Copies) BOOK LENDING (Book id, Branch id, Card No, Date Out, Due Date) LIBRARY BRANCH (Branch id, Branch Name, Address) BORROWER (Card no, Name, Address, Phone) Write SQL queries to a. Retrieve details of all books in the library – id, title, name of publisher, authors, number of copies in each branch, etc. b. Get the particulars of borrowers who have borrowed more than 3 books, but from Jan 2017 to Jun 2017. c. Delete a book in BOOK table. Update the contents of other tables to reflect this data manipulation operation. d. Partition the BOOK table based on year of publication. Demonstrate its working with a simple query. e. Create a view of all books and its number of copies that are currently available in the Library.
2	Consider the following schema for an 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 a. Count the customers with grades above Bangalore's average. b. Find the name and numbers of all salesmen who had more than one customer. c. List all the salesmen and indicate those who have and don't have customers in their cities (Use UNION operation). d. Create a view that finds the salesman who has the customer with the highest order of a day. e. Demonstrate the DELETE operation by removing salesman with id 1000. All his orders must also be deleted.

3	Consider the following schema for a 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 a. List the titles of all movies directed by 'Hitchcock'. b. Find the movie names where one or more actors acted in two or more movies. c. List all actors who acted in a movie before 2000 and also in a movie after 2015 (use JOIN operation). d. 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. e. Update the rating of all movies directed by 'Steven Spielberg' to 5.
4	Consider the following schema for a College Database: STUDENT (USN, SName, Address, Phone, Gender) SEMSEC (SSID, Sem, Sec) CLASS (USN, SSID) SUBJECT (Subcode, Title, Sem, Credits) IAMARKS (USN, Subcode, SSID, Test1, Test2, Test3, FinalIA) Write SQL queries to a. List all the student details studying in fourth semester 'C' section. b. Compute the total number of male and female students in each semester and in each section. c. Create a view of Test1 marks of student USN '1RN25CS100' in all subjects. d. Calculate the FinalIA (average of the best two test marks) and update the corresponding table for all students. e. Categorize students based on the following criterion: If FinalIA = 17 to 20 then CAT = 'Outstanding' If FinalIA = 12 to 16 then CAT = 'Average' If FinalIA 12 then CAT = 'Weak'. Give these details only for 8th semester A, B and C section students.

5	Consider the following schema for a Company Database: EMPLOYEE (SSN, Name, Address, Sex, Salary, SuperSSN, DNo) DEPARTMENT (DNo, DName, MgrSSN, MgrStartDate) DLOCATION (DNo, DLoc) PROJECT (PNo, PName, PLocation, DNo) WORKS ON (SSN, PNo, Hours) Write SQL queries to a. Make a list of all project numbers for projects that involve an employee whose last name is 'Scott', either as a worker or as a manager of the department that controls the project. b. Show the resulting salaries if every employee working on the 'IoT' project is given a 10 percent raise. c. Find the sum of the salaries of all employees of the 'Accounts' department, as well as the maximum salary, the minimum salaryand the average salary in this department. d. Retrieve the name of each employee who works on all the projects controlled by department number 5 (use NOT EXISTS operator). e. For each department that has more than five employees, retrieve the department number and the number of its employees who are making more than Rs. 6,00,000.
6	Installation of an Open-Source NoSQL Database MongoDB and perform basic CRUD (Create, Read, Update and Delete) operations. Download MongoDB Community Server from: https://www.mongodb.com/try/download/community

COURSE OUTCOMES

After successfully completing the course, the student will be able to:

CO1	Define the fundamentals of DBMS architecture, data models and ER modelling concepts.
CO2	Construct ER diagrams into relational schemas and apply relational algebra operations.
CO3	Formulate SQL queries and differentiate between SQL and NoSQL databases.
CO4	Apply normalization techniques to design relational schemas up to BCNF.
CO5	Analyse transaction processing and implement concurrency control and recovery techniques.

ASSESSMENT AND EVALUATION REGULATIONS OF IPCC

Assessment Type	Maximum Marks	Minimum Passing Marks	Evaluation Details
CIE- IA Tests (A)	20	-	Two tests each of 50 marks shall be conducted. Average of Two Internal Assessment Tests shall be scaled down to 20 marks.
Continuous and Comprehensive Evaluation (B)	10	-	Any one Assessment methods as per 24RNBE4.2 scaled to 10 marks.
Total CI Theory (A+B E)	30	12	Marks of Tests and Assignments awarded for a maximum of 30.
CIE Practical	12	-	Marks awarded for Weekly Conduction of Experiments and Submission of Laboratory records, scaled to 12 marks.
CIE Practical Test	8	-	Average of marks of Two tests, each conducted for 100 marks covering all experiments, scaled to 8.
Total CIE Practical (C)	20	8	Marks of Experiments, Record and Test awarded for a maximum of 20 marks.
CIE: Theory + Practical (A + B + C)	50	20	CIE Evaluation is done for a maximum of 50 marks.
SEE (D)	50	18	SEE is a theory exam, conducted for 100 marks and scaled down to 50 marks. Exam duration shall be for 3 hours.
CIE+SEE (A+B+C+D)	100	40	Final marks shall be the sum of marks scored in Components A, B, C and D.
The minimum marks to be secured in CIE is 20 (40%) out of allotted 50 marks to appear for SEE. The laboratory component of the IPCC shall be for CIE only. However, in SEE, the questions from the laboratory component shall be included in their respective modules only.			

Textbooks:

1. Fundamentals of Database Systems, Ramez Elmasri and Shamkant B. Navathe, 7th Edition, 2017, Pearson.

Reference Books:

1. Database Management Systems, Ramakrishnan and Gehrke, 3rd Edition, 2014, McGraw Hill.
2. Silberschatz Korth and Sudharshan, Database System Concepts, 6th Edition, Mc-Graw Hill, 2013.

Web Links:

1. https://www.youtube.com/playlist?...PLJwqWlxkbMhdAM5pv3Yfx5CWkm83tZy0s
2. https://www.youtube.com/playlist?...PLxCzCOWd7aiFAN6I8CuViBuCdJgiOkT2Y
3. https://www.youtube.com/watch?v=c5HAwKX-suM
4. https://www.geeksforgeeks.org/dbms/dbms/

Self Study topics:

1. Module 3: (Chapter 24.4 – 24.6)
   NOSQL Key-Value Stores, Column-Based or Wide Column NOSQL Systems, NOSQL Graph Databases and Neo4j.
2. Module 4: (Chapter 14.6 – 14.7)
   Multivalued Dependency and Fourth Normal Form, Join Dependencies and Fifth Normal Form.
3. Module 5: (Chapter 21.3 – 21.5)
   Multiversion Concurrency control techniques, Validation Concurrency control tech-niques, Granularity of Data items and Multiple Granularity Locking.

Mini Project:

1. https://www.hackerrank.com/domains/sql
2. Case Study based Flip Class

B.E. (Computer Science and Engineering (AI & ML))
Outcome Based Education (OBE) and Choice Based Credit System (CBCS)
SEMESTER – IV

Course Title	DESIGN AND ANALYSIS OF ALGORITHMS		
Course Code	25BCSTH403	CIE MARKS	50
(L : T : P) + SL	(3:2:0)+(45 Hours/Sem)	SEE MARKS	50
Credits	4	EXAM HOURS	3

COURSE LEARNING OBJECTIVES

The purpose of the course is to facilitate the learner to:

1. Learn the methods for analysing algorithms and evaluating their performance.
2. Demonstrate the efficiency of algorithms using asymptotic notations.
3. 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. Learn the concepts of P and NP complexity classes.

Module-1 **9 Hours**

Fundamentals: 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 and Exhaustive search: Selection Sort, Bubble Sort, Sequential Search and String Matching, Closest Pair points and Convex-Hull problems, Travelling Salesman Problem, Assignment Problem, Knapsack Problem.

Textbook 1: Chapter 2 (2.1 - 2.4), Chapter 3 (3.1 - 3.4)

Module-2 **9 Hours**

Decrease-and-Conquer: Topological Sorting, Fake Coin problem, Interpolation Search.

Divide-and-Conquer: Merge Sort, Quicksort.

Divide-and-Conquer: Max Min Algorithm.

Textbook 1: Chapter 4 (4.2, 4.4, 4.5), Chapter 5 (5.1 - 5.2)

Textbook 2: Chapter 3 (3.3)

Module-3 **9 Hours**

Transform and Conquer: Balanced Search Trees (AVL trees,2-3 trees), Heaps and Heapsort.

Greedy Technique: Prim's Algorithm, Kruskals Algorithm, Dijkstra's Algorithm, Huff-man Trees, Knapsack Problem, Job sequencing with deadlines.

Textbook 1: Chapter-6 (6.3-6.4) Chapter-9 (9.1-9.4)

Text book 2: Chapter-4 (4.2,4.4)

Module-4 **9 Hours**

Dynamic Programming: Multistage graph, The Knapsack Problem and Memory func-tions, Warshall's Algorithm, Floyd's Algorithms, Reliability Design. **Space and Time Trade-offs:** Input Enhancement in String Matching: Horspool's algo-rithm, Boyer Moore's Algorithm. **Textbook 1: Chapter 8 (8.2, 8.4), Chapter 7 (7.2)** **Textbook 2: Chapter 5 (5.2 - 5.8)**
Module-5 **9 Hours**
Backtracking: n-Queens Problem, Hamiltonian Circuit problem, Subset-Sum Problem, Graph coloring. **Branch-and-Bound:** Assignment Problem, Knapsack Problem, Traveling Salesman Problem. **Problem Complexity:** Limitations of Algorithm Power, P, NPand NP-Complete Prob-lems, Approximation algorithms for NP Hard (Knapsack, Travelling Salesman Problem). **Textbook 1: Chapter 12 (12.1 - 12.3), Chapter 11 (11.3)** **Textbook 2: Chapter 7 (7.4)**

COURSE OUTCOMES

After successfully completing the course, the student will be able to:

CO1	Explain the fundamentals of algorithm analysis, asymptotic notations, brute-force techniques and analyze the efficiency of sorting algorithms such as Selec-tion Sort, Merge Sort and Quick Sort.
CO2	Apply divide-and-conquer, decrease-and-conquer, transform-and-conquer, greedy and graph algorithms (Topological Sort, Dijkstra's, Floyd's, Warshall's, Kruskal's and Prim's) to solve optimization and scheduling problems.
CO3	Apply dynamic programming, backtracking and branch-and-bound techniques to design efficient solutions for optimization and combinatorial problems.
CO4	Analyze and compare the time and space complexities of different algorithmic paradigms to evaluate their suitability for solving various computational prob-lems.
CO5	Analyze computational complexity classes (P, NP, NP-Complete) and imple-ment exact, approximation and backtracking algorithms to solve computation-ally hard problems such as the N-Queens problem.

ASSESSMENT AND EVALUATION REGULATIONS OF PCC

Assessment Type	Maximum Marks	Minimum Passing Marks	Evaluation Details
CIE Practical (A)	30	-	Two tests each of 50 marks shall be conducted. Average of Two Internal Assessment Tests shall be scaled down to 30 marks.
CIE Practical Test (B)	20	-	Any two Assessment methods as per 24RNBE4.2 (*if it is project based, one assignment shall be given), scaled to 20 marks.
Total CIE Practical (A+B)	50	20	CIE Evaluation is done for a maximum of 50 marks.
SEE (C)	50	18	SEE is a theory exam conducted for 100 marks and scaled down to 50 marks. Exam duration shall be for 3 hours.
CIE + SEE (A+B+C)	100	40	Final marks shall be the sum of marks scored in Components A, B and C.
The minimum marks to be secured in CIE are 20 (40%) out of the allotted 50 marks to appear for SEE, with a minimum of 40% scored in every component of CIE.			

Textbooks:

1. Anany Levitin, Introduction to the Design and Analysis of Algorithms, 3rd Edition, Pearson 2017.
2. Ellis Horowitz, Satraj Sahni, Rajasekharam, Fundamentals of Computer Algo-rithms, 2nd Edition 2019.

Reference Books:

1. Thomas H Cormen, Charles E Leiserson, Ronald L Rivest, Clifford Stein Introduc-tion to Algorithms, 4th MIT Press 2009.
2. Padma Reddy, Analysis and Design of Algorithms, 1st Sri Nandi Publications 2009.

B.E. (Computer Science and Engineering (AI & ML))
Outcome Based Education (OBE) and Choice Based Credit System (CBCS)
SEMESTER – IV

Course Title	ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING		
Course Code	25BCSTH404	CIE MARKS	50
(L : T : P) + SL	(3:2:0)+(45 Hours/Sem)	SEE MARKS	50
Credits	4	EXAM HOURS	3

COURSE LEARNING OBJECTIVES

The purpose of the course is to facilitate the learner to:

1. Explain the basics of Artificial Intelligence & Machine Learning algorithms.
2. Identify the problems applicable for Artificial Intelligence and Machine Learning techniques.
3. Discuss knowledge representation issues and different kind of learning algorithms.
4. Demonstrate application of algorithms to real-world problems.

Module-1	9 Hours
Introduction: What is AI? The state of the art. **Intelligent agents:** Agents and environment, Good Behavior: The Concept of Rationality, The nature of Environments, The structure of Agents. **Textbook 1: Chapter 1(1.1, 1.4), Chapter 2 (2.1 - 2.4)**	
Module-2	**9 Hours**
Problem Solving by Searching: Problem-solving agents, Example Problems, Search algorithms, Uninformed Search Strategies, Informed search Strategies. **Adversarial search:** Game Theory, Optimal Decision in games. **Textbook 1: Chapter 3 (3.1 - 3.5), Chapter 6 (6.1 - 6.2)**	
Module-3	**9 Hours**
Introduction: Need for Machine Learning, Machine Learning Explained, Machine Learning in Relation to other Fields, Types of Machine Learning, Challenges of Machine Learning, Machine Learning Process, Machine Learning Applications. **Similarity-based Learning:** Nearest-Neighbor Learning, Weighted K-Nearest-Neighbor Algorithm, Nearest Centroid Classifier, Locally Weighted Regression (LWR). **Regression Analysis:** Introduction to Regression, Introduction to Linearity correlation and Causation, Introduction to Linear Regression, Multiple Linear Regression, Polynomial Regression, Logistic Regression. **Textbook 2: Chapter 1, Chapter 4 (4.2 - 4.5), Chapter 5 (5.1 - 5.3, 5.5 - 5.7)**	

Module-4	9 Hours
Bayesian Learning: Introduction to Probability-based Learning, Fundamentals of Bayes Theorem, Classification Using Bayes Model, Na¨ıve Bayes Algorithm for Continuous Attributes. **Artificial Neural Networks:** Introduction, Biological Neurons, Artificial Neurons, Perceptron and Learning Theory, Types of Artificial Neural Networks, Popular Applications of Artificial Neural Networks, Advantages and Disadvantages of ANN, Challenges of ANN. **Textbook 2: Chapter 8 (8.1 - 8.4), Chapter 10 (10.1 - 10.5, 10.9 - 10.11)**	
Module-5	**9 Hours**
Decision Tree Learning: Introduction to Decision Tree Learning Model, Decision Tree Induction Algorithms. **Reinforcement Learning:** Overview of Reinforcement Learning, Scope of Reinforcement Learning, Reinforcement Learning as Machine Learning, Components of Reinforce-ment Learning, Model Free Methods, Q-Learning. **Textbook 2: Chapter 6 (6.1 - 6.2), Chapter 14 (14.1 - 14.4, 14.8, 14.9)**	

COURSE OUTCOMES

After successfully completing the course, the student will be able to:

CO1	Understand how intelligent agents work in real-world applications.
CO2	Utilize search algorithms to construct effective AI agent solutions.
CO3	Examine machine learning techniques to address real-world problems.
CO4	Implement Bayesian learning methods for solving classification tasks.
CO5	Demonstrate machine learning applications using neural networks and reinforcement learning approaches.

ASSESSMENT AND EVALUATION REGULATIONS OF PCC

Assessment Type	Maximum Marks	Minimum Passing Marks	Evaluation Details
CIE – IA Tests (A)	30	-	Two tests each of 50 marks shall be conducted. Average of two Internal Assessment Tests shall be scaled down to 30 marks.

Continuous and Comprehensive Evaluation (B)	20	-	Any two assessment methods as per 24RNBE4.2 (*if it is project based, one assignment shall be given), scaled to 20 marks.
Total CIE (A+B)	50	20	CIE evaluation maximum 50 marks.
SEE (C)	50	18	SEE is a theory exam conducted for 100 marks and scaled down to 50 marks. Exam duration shall be 3 hours.
CIE + SEE (A+B+C)	100	40	Final marks shall be the sum of marks scored in components A, Band C.
The minimum marks to be secured in CIE is 20 (40%) out of allotted 50 marks to appear for SEE.			

Textbooks:

1. Stuart Russell and Peter Norvig, Artificial Intelligence: A Modern Approach, 4th Edition, Pearson Education, 2023.
2. S Sridhar, M Vijayalakshmi, Machine Learning, Oxford University Press, 2021, First Edition.

Reference Books:

1. Aurelien Geron, Hands-On Machine Learning with Scikit-Learn and TensorFlow: Concepts, Tools and Techniques to Build Intelligent Systems, 3rd Edition, Shroff / O'Reilly Media, 2022.
2. Tom M. Mitchell, Machine Learning, 1st Edition, McGraw Hill Education, 2017.
3. Ethem Alpaydin, Introduction to Machine Learning, 2nd Edition, PHI Learning Pvt. Ltd., 2014.
4. George F. Luger, Structures and Strategies for Complex Problem Solving, 5th Edition, Pearson Education, 2011.
5. Trevor Hastie, Robert Tibshirani, Jerome Friedman, The Elements of Statistical Learning, 2nd Edition, Springer New York, NY, 2009.

Web Links:

1. https://nptel.ac.in/courses/106106139
2. https://nptel.ac.in/courses/106102220
3. https://www.coursera.org/.../machine-learning-introduction

Self Study Topics:

1. Compare Uninformed vs Informed Search.
2. Implement BFS & DFS in Python.
3. Explore A* Search with heuristics.
4. Learn Bayes' theorem applications in classification.
5. Naive Bayes text classification example.
6. Neural Networks and Backpropagation demo.
7. Q-Learning on a grid world.
8. Temporal Difference vs Monte Carlo Method.
9. Utility-based Agents vs Goal-based Agents.

ESTD:2001
An Institute with a Difference

B.E. (Computer Science and Engineering (AI & ML))
Outcome Based Education (OBE) and Choice Based Credit System (CBCS)
SEMESTER – IV

Course Title	DESIGN AND ANALYSIS OF ALGORITHMS LABORATORY		
Course Code	25BCSLB405	CIE MARKS	50
(L : T : P)	(0:0:2)	SEE MARKS	50
Credits	1	EXAM HOURS	3

COURSE LEARNING OBJECTIVES

The purpose of the course is to facilitate the learner to:

1. Learn the methods for analysing algorithms and evaluating their performance to demonstrate the efficiency of algorithms using asymptotic notations.
2. Demonstrate the efficiency of algorithms using asymptotic notations.
3. 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. Learn the concepts of P and NP complexity classes.

Program 1 - Selection Sort – Sorting Student IDs
Design and implement a C program to sort a list of student roll numbers from a university database using the Selection Sort algorithm. Objective: Record and compare the time taken for sorting as the number of student records increases (n > 5000). Application: Helps in managing ordered student data efficiently for attendance systems or result generation.
Program 2 - Merge Sort – Organizing Medical Reports
Design and implement a C program to sort large sets of patient report IDs using Merge Sort. Objective: Track execution time for datasets with n > 5000 and plot time vs data size. Application: Efficient sorting of medical records in a hospital management system.
Program 3 - Quick Sort – E-Commerce Order Sorting
Design and implement a C program to sort customer order IDs based on timestamps using Quick Sort. Objective: Measure performance on dataset size > 5000 and plot the performance graph. Application: Fast processing of online orders in an e-commerce platform.

Program 4 - Topological Sort – Task Scheduling in Project Management
Implement a C program to find the topological ordering of tasks in a project where some tasks depend on the completion of others. Application: Automating task scheduling tools like Jira or Trello where dependencies exist.
Program 5 - Bellman-Ford Algorithm – Dynamic Routing in Unstable Networks
Objective: Implement a C/C++ program to find the shortest paths from a single source vertex to all other vertices in a directed graph that may contain negative edge weights using the Bellman-Ford algorithm, including negative cycle detection. Application: Optimizing autonomous delivery or logistics routes where certain pathways pass through energy-harvesting zones (recharging grids represented as negative weights), while ensuring the system flags infinite battery-draining loops (negative cycles).
Program 6 - Greedy Knapsack – Stock Refill Strategy
Implement a C/C++ program to solve discrete and fractional knapsack problems using greedy methods to choose items for shelf restocking in a supermarket based on value-to-weight ratio. Application: Inventory management and optimization.
Program 7 - Dijkstra's Algorithm – GPS Navigation System
Implement a C/C++ program to find shortest paths from a given location to all other locations in a city's road network. Application: GPS systems like Google Maps, for calculating the shortest routes.
Program 8a - Floyd's Algorithm – Travel Time Optimization Problem
Implement a C/C++ program to find the shortest paths between all pairs of cities in a country using Floyd's algorithm. Application: Railway or airline scheduling and route planning.
Program 8b - Warshall's Algorithm – Webpage Reachability
Implement a C/C++ program to determine reachability between all webpages using Warshall's algorithm on a hyperlink graph. Application: Search engines identifying which pages link to others.
Program 9 - Kruskal's Algorithm – Designing Network Layouts
Implement a C/C++ program to find the Minimum Cost Spanning Tree of a network using Kruskal's algorithm. Application: Laying cables (like fiber optic) for minimum cost in a connected campus or city.

Program 10 - Prim's Algorithm – Power Grid Optimization
Implement a C/C++ program to build the minimum cost electricity network using Prim's algorithm. Application: Designing cost-effective electricity distribution networks.
Program 11 - Subset Sum – Payment Combinations
Implement a C/C++ program to find all payment combinations using a set of coin or currency denominations that sum up to a required amount. Application: ATM cash dispensing or vending machines.
Program 12 - N-Queens – Security Camera Placement
Implement a C/C++ program to solve the N-Queens problem to place security cameras in a museum grid such that no two cameras cover the same row, column, or diagonal. Application: Surveillance system optimization.

COURSE OUTCOMES

After successfully completing the course, the student will be able to:

CO1	Analyse and implement sorting algorithms such as Selection Sort, Merge Sort and Quick Sort to solve domain-specific problems.
CO2	Apply graph-based algorithms such as Topological Sort, Dijkstra's, Floyd's, Warshall's, Kruskal's and Prim's algorithms to solve real-time optimization and scheduling problems.
CO3	Design and develop efficient solutions using Dynamic Programming techniques for combinatorial problems.
CO4	Solve resource allocation problems using Greedy algorithms and demonstrate their effectiveness in constrained environments.
CO5	Implement backtracking techniques to solve constraint satisfaction problems such as the N-Queens problem.

ASSESSMENT AND EVALUATION REGULATIONS OF PCCL

Assessment Type	Maximum Marks	Minimum Passing Marks	Evaluation Details
CIE Practical (A)	30	-	Marks awarded for Weekly Conduction of Experiments and Submission of Laboratory records, scaled to 30 marks.

CIE Practical Test (B)	20	-	Average of marks of Two tests, each conducted for 100 marks covering all experiments, scaled to 20.
Total CIE Practical (A+B)	50	20	Sum of Marks of Experiments, Record and Test shall be CIE marks awarded for a maximum of 50.
SEE (C)	50	20	SEE is a lab exam, conducted for 100 marks and scaled down to 50 marks. Exam duration shall be for 3 hours.
CIE + SEE (A+B+C)	100	40	Final marks shall be the sum of marks scored in Components A, B and C.
The minimum marks to be secured in CIE is 20 (40%) out of allotted 50 marks to appear for SEE.			

Web Links:

1. https://cse01-iiith.vlabs.ac.in/

ESTD:2001
An Institute with a Difference

B.E. (Computer Science and Engineering (AI & ML))
Outcome Based Education (OBE) and Choice Based Credit System (CBCS)
SEMESTER – IV

Course Title	INTRODUCTION TO UNIX		
Course Code	25BCSAE406A	CIE MARKS	50
(L : T : P)	(0:0:2)	SEE MARKS	50
Credits	1	EXAM HOURS	3

COURSE LEARNING OBJECTIVES

The purpose of the course is to facilitate the learner to:

1. Explain the fundamental structure, architecture, components, and key features of the Unix/Linux operating system.
2. Demonstrate proficiency in using the Unix/Linux command-line interface (CLI) to navigate the file system, manage files and directories, and perform basic system oper-ations.
3. Develop and execute shell scripts using variables, decision-making statements, loops, and Unix commands to automate routine tasks.
4. Apply Unix/Linux system administration utilities to manage processes, files, users, permissions, and monitor system resources effectively.

Program 1 - Unix Commands

A Linux System Administrator is assigned to perform a routine system inspection before carrying out maintenance activities on a server. Develop and execute a Bash script that displays the current working directory, lists all files including hidden files in the current directory, sorts the files in descending order based on their size, displays the current date and time in detailed format, and shows the name of the currently logged-in user. The script should produce clearly labeled output for each task and help the administrator quickly obtain essential system information in an organized manner.

Program 2 - File and Directory Operations

A project coordinator is responsible for organizing project documents in a Unix/Linux environment before the start of a new development cycle. Develop and execute a Bash script that creates a nested directory structure named project/year2025/month07/week1, generates multiple text files inside the week1 directory using a loop, moves and renames these files into a new directory named archive, creates a backup by copying the entire archive directory to a new location named backup, and finally deletes all .txt files from the archive directory using appropriate wildcard patterns. The script should automate the complete file management process efficiently and display suitable messages for each operation.

Program 3 - File Permissions and Ownership

An System Engineer is required to secure a newly created file by modifying its access permissions and ownership before making it available to other users. Develop and execute a Bash script that creates a sample file named example.txt, displays its original permis-sions using the long listing format, changes the file permissions using both symbolic and numeric modes, displays the updated permissions after each modification, and optionally changes the ownership of the file to another user if appropriate privileges are available. The script should clearly show the permission details before and after each operation and include suitable messages to explain each step.

Program 4 - Text Processing Utilities

A college administrator has been provided with a tab-separated file named students.txt containing student records such as Roll Number, Name, Department, and Marks. Develop and execute a Bash script to analyze and process the file using Unix/Linux text-processing utilities. The script should display the complete file contents, show the first three and last two records, extract only the student names, convert the names to uppercase, sort the records based on marks in ascending order, display the list of unique departments, print the names of students who scored more than 80 marks, and replace the department name ”Computer” with ”CSE”. Ensure that the output of each command is clearly labeled to make the generated report easy to understand.
The contents of students.txt are as follows:

Roll.No	Name	Department	Marks
101	John	Computer	85
102	Ravi	Electronics	78
103	Asha	Computer	92
104	Maya	Electronics	85
105	Arjun	Mechanical	78

Program 5 - Redirection and Pipelines

A Human Resources (HR) executive has been provided with a comma-separated file named data.txt containing employee records with their ID, Name, and Department. The executive needs to identify employees belonging to the Computer department and generate a formatted report using Unix/Linux command-line utilities. Develop and execute a Bash script that uses input/output redirection and pipelines to read the data from the file, extract only the records belonging to the Computer department, retrieve the employee names, convert them to uppercase, save the intermediate output to a file named filtered names txt, sort the names, count the occurrence of each name, and display the final report on the terminal. The script should demonstrate the use of grep, cut, tr, sort, uniq redi-rection, and pipes, ensuring that each stage of processing is clearly labeled. The contents of data txt are as follows:

ID	Name	Department
101	John	Computer
102	Ravi	Electronics
103	Asha	Computer
104	Maya	Electronics
105	Arjun	Mechanical
106	David	Computer

Program 6 - File Search and Log Analysis

An IT Infrastructure Engineer is assigned to inspect a server's file system to locate important files and identify errors recorded in log files before performing system maintenance. Develop and execute a Bash script that recursively searches the current directory to locate a specific file, report.txt, identifies files of specific types such as directories or symbolic links, and finds files larger than 1 MB. The script should also search all .log files for lines containing the keyword "ERROR", display the filename along with each matching line, and save the complete error report to a file named error report.txt. Use appropriate find options (-name, -type, -size, etc.) and grep options (-r, -i, -n, --include, etc.) to perform the required tasks. Ensure that the script contains meaningful comments and clearly labeled output for each operation.

Program 7 - Process Management

A Server Administrator is responsible for monitoring and managing system processes on a production server to ensure efficient resource utilization and proper job control. Develop and execute a Bash script that displays a snapshot of the currently running processes, iden-tifies the top five memory-consuming processes by showing their PID, User, Command, starts a long-running process in the background, displays its job ID and PID, monitors it using appropriate commands, brings the background job to the foreground, suspends and resumes the process using Unix/Linux job control commands, and finally terminates the process gracefully. The script should include meaningful comments, clearly labeled output, and log each step to demonstrate effective process monitoring and management.

Program 8 - Process Monitoring and Job Control
A Linux System Administrator is testing Unix/Linux process monitoring and job con-trol features to ensure that background tasks can be effectively managed during system maintenance. Develop and execute a Bash script that displays the current list of run-ning processes, identifies the top five memory-consuming processes by showing their PID, USER, % MEM, and COMMAND, starts a dummy long-running process in the back-ground, displays the background job and its corresponding PID, brings the job to the foreground, suspends and resumes the process using appropriate job control commands, and finally terminates the process gracefully. The script should include meaningful com-ments and clearly labeled output to explain each stage of process monitoring and job control.
Program 9 - Shell Variables and Quoting
A DevOps engineer is preparing a training session to help new team members understand how the Unix/Linux shell handles variables, environment variables, command substitu-tion, and different quoting mechanisms. Develop and execute a Bash script that creates and displays shell variables, performs simple arithmetic operations, converts a shell vari-able into an environment variable using the export command and verifies it using printenv or env, demonstrates the behavior of single quotes, double quotes, backticks ( ), and $ () for command substitution, and includes examples that clearly illustrate how the shell interprets quoted and unquoted text differently. The script should produce descriptive and well-labeled output for each demonstration
Program 10 - Decision Making, Loops, and File Handling
A software trainee is developing a Unix/Linux shell script to practice decision-making, loops, and file handling as part of a programming assignment. Develop and execute a Bash script that accepts a number from the user, determines whether it is even or odd, checks whether it is divisible by 3, uses a loop to display all even numbers between 1 and 50, and traverses the current directory to list the names of all files with the .txt extension. The script should use appropriate conditional statements, looping constructs, and file-handling commands, while displaying clearly labeled and user-friendly output for each task.

COURSE OUTCOMES

After successfully completing the course, the student will be able to:

CO1	Apply fundamental Unix/Linux commands for file, directory and system oper-ations.
CO2	Develop shell scripts using variables, control structures, loops, and command substitution to automate Unix operations.
CO3	Apply Unix utilities for process management, text processing, and file permis-sion management.
CO4	Analyze system requirements to automate tasks and monitor system perfor-mance using Unix scheduling tools.

ASSESSMENT AND EVALUATION REGULATIONS OF AEC

Assessment Type	Maximum Marks	Minimum Passing Marks	Evaluation Details
CIE – IA Tests (A)	30	-	Marks awarded for Weekly Conduction of Experiments and Submission of Laboratory records, scaled to 30 marks.
Alternate Assessment (B)	20	-	Average of marks of Two tests, each conducted for 100 marks covering all experiments, scaled to 20.
Total CIE (A+B)	50	20	Sum of Marks of Experiments, Record and Test shall be CIE marks awarded for a maximum of 50.
SEE (C)	50	20	SEE is a lab exam, conducted for 100 marks and scaled down to 50 marks. Exam duration shall be for 3 hours.
CIE + SEE (A+B+C)	100	40	Final marks shall be the sum of marks scored in Components A, B and C.
The minimum marks to be secured in CIE are 20 out of allotted 50 marks to appear for SEE, with minimum 40% scored in every component of CIE.			

Text Books:

1. Sumitabha Das , Your UNIX/Linux: The Ultimate Guide, 3rd edition, McGraw-Hill 2012
2. Sumitabha Das, Unix: Concepts and Applications, 4th Edition, McGraw Hill, 2006.
3. W. Richard Stevens and Stephen A. Rago, Advanced Programming in the UNIX Environment, 3rd Edition, Addison-Wesley, 2013.

Reference Books:

1. Behrouz A. Forouzan and Richard F. Gilberg, Unix and Shell Programming, 1st Edition, Cengage Learning, 2003.
2. William E. Shotts Jr., The Linux Command Line: A Complete Introduction, 2nd Edition, No Starch Press, 2019.
3. Free Software Foundation, GNU Bash Reference Manual, Edition 5.2, GNU Project, 2022.

B.E. (Computer Science and Engineering (AI & ML))
Outcome Based Education (OBE) and Choice Based Credit System (CBCS)
SEMESTER – IV

Course Title	**SCALA**		
Course Code	**25BCIAE406B**	**CIE MARKS**	**50**
L: T: P	**0:0:2**	**SEE MARKS**	**50**
Credits:	**1**	**EXAM HOURS**	**3**

Course Learning Objectives:

The purpose of the course is to facilitate the learner to:

1. Model data using algebraic data types, represented in Scala as families of sealed traits and case classes.
2. Use structural recursion and pattern matching to traverse and transform data.
3. Learn programming with the common data structures of Scala.
4. Learn object-oriented programming in Scala

Exp#	Experiment Title
1	1a. Write a Scala program to compute the sum of the two given integer values. If the two values are the same, then return triples their sum. 1b. Write a Scala program to check two given integers, and return true if one of them is 22 or if their sum is 32.
2	2a. Write a Scala program to remove the character in a given position of a given string. The given position will be in the range 0...string length -1 inclusive. 2b. Write a Scala program to create a new string taking the first 5 characters of a given string and return the string with the 5 characters added at both the front and back.
3	3a. Write a Scala program to print the multiplication table of a given number using a for loop. 3b. Write a Scala program to find the largest element in an array using pattern matching
4	4a. Write a Scala function to calculate the product of digits in a given number. 4b. Write a Scala function to check if a given number is a perfect square.
5	5a. Write a Scala program that creates a subclass Student that extends the Person class. Add a property called grade and implement methods to get and set it. 5b. Write a Scala program that creates a class Triangle with properties side1, side2, and side3. Implement a method isEquilateral to check if the triangle is equilateral.
6	6a. Write a Scala program that creates an enum class Color with values for different colors. Use the enum class to represent an object's color. 6b. Write a Scala program that creates a class ContactInfo with properties name, email, and address. Create a class Customer that includes a ContactInfo object.
7	7a. Write a Scala program to create a set and find the difference and intersection between two sets. 7b. Write a Scala program to create a set and find the second largest element in the set.
8	8a. Write a Scala program to create a list in different ways. Note: Use Lisp style, Java style, Range list, Uniform list, Tabulate list. 8b. Write a Scala program to flatten a given List of Lists, nested list structure.
9	9a. Write a Scala program to add each element n times to a given list of integers. 9b. Write a Scala program to split a given list into two lists.
10	10a. Write a Scala program to swap the elements of a tuple Further print no swapping required if elements are same. 10b. Write a Scala program to find non-unique elements in a tuple.

COURSE OUTCOMES

After successfully completing the course, the student will be able to:

CO1	Get familiar with the Scala syntax and object-oriented principles
CO2	Learn advanced concepts - loops, expressions, inheritance, pattern matching
CO3	Learn to write clean and functional Scala codes and test it.
CO4	Learn functional programming using Scala

ASSESSMENT AND EVALUATION REGULATIONS OF AEC

Assessment Type	Maximum Marks	Minimum Passing Marks	Evaluation Details
CIE Practical (A)	30	-	Marks awarded for Weekly Conduction of Experiments and Submission of Laboratory records, scaled to 30 marks.
CIE Practical Test (B)	20	-	Average of marks of Two tests, each conducted for 100 marks covering all experiments, scaled to 20.
Total CIE Practical (A+B)	50	20	Sum of Marks of Experiments, Record and Test shall be CIE marks awarded for a maximum of 50.
SEE (C)	50	20	SEE is a lab exam, conducted for 100 marks and scaled down to 50 marks. Exam duration shall be for 3 hours.
CIE + SEE (A+B+C)	100	40	Final marks shall be the sum of marks scored in Components A, B and C.
The minimum marks to be secured in CIE is 20 (40%) out of allotted 50 marks to appear for SEE.			

Textbook

1. Programming Scala, Third Edition, O'Reilly Media.
2. Paul Chiusano, Rúnar Bjarnason, Functional Programming in Scala 1st Edition, Manning Publications

E- Learning Resources

1. https://docs.scala-lang.org/tutorials/scala-for-java-programmers.html
2. https://www.javatpoint.com/scala-tutorial

B.E. (Computer Science and Engineering (AI & ML))
Outcome Based Education (OBE) and Choice Based Credit System (CBCS)
SEMESTER – IV

Course Title	**JULIA**		
Course Code	**25BCIAE406C**	**CIE MARKS**	**50**
L: T: P	**0:0:2**	**SEE MARKS**	**50**
Credits:	**1**	**EXAM HOURS**	**3**

Course Learning Objectives:

The purpose of the course is to facilitate the learner to:

1. To introduce the basics of Julia programming language.
2. To illustrate the data structures of Julia programming language.
3. To make use of built-in functions and packages.

Exp#	Experiment Title
1	1a. Develop a Julia program to simulate a calculator (for integer and real numbers). 1b. Develop a Julia program to add, subtract, multiply and divide complex numbers. 1c. Develop a Julia program to evaluate expressions having mixed data types (integer, real, floating-point number and complex).
2	2a. Develop a Julia program for the following problem: A computer repair shop charges $100 per hour for labour plus the cost of any parts used in the repair. However, the minimum charge for any job is $150. Prompt for the number of hours worked and the cost of parts (which could be $0) and print the charge for the job. 2b. Develop a Julia program to calculate a person's regular pay, overtime pay and gross pay based on the following: If hours worked is less than or equal to 40, regular pay is calculated by multiplying hours worked by rate of pay, and overtime pay is 0. If hours worked is greater than 40, regular pay is calculated by multiplying 40 by the rate of pay, and overtime pay is calculated by multiplying the hours in excess of 40 by the rate of pay by 1.5. Gross pay is calculated by adding regular pay and overtime pay.
3	3a. An amount of money P (for principal) is put into an account which earns interest at r% per annum. So, at the end of one year, the amount becomes P + P×r/100. This becomes the principal for the next year. 3b. Develop a Julia program which reads numbers from a file (input.txt) and finds the largest number, smallest number, count, sum and average of numbers.
4	4a. Develop a Julia program and two separate functions to calculate GCD and LCM. 4b. Develop a Julia program and a recursive function to calculate factorial of a number. 4c. Develop a Julia program and a recursive function to generate Fibonacci series.

5	5a. Develop a Julia program which reads a string (word) and prints whether the word is palindrome. 5b. Develop a Julia program which reads and prints the words present in a file (input.txt) having Random Data in which words are dispersed randomly (Assumption: a word is a contiguous sequence of letters. A word is delimited by any non-letter character or end-of-line).
6	6a. Develop a Julia program to determine and print the frequency with which each letter of the alphabet is used in a given line of text. 6b. Develop a Julia program to generate a plot of mathematical equation: y = sin(x) + sin(2x).
7	7a. A survey of 10 pop artists is made. Each person votes for an artist by specifying the number of the artist (a value from 1 to 10). Develop a Julia program to read the names of the artists, followed by the votes, and find out which artist is the most popular. 7b. Develop a Julia program to generate a plot of (solid & dotted) a function: y=x2 (use suitable data points for x).
8	8a. Given a line of text as input, develop a Julia program to determine the frequency with which each letter of the alphabet is used (make use of dictionary) . 8b. Develop a Julia program to fetch words from a file with arbitrary punctuation and keep track of all the different words found (make use of set and ignore the case of the letters: e.g. to and To are treated as the same word).
9	9a. Develop a Julia program to evaluate expressions consisting of rational, irrational number and floating-point numbers) 9b. Develop a Julia program to determine the following properties of a matrix: determinant, inverse, rank, upper & lower triangular matrix, diagonal elements, Euclidean norm and Square Root of a Matrix.
10	10a. Develop a Julia program to determine addition and subtraction of two matrices (element -wise). 10b. Develop a Julia program to perform multiplication operation on matrices: scalar multiplication, element wise multiplication, dot product, cross product.

COURSE OUTCOMES

After successfully completing the course, the student will be able to:

CO1	Understand the syntax, environment setup, and fundamental constructs of the Julia language.
CO2	Apply Julia's control structures and functions to develop basic programs.
CO3	Use and manipulate data structures such as arrays, tuples, sets, and dictionaries in Julia.
CO4	Utilize built-in functions and external packages for mathematical and scientific computation.
CO5	Demonstrate the ability to debug, test, and optimize Julia code for problem-solving tasks.

ASSESSMENT AND EVALUATION REGULATIONS OF AEC

Assessment Type	Maximum Marks	Minimum Passing Marks	Evaluation Details
CIE Practical (A)	30	-	Marks awarded for Weekly Conduction of Experiments and Submission of Laboratory records, scaled to 30 marks.
CIE Practical Test (B)	20	-	Average of marks of Two tests, each conducted for 100 marks covering all experiments, scaled to 20.
Total CIE Practical(A+B)	50	20	Sum of Marks of Experiments, Record and Test shall be CIE marks awarded for a maximum of 50.
SEE (C)	50	20	SEE is a lab exam, conducted for 100 marks and scaled down to 50 marks. Exam duration shall be for 3 hours.
CIE + SEE (A+B+C)	100	40	Final marks shall be the sum of marks scored in Components A, B and C.
The minimum marks to be secured in CIE is 20 (40%) out of allotted 50 marks to appear for SEE.			

Textbook

1. "Think Julia: How to Think Like a Computer Scientist", Authors: Ben Lauwens, Allen B.
   Downey, Publisher: O'Reilly Media, ISBN: 9781492045034.
2. "Julia Programming Projects", Authors: Adrian Salceanu, Publisher: Packt Publishing

Suggested Learning Resources:

1. Julia Programming Projects, Author: Adrian Salceanu, Publisher: Pack Publishing

B.E. (Computer Science and Engineering (AI & ML))
Outcome Based Education (OBE) and Choice Based Credit System (CBCS)
SEMESTER – IV

Course Title	**NOSQL USING MONGODB**		
Course Code	**25BCIAE406D**	**CIE MARKS**	**50**
L: T: P	**0:0:2**	**SEE MARKS**	**50**
Credits	**1**	**EXAM HOURS**	**3**

Course Learning Objectives:

The purpose of the course is to facilitate the learner to:

1. To introduce students to the fundamentals of NoSQL databases and the advantages of using MongoDB in modern application development.
2. To enable students to perform CRUD operations, indexing, aggregation, and advanced querying techniques using MongoDB.
3. To develop proficiency in handling complex data structures such as embedded documents and arrays within collections.
4. To equip students with the ability to build data-driven applications by integrating MongoDB with platforms like Node.js for real-world solutions.

Exp#	Experiment Title
1	Create a students collection with fields: rollNo, name, branch, cgpa, skills (array).
2	Create a products collection with productId, name, category, price, inStock, ratings (array).

3	Create orders collection with embedded documents:
	{
	orderId, customerName,
	items: [{ productId, quantity, price }], orderDate,
	status
	}

4	Build employees collection with empId, name, department, salary, joiningDate, skills.
5	Create books collection with isbn, title, author, genres, publishedYear, availableCopies.
6	Create movies collection with title, releaseYear, genres, ratings (array), actors.
7	Create patients collection with patientId, name, age, diseases (array), admissionDate, discharged.
8	Create blogs collection with postId, author, title, content, comments (embedded array of { name, comment, date }).
9	Create courses with courseCode, title, credits, department, enrolledStudents (array of student IDs).
10	Create sales collection with saleId, product, amount, quantity, date, region.
11	Create users collection with userId, name, email, enrolledCourses, progress (embedded object)
12	Create flights collection with flightId, airline, from, to, departureTime, bookings (array of passenger IDs)
13	Create restaurants with name, cuisine, location, reviews: array of { user, rating, comment }
14	Create events collection with eventId, title, date, participants, venue, category

COURSE OUTCOMES

After successfully completing the course, the student will be able to:

CO1	Apply foundational MongoDB commands to create and manage databases and collections, and perform CRUD operations effectively.
CO2	Construct and execute advanced queries using operators, projections, and array manipulations for efficient data retrieval and transformation.
CO3	Implement data aggregation pipelines, indexing strategies, and embedded document operations to support performance optimization and complex data relationships.
CO4	Design and develop practical applications using MongoDB, integrating it with programming environments like Node.js for real-world data handling scenarios.
CO5	Apply foundational MongoDB commands to create and manage databases and collections, and perform CRUD operations effectively.

ASSESSMENT AND EVALUATION REGULATIONS OF AEC

Assessment Type	Maximum Marks	Minimum Passing Marks	Evaluation Details
CIE Practical (A)	30	-	Marks awarded for Weekly Conduction of Experiments and Submission of Laboratory records, scaled to 30 marks.
CIE Practical Test (B)	20	-	Average of marks of Two tests, each conducted for 100 marks covering all experiments, scaled to 20.
Total CIE Practical (A+B)	50	20	Sum of Marks of Experiments, Record and Test shall be CIE marks awarded for a maximum of 50.
SEE (C)	50	20	SEE is a lab exam, conducted for 100 marks and scaled down to 50 marks. Exam duration shall be for 3 hours.
CIE + SEE (A+B+C)	100	40	Final marks shall be the sum of marks scored in Components A, B and C.
The minimum marks to be secured in CIE is 20 (40%) out of allotted 50 marks to appear for SEE.			

Textbook

Kristina Chodorow, "MongoDB: The Definitive Guide – Powerful and Scalable Data Storage", 3rd Edition, O'Reilly Media, 2019

Reference Books:

1. Navin Sabharwal and Shankatala Guha, "MongoDB Essentials", Packt Publishing, 2015.
2. Kyle Banker, "MongoDB in Action", Second Edition, Manning Publications, 2016.
3. Amol Nayak, "MongoDB for Developers", Packt Publishing, 2014.
4. Sasidharan C., "Mastering MongoDB 6.x", Packt Publishing, 2023.

B.E. (Computer Science and Engineering (AI & ML))
Outcome Based Education (OBE) and Choice Based Credit System(CBCS)
SEMESTER – IV

Course Title	**OBJECT ORIENTED PROGRAMMING**		
Course Code	**25BCIAE406E**	**CIE MARKS**	**50**
(L: T: P) + SL	**0:0:2**	**SEE MARKS**	**50**
Credits	**1**	**EXAM HOURS**	**3**

COURSE LEARNING OBJECTIVES:

The purpose of the course is to facilitate the learner to:

1. Introduce the fundamental concepts of object-oriented programming
2. Familiarize with object-oriented principles such as encapsulation, inheritance, polymorphism, abstraction, and interfaces.
3. Develop proficiency in designing and implementing applications using collections, packages, exception handling, and file handling techniques.
4. Enable students to apply advanced oops concepts including multithreading, graphical user interfaces (GUI), and event-driven programming.
5. Provide hands-on experience in developing real-world software solutions using object-oriented design.

Implement the following program using any one of the programming languages: C++, Java or Python

Experiment 1.

To discuss various **decision-making statements and loop**
Implement a program to determine whether a given number is prime or not.
Implement a menu-driven calculator application using appropriate selection constructs to perform arithmetic operations.

Experiment 2.

Illustrate the creation and use of **classes and objects** of java by designing a Student class with attributes such as Identification Number, Name, Branch, and Phone Number. Create multiple student objects and display their details.

Experiment 3.

Implement a program to illustrate the concept of **Encapsulation** by designing a class with private data members and providing controlled access through public methods.

Experiment 4.

Design and develop a application for a University Management System to demonstrate all **types of inheritance**.
Create a superclass Person containing common details such as ID, Name, and Age.
Derive a class Student from Person (Single Inheritance).
Further derive a class ResearchStudent from Student (Multilevel Inheritance).
Create additional subclasses Faculty and Staff from Person (Hierarchical Inheritance).
Define two interfaces SportsActivity and CulturalActivity, each containing appropriate methods.
Create a class CampusAmbassador that extends ResearchStudent and implements both interfaces (Multiple and Hybrid Inheritance through Interfaces).

Experiment 5.
Implement a program to demonstrate **Runtime Polymorphism** by creating a superclass Employee with a method calculateSalary(). Derive subclasses Manager, Developer, and Intern, each providing its own implementation of calculateSalary(). Use a superclass reference to invoke the overridden methods and display the salary details.
Experiment 6.
To demonstrate **constructor overloading, method overloading, and method overriding** using a Banking System application. Create a class BankAccount with a default constructor and a parameterized constructor to initialize account details. Demonstrate constructor overloading. Implement overloaded methods deposit() to allow depositing money with different parameter lists, such as deposit(amount) and deposit(amount, description). Demonstrate method overloading. Create subclasses SavingsAccount and CurrentAccount that inherit from BankAccount and override the method calculateInterest(). Demonstrate method overriding by calculating interest differently for each account type and displaying the results.
Experiment 7.
Design and implement a program which converter application that performs unit conversions such as currency, distance, and time conversions using appropriate **abstraction** and modularization techniques.
Experiment 8.
Design a resume generation system by creating different user profiles such as Teacher and Student. Implement **abstraction and interfaces** to model common and specialized attributes and behaviors.
Experiment 9.
Implement a program to demonstrate **exception handling** by performing division of two numbers and handling invalid cases appropriately.
Experiment 10.
Implement a program using **collection** data structures to perform the following string operations: a) Append a string to the collection b) Insert a string at a specified position c) Search for a string d) Display all strings beginning with a given character
Experiment 11.
Implement a program to perform **file handling operations** by accepting a file name as input and displaying its properties such as existence, accessibility, type, and size.
Program 12.
Implement a **multithreaded application** which one thread generates random numbers at regular intervals, while separate threads process and display the square and cube of the generated numbers.
Program 13.
Implement graphical **user interface (GUI)** applications to: a. Display a message on the screen using suitable GUI components. b. Design and implement a simple calculator application with a graphical user interface.

COURSE OUTCOMES:

After successfully completing the course, the student will be able to:

CO1	**Understand** the fundamental concepts of object-oriented programming and Java constructs.
CO2	**Apply** object-oriented principles such as encapsulation, inheritance, polymorphism, and abstraction in program development.
CO3	**Develop** Java applications using packages, collections, exception handling, and file handling techniques.
CO4	**Implement** multithreaded and GUI-based applications using Java programming concepts.
CO5	**Design** object-oriented solutions for real-world problems using advanced Java programming features.

ASSESSMENT AND EVALUATION REGULATIONS OF AEC

Assessment Type	Maximum Marks	Minimum Passing Marks	Evaluation Details
CIE Practical (A)	30	-	Marks awarded for Weekly Conduction of Experiments and Submission of Laboratory records, scaled to 30 marks.
CIE Practical Test (B)	20	-	Average of marks of Two tests, each conducted for 100 marks covering all experiments, scaled to 20.
Total CIE Practical (A+B)	50	20	Sum of Marks of Experiments, Record and Test shall be CIE marks awarded for a maximum of 50.
SEE (C)	50	20	SEE is a lab exam, conducted for 100 marks and scaled down to 50 marks. Exam duration shall be for 3 hours.
CIE + SEE (A+B+C)	100	40	Final marks shall be the sum of marks scored in Components A, B and C.
The minimum marks to be secured in CIE is 20 (40%) out of allotted 50 marks to appear for SEE.			

Suggested Learning Resources:

1. E Balagurusamy, Programming with Java, Graw Hill, 6th Edition, 2019.
2. Herbert Schildt, C: Java the Complete Reference, McGraw Hill, 11th Edition, 2020

B.E. (Computer Science and Engineering (AI & ML))
Outcome Based Education (OBE) and Choice Based Credit System (CBCS)
SEMESTER – IV

Course Title	**REDIS**		
Course Code	**25BCIAE406F**	**CIE MARKS**	**50**
(L: T: P) + SL	**0:0:2**	**SEE MARKS**	**50**
Credits	**1**	**EXAM HOURS**	**3**

COURSE LEARNING OBJECTIVES:
The purpose of the course is to facilitate the learner to:

1. To introduce the fundamental concepts, architecture, and installation of Redis.
2. To familiarize students with Redis data structures and commands.
3. To develop proficiency in implementing Redis-based applications for data management.
4. To enable students to design caching, session management, and messaging solutions using Redis.
5. To provide hands-on experience in building real-time and scalable applications using Redis.

Experiment 1. Installation and Configuration of Redis
Install and configure Redis Server and Redis CLI. Demonstrate the working of Redis by performing basic key-value operations using appropriate Redis commands.
Experiment 2. String Data Type Operations
Write a program to demonstrate Redis String operations using SET, GET, APPEND, INCR, DECR, and MGET commands.
Experiment 3. Student Information Management Using Hashes
Write a program to store, update, and retrieve student details such as USN, Name, Branch, and Semester using Redis Hashes.
Experiment 4. Queue Implementation Using Lists
Write a program to implement a queue management system using Redis Lists and perform enqueue and dequeue operations.
Experiment 5. Stack Implementation Using Lists
Write a program to implement stack operations using Redis Lists and perform PUSH, POP, and PEEK operations.
Experiment 6. Attendance Management Using Sets
Write a program to maintain attendance records using Redis Sets and perform union, intersection, and difference operations.
Experiment 7. Student Ranking System Using Sorted Sets
Write a program to create a student leaderboard using Redis Sorted Sets and display rankings based on marks obtained.
Experiment 8. Session Management System
Write a program to implement user session management using Redis with automatic session expiration using TTL.
Experiment 9. Online Voting Application
Write a program to develop a voting system using Redis Counters and Atomic Increment operations.
Experiment 10. Caching Frequently Accessed Data

Write a program to implement caching for frequently accessed records and compare retrieval performance before and after caching.
Experiment 11. Publish–Subscribe Messaging System
Write a program to implement a Publisher–Subscriber model using Redis Pub/Sub for real-time communication between clients.
Program 12. Inventory Management System
Write a program to develop an inventory management application using Redis data structures to store and manage product information.

COURSE OUTCOMES:

After successfully completing the course, the student will be able to:

CO1	Understand Redis architecture and installation procedures.
CO2	Apply Redis data structures for efficient data storage and retrieval.
CO3	Develop applications using Redis Lists, Sets, Hashes, and Sorted Sets.
CO4	Implement caching, session management, and real-time communication systems.
CO5	Design scalable applications using Redis for modern computing environments.

ASSESSMENT AND EVALUATION REGULATIONS OF AEC

Assessment Type	Maximum Marks	Minimum Passing Marks	Evaluation Details
CIE Practical (A)	30	-	Marks awarded for Weekly Conduction of Experiments and Submission of Laboratory records, scaled to 30 marks.
CIE Practical Test (B)	20	-	Average of marks of Two tests, each conducted for 100 marks covering all experiments, scaled to 20.
Total CIE Practical (A+B)	50	20	Sum of Marks of Experiments, Record and Test shall be CIE marks awarded for a maximum of 50.
SEE (C)	50	20	SEE is a lab exam, conducted for 100 marks and scaled down to 50 marks. Exam duration shall be for 3 hours.
CIE + SEE (A+B+C)	100	40	Final marks shall be the sum of marks scored in Components A, B and C.
The minimum marks to be secured in CIE is 20 (40%) out of allotted 50 marks to appear for SEE.			

Suggested Learning Resources:

1. L. Fugaro, "Redis Stack for Application Modernization", 1st Edition. Birmingham, UK: Packt Publishing, Jun. 2023.
2. Udemy Inc., "Redis: The Complete Developer's Guide", Udemy Online Learning Platform, 2024.Available: https://www.udemy.com/course/redis-the-complete-developers-guide
3. Redis Official Documentation, "Redis Commands and Data Structures Reference", Redis Ltd., 2024.. Available: https://redis.io/docs
4. Infosys Springboard, "Introduction to NoSQL Databases", Infosys Ltd., 2024. [Online]. Available: https://springboard.infosys.com

B.E. (Computer Science and Engineering (AI & ML))
Outcome Based Education (OBE) and Choice Based Credit System (CBCS)
SEMESTER – IV

Course Title	**CASSANDRA**		
Course Code	**25BCIAE406G**	**CIE MARKS**	**50**
(L: T: P) + SL	**0:0:2**	**SEE MARKS**	**50**
Credits	**1**	**EXAM HOURS**	**3**

COURSE LEARNING OBJECTIVES:

The purpose of the course is to facilitate the learner to:

1. Understand Apache Cassandra and distributed NoSQL concepts.
2. Create databases and perform CRUD operations using CQL.
3. Use advanced Cassandra features effectively.
4. Manage and maintain Cassandra databases.
5. Design scalable applications using Apache Cassandra.

Experiment 1: Create a database "sales" using Cassandra and perform the following operations

a. Create table "user", having ID, Fname, Lname, and location as attributes
b. Insert details of 5 users
c. Retrieve the names of the users.
d. Alter the table by adding phone number to the existing table

Experiment 2. : Create a database "College" using Cassandra and perform the following operations

a. Create table "employee", having ID, Fname, Lname, email ID and location as attributes
b. Insert details of 5 employees.
c. Extract the email ID of the employees of specific ID.
d. Update the email ID to the existing table of employee
e. Delete an element from the table with specific employee ID

Experiment 3. Create a database **"Company"** and perform the following operations:

a. Create a table employee_skills with attributes:
- emp_id
- emp_name
- skills (SET)
- phone_numbers (LIST)
- address (MAP)

b. Insert details of 3 employees.
c. Display all records.
d. Add a new skill to an employee.
e. Update the city in the address map.

Experiment 4.
Create a database **"Website"** and perform the following operations:
a. Create a table page_views containing:
- page_name
- views (COUNTER)

b. Increment the views of the Home page by 1.
c. Increment the views of the About page by 5.
d. Display all page view counts.
e. Decrement the Home page count by 1.

Experiment 5. Create a database **"Library"** and perform the following operations:
a. Create a table book_reservation.
b. Insert reservation details with a TTL of 120 seconds.
c. Retrieve the TTL value of the reservation.
d. Verify the record before expiry.
e. Observe the deletion of data after TTL expires.

Experiment 6. Create a database **"Hospital"** and perform the following operations:
a. Create a table patient.
b. Insert 5 patient records.
c. Add a new column blood_group.
d. Change the datatype of age.
e. Delete the column address.
f. Describe the modified table.

Experiment 7. Problem Statement:
Create a database **"Bank"** and perform the following operations:
a. Create a table customer.
b. Insert 5 records.
c. Display all records.
d. Remove all records using the TRUNCATE command.
e. Verify that the table is empty.
f. Drop the table.
g. Drop the keyspace

Experiment 8. Create a database **"Store"** and perform the following operations:
a. Create a table product.
b. Insert 5 product records.
c. Export the table contents into a CSV file.
d. Delete all records.
e. Import the data back from the CSV file.
f. Display the imported records.

Experiment 9. Create a database **"Transport"** and perform the following operations:
a. Create a table bus_details.
b. Insert records through STDIN.
c. Display all records.
d. Export the table contents to STDOUT.
e. Verify the exported output.

Experiment 10. Create a database **"ECommerce"** and perform the following operations: a. Create a table orders. b. Insert order details using consistency level ONE. c. Read the records using consistency level QUORUM. d. Insert another record using consistency level ALL. e. Compare the behavior of different consistency levels. f. Record your observations.
Experiment 11. Create a database **"EventManagement"** and perform the following operations: a. Create a table events containing: • event_id (UUID) • event_name • event_date (TIMESTAMP) • venue b. Insert details of 5 events. c. Retrieve all event details. d. Display events conducted after a specific date. e. Update the venue of an event.
Experiment 12. Create a database **"Attendance"** and perform the following operations: a. Create a table student_attendance with attributes: • student_id • student_name • subject • attendance_count b. Insert attendance details of 5 students. c. Retrieve attendance information of a specific student. d. Update attendance counts. e. Delete the attendance record of a student. f. Display all records. g. Export the attendance details into a CSV file.

COURSE OUTCOMES:

After successfully completing the course, the student will be able to:

CO1	Understand the architecture and fundamental concepts of Apache Cassandra, including keyspaces, partitioning, replication, gossip protocol, and tunable consistency.
CO2	Create and manage Cassandra keyspaces and tables using CQL and appropriate data types.
CO3	Perform CRUD operations (Create, Read, Update, and Delete) on Cassandra databases using CQL commands.
CO4	Apply advanced Cassandra features such as collections, counters, UUID, timestamps, and Time-To-Live (TTL) in database applications.
CO5	Modify database schemas and perform data administration tasks including ALTER, TRUNCATE, DROP, and data import/export operations using Cassandra utilities

ASSESSMENT AND EVALUATION REGULATIONS OF AEC

Assessment Type	Maximum Marks	Minimum Passing Marks	Evaluation Details
CIE Practical (A)	30	-	Marks awarded for Weekly Conduction of Experiments and Submission of Laboratory records, scaled to 30 marks.
CIE Practical Test (B)	20	-	Average of marks of Two tests, each conducted for 100 marks covering all experiments, scaled to 20.
Total CIE Practical (A+B)	50	20	Sum of Marks of Experiments, Record and Test shall be CIE marks awarded for a maximum of 50.
SEE (C)	50	20	SEE is a lab exam, conducted for 100 marks and scaled down to 50 marks. Exam duration shall be for 3 hours.
CIE + SEE (A+B+C)	100	40	Final marks shall be the sum of marks scored in Components A, B and C.
The minimum marks to be secured in CIE is 20 (40%) out of allotted 50 marks to appear for SEE.			

Textbook

1. Jeff Carpenter and Eben Hewitt, *Cassandra: The Definitive Guide – Distributed Data at Web Scale*, 2nd Edition, O'Reilly Media, 2022.

Reference Books

1. Lakshman Avinash and Prashant Malik, *Cassandra: The Definitive Guide*, O'Reilly Media, 2010.
2. Russell Bradberry and Eric Lubow, *Practical Cassandra: A Developer's Approach*, Addison-Wesley Professional, 2015.
3. Vivek Mishra, *Getting Started with Apache Cassandra*, Packt Publishing, 2014.
4. Gerardus Blokdyk, *Apache Cassandra: A Complete Guide*, 5StarCooks, 2021.
5. DataStax Documentation Team, *Apache Cassandra Documentation*, DataStax Inc. (Online Resource).

B.E. (Computer Science and Engineering (AI & ML))
Outcome Based Education (OBE) and Choice Based Credit System (CBCS)
SEMESTER – IV

Course Title	BIOLOGY FOR ENGINEERS		
Course Code	25BFETH407	CIE MARKS	50
(L : T : P) + SL	(2:0:0)+(30 Hours/Sem)	SEE MARKS	50
Credits	2	EXAM HOURS	2

COURSE LEARNING OBJECTIVES:

The purpose of the course is to facilitate the learner to:

1. Familiarize the students with the basic biological concepts and their engineering applications.
2. Enable the students with an understanding of bio design principles to create novel devices and structures.
3. Provide the students an appreciation of how biological systems can be re-designed as substitute products for natural systems.
4. Motivate the students to develop interdisciplinary vision of biological engineering.

Module-1	6 Hours
Introduction to fundamentals of life. Structure and functions of a cell. Biomolecules: Properties and functions of Carbohydrates, Nucleic acids, Proteins, Enzymes and Lipids.	
Module-2	**6 Hours**
Introduction to applications of biomolecules: Carbohydrates in cellulose-based water filters production, PHA and PLA in bioplastics, Nucleic acids in vaccines and diagnosis, Proteins in food production, Enzymes in biosensors fabrication, Genome & protein data types.	
Module-3	**6 Hours**
Introduction to adaptations of anatomical principles for bioengineering design, Brain as a CPU system. Eye as a Camera system. Heart as a pump system. Lungs as purification system. Kidney as a filtration system.	
Module-4	**6 Hours**
Introduction to nature inspired biomaterials and mechanisms - Echolocation, Photosynthesis, Bird flying, Lotus leaf effect, Shark skin, Kingfisher beak. Artificial blood - haemoglobin-based oxygen carriers (HBOCs).	

Module-5	6 Hours
Introduction to trends in bioengineering, Tissue engineering, stem cells and their appli-cations, Bioprinting techniques and materials. Electrical tongue and electrical nose in food science, DNA origami and Biocomputing, Bioimaging and Artificial Intelligence for disease diagnosis. Bioconcrete.	

COURSE OUTCOMES

After successfully completing the course, the student will be able to:

CO1	Corroborate the concepts of biomimetics for specific requirements.
CO2	Understand the basic biological concepts for relevant industrial applications. adaptation.
CO3	Evaluate the principles of design and development, for exploring engineering knowledge in biological.
CO4	Explore innovative biobased solutions for socially relevant problems.

ASSESSMENT AND EVALUATION REGULATIONS OF BSC

Assessment Type	Maximum Marks	Minimum Passing Marks	Evaluation Details
CIE – IA Tests (A)	30	-	Average of Two Internal Assessment Tests (MCQs) each conducted for 30 marks.
Continuous and Com-prehensive Evaluation (B)	20	-	Any two Assessment methods as per 24RNBE4.2, scaled to 20 marks.
Total CIE (A+B)	**50**	**20**	**CIE Evaluation is done for a maximum of 50 marks.**
SEE (C)	**50**	**18**	**Question papers having 50 MCQs with each question carrying 01 mark, and Exam duration shall before 2hours.**
CIE + SEE (A+B+C)	**100**	**40**	Final marks shall be the sum of marks scored in Components **A, B and C.**
The minimum marks to be secured in CIE is 20 (40%) out of allotted 50 marks to appear for SEE.			

Textbooks:

1. B. M. Chandra Shekara and B. C. Basavaraju, Basuchandra's Biology for Engineers, 1st Edition, Basuchandra Publishers, 2025.
2. C. Rajendra Singh and N. Rathnakar Rao, Biology for Engineers, 1st Edition, Ra-jendra Singh C and Rathnakar Rao N Publishing, 2023.

Reference Books:

1. Stuart Fox and Krista Rompolski, Human Physiology, 16th Edition, McGraw-Hill Education, 2022.
2. S. Thyagarajan, N. Selvamurugan, M. P. Rajesh, R. A. Nazeer, W. Thilagaraj, S. Barathiand M. K. Jaganthan, Biology for Engineers, 1st Edition, Tata McGraw-Hill, 2012.
3. Arthur T. Johnson, Biology for Engineers, 1st Edition, CRC Press, 2011.
4. Leslie Cromwell, Biomedical Instrumentation and Measurements, 2nd Edition, Prentice Hall, 2011.
5. Sohini Singh and Tanu Allen, Biology for Engineers, 1st Edition, Vayu Education of India, 2014.
6. Yoseph Bar-Cohen, Biomimetics: Nature-Based Innovation, 1st Edition, CRC Press, 2012.
7. Dario Floreano and Claudio Mattiussi, Bio-Inspired Artificial Intelligence: Theories, Methodsand Technologies, 1st Edition, MIT Press, 2008.
8. C. R. Sunilkumar, N. Geethaand A. C. Udayashankar, Bioremediation of Heavy Metals: Bacterial Participation, 1st Edition, Lambert Academic Publishing, 2019.

B.E. (Computer Science and Engineering (AI & ML))
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SEMESTER – IV

Course Title	**NATIONAL SERVICE SCHEME**		
Course Code	**25BNSSP409**	**CIE MARKS**	**100**
(L : T : P) + SL	**(0:0:0)+(30 Hours/Sem)**	**SEE MARKS**	**–**
Credits	**–**	**EXAM HOURS**	**–**

COURSE LEARNING OBJECTIVES

The purpose of the course is to facilitate the learner to:

1. Identify the needs and problems of the community and participate in problem-solving activities.
2. Develop a sense of social and civic responsibility and utilize knowledge to find practical solutions to individual and community problems.
3. Develop the competencies required for group living and sharing responsibilities, and gain skills in mobilizing community participation to acquire leadership qualities and democratic attitudes.

Module-1
Environment Issues and Role of NSS
Module-2
Disaster Management and Role of NSS
Module-3
Activities-1 (Choose from Activity List)
Module-4
Activities-2 (Choose from Activity List)
Module-5
Activities-3 (Choose from Activity List)

ACTIVITY LIST	
Helping local schools achieve good results and enhance their enrolment in Higher/Technical/Vocational Education.	Preparing an actionable business proposal for enhancing the village income.
Reduction in energy consumption.	Preparing an actionable business proposal for enhancing the village's income.
Creating awareness about rainwater harvesting in urban and rural areas.	Developing a Sustainable Water Management System.

COURSE OUTCOMES

After successfully completing the course, the student will be able to:

CO1	Understand the motto and concepts of NSS.
CO2	Develop overall personality of volunteers and make them as leaders and responsible citizens of our nation.
CO3	Analyze the environmental and societal problems/issues and will be able to design solutions for the same.
CO4	Plan and implement government initiatives or self-driven projects effectively in real-life community settings.
CO5	Communicate effectively with the community and with the officials.

ASSESSMENT AND EVALUATION REGULATIONS OF NCMC

Assessment Type	Maximum Marks	Minimum Passing Marks	Evaluation Details
CIE - IA Tests (A)	60	-	Sum of Two Internal Assessment Tests (MCQs) each conducted for 30 marks.
Continuous and Comprehensive Evaluation (B)	40	-	Any two Assessment methods as per 24RNBE4.2, scaled to 40 marks.
Total CIE (A+B)	100	40	CIE Evaluation is done for a maximum of 100 marks.
The minimum marks to be secured in CIE is 40 (40%) out of allotted 100 marks to Pass.			

Reference Books:

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

Web Links:

1. https://nss.gov.in/
2. https://pledge.mygov.in/

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SEMESTER – IV

Course Title	**PHYSICAL EDUCATION**		
Course Code	**25BPEDU409**	**CIE MARKS**	**100**
(L:T:P) + SL	**(0:0:0)+(30 Hours/Sem)**	**SEE MARKS**	**—**
Credits	**—**	**EXAM HOURS**	**—**

COURSE LEARNING OBJECTIVES

The purpose of the course is to facilitate the learner to:

1. Understand the fundamental concepts of Physical Education, games and sports skills, Health, Nutrition and Fitness.
2. Familiarization of health-related Exercises, Sports for overall growth and development.
3. Participate in the competition at regional/state / national / international levels.
4. Create consciousness among the students on Health, Fitness and Wellness in developing and maintaining a healthy lifestyle.

Module-1: Title: Athletics - Track Events - Relays	**3 Hours**

Relays

1. Relay Race: Starting, Baton Holding/Carrying, Baton Exchange in between zoneand Finishing.

Module-2: Title: Athletics - Triple Jumps	**3 Hours**

Triple Jump

A) Approach Run
B) Take-off
C) Step
D) Flight in the Hop
E) Jump and Landing

Module-3: Title: Athletics - Throws	**3 Hours**

Javelin Throw

A) Grip
B) Carry and Recovery (3/5 Impulse stride)
C) Release

Module-4: Title: CRICKET	**3 Hours**

A. Fundamental skills

1. Batting - Forward Defense Stroke, Backward Defense Stroke, Off Drive, On Drive, Straight Drive, Cover Drive, Square Cut.
2. Bowling - Out-swing, In-swing, Off Break, Leg Break and Googly.
3. Fielding: Catching - The High Catch, The Skim Catch, The Close Catch and throwing at the stumps from different angles. Long Barrier and Throw, Short Throw, Long Throw, Throwing on the Turn.
4. Wicket Keeping.

B. Rules and their interpretation and duties of the officials

Module-5: Title: BASEBALL	**3 Hours**

A. Fundamental skills

1. Player Stances – walking, extending walking, L stance, cat stance.
2. Grip – standard grip, choke grip.
3. Batting – swing and bunt. Pitching.
4. Baseball: slider, fast pitch, curve ball, drop ball, rise ball, change up, knuckle ball, screw ball.

B. Rules and their interpretation and duties of the officials

COURSE OUTCOMES

After successfully completing the course, the student will be able to:

CO1	Demonstrate the techniques of relay races, including starting, baton holding, exchange within the zoneand finishing, along with basic skills of javelin throw.
CO2	Apply the fundamental techniques of triple jump, including approach run, take-off, hop, step, jump, flightand landing.
CO3	Develop and perform javelin throw techniques, including grip, carry, impulse stride, releaseand recovery with proper coordination.
CO4	Exhibit fundamental skills of cricket, including batting, bowling, fielding, wicket keepingand understand rules and duties of officials.
CO5	Demonstrate basic skills and techniques in baseball, including player stances, grip, batting, pitchingand understand rules and officiating.

ASSESSMENT AND EVALUATION REGULATIONS OF NCMC

Assessment Type	Maximum Marks	Minimum Passing Marks	Evaluation Details
CIE – IA Tests (A)	60	—	Sum of Two Internal Assessment Tests (MCQs) each conducted for 30 marks.
Project (B)	40	—	———
Total CIE (A+B)	100	40	CIE Evaluation is done for a maximum of 100 marks.
The minimum marks to be secured in CIE is 40 (40%) out of 100 marks allotted to Pass.			

Textbooks:

1. Health and Physical Education by V.K. Sharma.
2. Introduction to Physical Education, Fitnessand Sport by Daryl Siedentop.
3. Physical Education Activities, Sports and Games: The Origin and Background, Rules of Play, Teaching Hints and Fundamentals by Louis E. Means.

Reference Books:

1. Saraswati Health and Physical Education Textbook.
2. Foundations of Physical Education, Exercise Science and Sport by Deborah A. Wuest.

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SEMESTER – IV

Course Title	**YOGA**		
Course Code	**25BYOGA409**	**CIE MARKS**	**100**
(L:T:P) + SL	**(0:0:0)+(30 Hours/Sem)**	**SEE MARKS**	**—**
Credits	**—**	**EXAM HOURS**	**—**

COURSE LEARNING OBJECTIVES

The purpose of the course is to facilitate the learner to:

1. Physical, Mental and Spiritual objectives of Yoga.
2. Explain the meaning of Yoga.
3. Discuss the importance of Yoga and its scope.
4. Describe the aims and objectives of Yoga.
5. Clarify the misconceptions on Yoga.

Module-1: Title: Suryanamaskara **3 Hours**

Suryanamaskara - Revision of practice 12 count 8 rounds

a) Suryanamaskar prayer.
b) Meaning, need & Importance
c) Benefits of Suryanamaskara

Module-2: Title: Asanas **3 Hours**

Need & importance of different Asana, Asana its meaning by name, technique, precautionary measures and benefits of each asana.

Sitting:

1. Bakasana
2. Hanumanasana
3. Yogamudra in Vajrasana

Standing:

1. Vatayanasana
2. Garudasana

Module-3: Title: Asanas **3 Hours**

Need, importance of Asana. Different types, Asana by name, technique, precautionary measures and benefits of each asana

Prone line

1. Bhujangasana
2. Shalabh asana

Supine line

1. Utthita dvipadasana,
2. Ardha halasana

Balancing

Sheershasana

Module-4: Title: Pranayama	3 Hours
Kapalabhati - Revision of Kapalabhati practice 80 strokes/min 3 rounds	
Module-5: Title: Pranayama	**3 Hours**
Pranayam 1. Bhastrika 2. Bhramari Meaning, Need, importance of Pranayama. Different types. Meaning by name, technique, precautionary measures and benefits of each Pranayama	

COURSE OUTCOMES

After successfully completing the course, the student will be able to:

CO1	Explain the meaning, objectives, scopeand importance of Yoga, including its physical, mentaland spiritual benefits and misconceptions.
CO2	Demonstrate Suryanamaskara (12 counts, 8 rounds) with correct technique, prayerand understanding of its need and benefits.
CO3	Perform sitting and standing Asanas (Bakasana, Hanumanasana, Yogamudra in Vajrasana, Vatayanasana, Garudasana) with proper technique, precaution-sand benefits.
CO4	Execute prone, supineand balancing Asanas (Bhujangasana, Shalabhasana, Utthita Dvipadasana, Ardha Halasana, Sheershasana) with correct body align-ment and safety measures.
CO5	Practice Pranayama techniques (Kapalabhati, Bhastrika, Bhramari) with proper method, breathing controland understanding of their importance and health benefits.

ASSESSMENT AND EVALUATION REGULATIONS OF NCMC

Assessment Type	Maximum Marks	Minimum Pass-ing Marks	Evaluation Details
CIE – IA Tests (A)	60	—	Sum of Two Internal Assess-ment Tests (MCQs) each con-ducted for 30 marks.
Project (B)	40	—	——
Total CIE (A+B)	100	40	CIE Evaluation is done for a maximum of 100 marks.
The minimum marks to be secured in CIE is 40 (40%) out of 100 marks allotted to Pass.			

Textbooks:

1. The Yoga Sutras of Patanjali by Sri Swami Satchidananda.
2. Light on Yoga by B.K.S. Iyengar

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Reference Books:

1. The Heart of Yoga by T.K.V. Desikachar.
2. Asana Pranayama Mudra Bandha by Swami Satyananda Saraswati.

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SEMESTER – III

Course Title	**MUSIC**		
Course Code	**25BMUSK409**	**CIE MARKS**	**100**
(L : T : P) + SL	**(0:0:0)+(30 Hours/Sem)**	**SEE MARKS**	**—**
Credits	**—**	**EXAM HOURS**	**—**

COURSE LEARNING OBJECTIVES

The purpose of the course is to facilitate the learner to:

1. Understand the significance of music in daily life and gain an overview of Indian folk, contemporary, and Western music traditions.
2. Acquire basic knowledge of introductory Carnatic music exercises and compositions.
3. Compare the fundamental features of Carnatic and Hindustani music.
4. Recognize the classification of wind instruments and appreciate the contributions of eminent composers to Indian classical music.

Module-1	**3 Hours**
Importance of music in daily life ,Indian folk, and contemporary music.Introduction to Western music.	
Module-2	**3 Hours**
Compositions: Introduction to the few types of composition in Carnatic Music- Nottu Swara, Sarale and janti varase, Alakara.	
Module-3	**3 Hours**
Comparative Study of Carnatic and Hindustani Music based on Geographical origin and development , Musical structure and style ,Raga and Tala systems.	
Module-4	**3 Hours**
Music Instruments: Classification and construction of wind instrurnents in both Car-natic and Hindustani Music.	
Module-5	**3 Hours**
Composers: Biography and contributions of of the following eminent personalities Mut-tuswami Dikshitaru , Shyama Shastri, Mysore Vasudevacharya, Pt. Bheemasen Joshi	

COURSE OUTCOMES

After successfully completing the course, the student will be able to:

CO1	Explain the origin, evolution and fundamental concepts of Indian classical music.
CO2	DCompare and distinguish the characteristics of selected Carnatic and Hindustani music compositions.
CO3	Classify the major categories of Indian musical instruments and describe their construction and applications in Carnatic and Hindustani music.
CO4	Examine the contributions of eminent Composers/Musicians and appreciate their role in preserving and promoting Indian classical music.

ASSESSMENT AND EVALUATION REGULATIONS OF NCMC

Assessment Type	Maximum Marks	Minimum Passing Marks	Evaluation Details
CIE – IA Tests (A)	60	-	Sum of Two Internal Assessment Tests (MCQs) each conducted for 30 marks.
Project (B)	40	—	Submission of report on a topic related to music.
Total CIE (A+B)	100	40	CIE Evaluation is done for a maximum of 100 marks.
The minimum marks to be secured in CIE is 40 (40%) out of 100 marks allotted to Pass.			

Textbooks:

1. T Sachidevi and T Sharadha (Thirumalai Sisters), Karnataka Sangeetha Dharpana-Vol. 1 (English), Shreenivaas Prakaashana, 2018.
2. B. Chaitanya Deva, An Introduction to Indian Music, Publications Division, Gov-ernment of India, New Delhi.

Reference Books:

1. Lakshminarayana Subramaniam, Viji Subramanaim, Classical Music of India: A Practical Guige, Tranqueber 2018.
2. Vamanrao H. Deshpande, Indian Musical Traditions: An Aesthetic Study of the Gharanas in Hindustani Music, Popular Prakashan, Mumbai

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SEMESTER – IV

Course Title	**ADDITIONAL MATHEMATICS-II**		
Course Code	**25BMADP410**	**CIE MARKS**	**100**
(L : T : P) + SL	**(1:0:0)+(14 Hours/Sem)**	**SEE MARKS**	**–**
Credits	**–**	**EXAM HOURS**	**–**

COURSE LEARNING OBJECTIVES

The purpose of the course is to facilitate the learner to:

1. Apply the fundamental concepts of linear algebra to solve systems of linear equations and analyze mathematical models.
2. Solve second-order and higher-order ordinary differential equations using appropriate analytical methods in engineering applications.
3. Develop the knowledge and problem-solving skills required to evaluate multiple integrals and apply the change of order of integration.
4. Apply numerical methods to obtain approximate solutions to mathematical problems arising in science and engineering.

Module-1
Linear Algebra: Introduction, rank of a matrix by elementary row operations, echelon form, consistency of systems of linear equations, Gauss elimination method, eigenvalues and eigenvectors of a square matrix and problems.
Module-2
Numerical Methods: Finite differences, interpolation/extrapolation using Newton's forward and backward difference formulae (statements only), solution of polynomial and transcendental equations using Newton–Raphson and Regula–Falsi methods (formulae only) with illustrative examples, numerical integration using Simpson's one-third rule (without proof)and problems.
Module-3
Higher Order Ordinary Differential Equations: Linear differential equations of second and higher order with constant coefficients, homogeneous and non-homogeneous equations, inverse differential operators and particular integral restricted to $R(x) = e^{ax}$, sin $ax$and cos ax for $f(D)y = R(x)$.

Module-4
Double Integrals: Definition, evaluation over rectangular and general regions and change of order of integration.
Module-5
Triple Integrals: Definition, evaluation over simple regions and applications of triple integrals to the evaluation of volumes.

COURSE OUTCOMES

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

CO1	Solve systems of linear equations using matrix algebra.
CO2	Apply the knowledge of numerical methods in modelling and solving engineering problems.
CO3	Apply analytical methods to solve higher-order differential equations.
CO4	Solve double integrals, including change of order of integration.
CO5	Solve triple integrals and evaluate volumes of geometrical regions.

ASSESSMENT AND EVALUATION REGULATIONS OF NCMC

Assessment Type	Maximum Marks	Minimum Passing Marks	Evaluation Details
CIE - IA Tests (A)	60	-	Sum of Two Internal Assessment Tests (MCQs) each conducted for 30 marks.
Continuous and Comprehensive Evaluation (B)	40	-	Any two Assessment methods as per 24RNBE4.2, scaled to 40 marks.
Total CIE (A+B)	100	40	CIE Evaluation is done for a maximum of 100 marks.
The minimum marks to be secured in CIE is 40 (40%) out of allotted 100 marks to Pass.			

Textbooks:

1. B. S. Grewal, Higher Engineering Mathematics, 43rd Edition, Khanna Publishers, 2015.

Reference Books:

1. Erwin Kreyszig, Advanced Engineering Mathematics, 10th Edition, John Wiley & Sons, 2015.
2. N. P. Bali and Manish Goyal, Engineering Mathematics, 7th Edition, Laxmi Pub-lishers, 2007.
3. Rohit Khurana, Engineering Mathematics, Vol. I, 1st Edition, Cengage Learning, 2015.

Additional Mathematics I and II:

1. These courses are prescribed for III and IV semesters, respectively, for lateral entry Diploma holders admitted to the III semester of B.E./B.Tech. programmes. Stu-dents shall attend the classes during the respective semesters to complete all the formalities of the course and appear for the Continuous Internal Evaluation (CIE). In case a student fails to register for the course or fails to secure the minimum 40% of the prescribed CIE marks, he/she shall be deemed to have secured an F grade. In such cases, the student shall fulfill the course requirements during subsequent semesters to earn the qualifying CIE marks. These courses are prescribed for CIE only and have no Semester End Examination (SEE).
2. Additional Mathematics I and II shall not be considered for vertical progression or for the calculation of SGPA and CGPA. However, successful completion of these courses is mandatory for the award of the degree.
3. Successful completion of Additional Mathematics I and II shall be indicated as Satisfactory in the grade card. Non-completion of these courses shall be indicated as Unsatisfactory.

Community Project / Societal Project (Project-Based Learning)			
Course Code	25BCBPR308	Scheme	**2025**
Type of Course	AEC/SDC	Semester	3
Teaching Hours/Week (L:T:P)	0:0:0	CIE Marks	50
Total Hours of Pedagogy per Semester CI (L /T): LI(P):TW&SL:TH	0:0:0:30:30	SEE Marks	50
Credits	1	Total Marks	100
Examination type (SEE)	Practical	Exam Hours	03

Course Objective:

The Community Project / Societal Project is a practical, project-based learning course that builds students' awareness on Educational Social Responsibility (ESR). It focuses on real issues such as the adaptation of technology for rural and urban development, the application of tools for enhanced governance in civic societies, and sustainable technological solutions for better living. Students may work individually or in groups of up to four, including interdisciplinary topics, and assessment is based on the prescribed rubrics.

Course outcome (Course Skill Set):

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

CO1 (L2 – Understand): Identify and analyze societal problems through field interaction and technical assessment.

CO2 (L3 – Apply): Develop skills in project planning, field survey, data collection, implementation, documentation, and reporting.

CO3 (L3 – Apply): Apply principles of social responsibility in engineering practice through community-oriented interventions

CO4 (L4 – Analyze): Exhibit multidisciplinary learning, problem-solving ability, and communication skills based on collected data (requirements), stakeholder feedback, and baseline conditions.

CO5 (L5 – Evaluate): Choose feasible societal problem statements and solutions considering practical constraints and sustainability aspects.

CO6 (L6 – Create): Create a product by collaborating with stakeholders and within the team to deliver a product/project to the intended community/organization.

Restrictions and professional conduct:

Societal projects should be academic, socially responsible, technically focused, and politically neutral. Students and faculty must maintain professionalism, ethical conduct, and respect while working with communities and stakeholders and avoid any political, ideological, commercial, or disruptive activities. Projects should also consider practical constraints such as cost, resources, safety, social impact, and stakeholder cooperation.

SET OF PROJECT ACTIVITIES (TW/SL = 30 HOURS)

Methods for project identification:

Students may identify the project topic using one or more of the following methods (not limited to): Interaction with local rural or urban stakeholders such as local leaders, corporation/municipality/Panchayath officers, NGOs, etc.; review of issues highlighted in print and electronic media and social networks. After selecting a broad topic, collect data and requirements, conduct a feasibility survey, estimate timelines and resources, approximate expenditure (if applicable), and define the problem statement with objectives clearly.

List of Project Topics/Titles (Not Limited):

Sl. No.	Broad Areas/Project titles	Measurable engineering outcome	Specific POs	SDGs
1	Computer-Based Learning Tool for Mentally Challenged Students	Design and develop a web/browser-based learning tool as per the requirements of the special school.	5, 6	4
2	Medication management system for an old-age home.	Design and develop a web-based application to monitor the administration of medicine to senior citizens residing at an old-age home.	6	3

3	Virtual Labs for Learning Science	Design and Development simulation environment to do the experimentation list in Physics/Chemistry/Biology for high school in a rural area	5, 6	4
4	Local Skill Development and Employment Information Portal	Design and develop a web-based portal that provides information on local skill development programs, vocational training, internships, and employment opportunities for youth in the community.	6	4, 8
5	Digital Complaint Portal for Gram Panchayat	Design and develop a web-based complaint portal (Specific nature) for Gram Panchayat	6	16
6	Plant Care Reminder Application	Implement a reminder mechanism that generates timely notifications for watering, fertilizing, pruning, and other plant-care activities.	6	13,15
7	Basic Crop Recommendation System	Develop a basic crop recommendation system that recommends suitable crops based on user-provided parameters such as soil type, season, rainfall, and water availability	6	2, 13, 15
8	Lost and Found Application	Develop a Lost and Found Application that enables users to report, search, and manage lost and found items	6	11, 16
9	Campus Navigation System	Develop a campus navigation system that enables users to locate important campus facilities and obtain directions between selected locations, which provides a simple digital map and location information for important facilities on campus.	6	15
10	Public Waste Collection Monitoring System	Design and develop a web/mobile application that enables citizens to report uncollected garbage with geo-tagged photos, track complaint status, and assist local municipal authorities in monitoring waste collection and sanitation services.	6	3, 11, 16
11	Volunteer Management System for NGOs	Develop a web-based system to manage volunteer registration, event scheduling, attendance, and activity reporting for NGOs.	6	16
12	Local Farmer Market Information System	Design and develop a digital platform that connects farmers directly with consumers by providing crop availability, prices, and contact information.	6	2, 8, 12
13	Government scheme awareness for betterment of livelihood	Design a UI in the native language for people in rural areas to make best utilization of the government scheme	6	11

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14	Community Renewable Energy Awareness and Management Portal	Design and develop a web/mobile portal to provide information on renewable energy resources and estimate energy savings within the community.	6	7, 11, 13
15	Digital Learning Platform for Rural Government Schools	Design and develop a digital learning platform (Tool) that provides interactive learning content and activity-based learning materials in regional languages for rural and small village govt schools (primary govt. schools often lack interactive learning tools)	5, 6	4
16	Digital Heritage Preservation and Cultural Information Portal	Develop a digital platform to document, preserve, and promote local heritage sites, cultural events, and historical information	6	11, 16
17	Community Disaster Preparedness and Emergency Information System	Design and develop a web/mobile application for disaster preparedness and emergency alerts during natural disasters.	6	11, 13
18	Pesticide Usage Advisory and Organic Farming Awareness System	Design and develop an application that provides recommendations on appropriate pesticide usage, promotes organic farming practices, and suggests suitable organic alternatives based on soil test reports and crop information.	6	2, 3, 15
19	Cyber Security Awareness Platform for Phishing, Digital Arrest Scams, and Malicious Applications	Create a simple web app where users paste suspected text/links to get a risk score based on known phishing patterns, deceptive URLs, and high-risk keywords	5, 6	16
20	Local Public Transportation Information and Route Assistance System	Design and develop a web or mobile application that provides location-based information on available public transportation services, route maps, estimated travel options, and nearby transport facilities to improve accessibility and promote the use of public transportation.	6	11, 15
21	Digital Inventory and Sales Management System	Design and develop a web-based inventory, billing, and sales analytics system for small businesses with dashboard reports and low-stock alerts.	6	8, 9
22	Smart Financial Literacy and Budget Planner for public	Develop a mobile/web application that helps users manage household budgets, savings, government schemes, and financial planning through support.	6	1, 8

23	Local Business Promotion and Market Analytics Portal	Design a digital platform that enables local vendors and small businesses to advertise products, analyze customer trends, and improve digital visibility.	6	8, 9
24	Blood Donor and Emergency Blood Availability Portal	Develop a web/mobile platform to connect blood donors, hospitals, and patients with real-time blood availability information.	6	3
25	Women Safety and Emergency Alert Application	Develop a mobile application with SOS alerts, live location sharing, emergency contacts, and nearby police station information.	6	5, 11, 16
26	Public Grievance and Civic Issue Reporting System	Develop a web/mobile application that allows citizens to report civic issues such as potholes, streetlight failures, and drainage problems and monitor complaint resolution status.	6	11,15, 16
27	Digital Public Library and Book Exchange System	Design and develop a web-based platform that enables community members or schools to manage book donations, borrowing, returns, and book exchange activities.	6	4
28	Community Water Quality Reporting and Awareness Portal	Design and develop a web-based portal for citizens to report drinking water issues, record simple water quality observations, and provide awareness on safe water practices through educational resources.	6	3, 6
29	Community Blood Donor Registry and Emergency Request System	Design and develop a web/mobile application that maintains a local blood donor database, enables emergency blood requests, and notifies eligible donors based on blood group and location.	6	3, 11
30	Smart Community Health Camp Management System	Design and develop a web/mobile application to manage community health camps by facilitating online patient registration & doctor scheduling/digital health record maintenance/medicine inventory tracking.	6	3
31	Food Waste Reduction and Food Donation Platform	Develop a platform connecting restaurants, hotels, and households with NGOs to donate surplus food before it is wasted.	6	2, 12
32	Community Tree Plantation and Green Cover Monitoring Portal	Develop a web/mobile application to record tree plantation activities.	6	13, 15
33	Career Guidance and Information Portal	Develop an app to get information on aptitude tests, Course/scholarship alerts/placement information	6	4, 8

34	NGO Donation and Resource Management System	Develop a web application to manage donations, inventory, volunteers, and financial transparency for NGOs.	6	16
35	Smart Local Tourism Business Portal	Develop a web platform promoting local tourism, homestays, guides, and cultural businesses with booking facilities.	6	8, 11, 15
36	Local Artisan and Handicraft Marketplace	Design and develop a platform promoting local artisans and traditional handicraft products.	6	8, 11
37	Waste Recycling Marketplace	Develop a digital platform connecting households, recyclers, and scrap collectors with pickup scheduling.	6	11, 12
38	Digital Accessibility Evaluation and Improvement for Public Websites	Evaluate the accessibility of at least 10 government or public-service websites using WCAG guidelines, develop accessibility improvement recommendations, and implement a prototype demonstrating compliance improvements.	6	16
39	Digital Library and Knowledge Sharing Platform for Government Schools	Develop a multilingual digital library with e-books, educational videos, and quizzes to improve access to learning resources.	6	4
40	Community Renewable Energy Awareness and Management Portal	Design and develop a web/mobile portal to provide information on renewable energy resources and promote the adoption of sustainable energy practices within the community.	6	7, 11, 15
41	Local Business Digital Marketplace	Web portal onboarding of at least 25 local vendors and product catalog	6	8, 12
42	Community Blood Donor and Emergency Volunteer Network	Web/mobile application connecting donors and volunteers	6	3
43	Mental Health Awareness and Helpline Directory App	Develop an application providing verified helpline contacts, self-help resources, and stigma-reducing content.	6	3
44	Diet & Nutrition Awareness Tool for Anganwadi Children	Develop an application to track and suggest balanced meal plans for children under a nutrition scheme.	5, 6	2, 3
45	Digital Literacy Portal for Elderly Citizens	Develop a simplified, accessible web application teaching basic smartphone and internet skills to senior citizens.	6	4, 11
46	Scholarship & Government Scheme Eligibility Checker	Develop a Web tool matching students to eligible scholarships and welfare schemes based on entered criteria.	5, 6	4
47	Digital Record-Keeping System for Self-Help Groups	Develop a Ledger and record-keeping application to help women's SHGs	6	5, 8

		manage savings, loans, and meeting records.		
48	Elderly Companion & Wellness Check-In App	Develop an application enabling family/volunteers to schedule and log wellness check-ins for the elderly living alone.	6	3
49	Old-Age Home Volunteer Coordination Portal	Develop a Platform matching volunteers with old-age homes for scheduled visits. events, and support activities.	6	3, 11
50	Local Job & Skill Matching Portal for Daily-Wage Workers	Develop a Web application connecting unskilled and semi-skilled workers with nearby job opportunities.	6	8
51	Street Vendor Digital Registry and Support Portal	Develop an application for the registry helping street vendors to access municipal registration information and gain customer visibility.	6	8
52	Microloan and Repayment Tracker for Small Vendors	Develop an application helping small vendors track micro-loans, repayments, and daily sales.	6	8
53	Rainwater Harvesting Feasibility & Awareness Tool	Develop a tool estimating rooftop rainwater harvesting potential based on roof area and local rainfall data.	5, 6	6,13
54	Water Quality Reporting System for a Village / Ward	Develop a Web/mobile application for citizens to report water contamination issues and track resolution status.	6	6
55	Community Skill-Building Workshop Registration and Tracker App	Develop an application to register participants and track attendance for community skill-building workshops such as tailoring, computer usage, and first-aid.	6	4, 11
56	Local Event & Festival Information Aggregator App	Develop an application aggregating community event and festival schedules for a town or ward.	6	11
57	Community Sports Ground / Facility Booking App	Develop an application for local youth to check availability and book shared sports grounds or courts.	6	3, 11
58	Talent Scouting Platform for Rural Sports Players	Develop a platform where local sports talent can register profiles and gain visibility to coaches and scouts.	6	3
59	Youth Skill Development and Internship Finder App	Develop an application listing local internships, apprenticeships, and skill-training programs for youth.	6	4, 8
60	Financial Literacy Awareness App for Rural Households	Develop an application teaching basic banking, savings, and fraud-avoidance concepts with local-language support.	6	4, 8

61	Legal Aid & Rights Awareness Portal	Develop a portal listing free legal aid contacts with simplified explanations of common citizen legal rights.	6	16
62	Digital Insurance / Pension Scheme Awareness Tool	Develop a tool helping unorganized-sector workers check eligibility and enroll in government insurance/pension schemes.	5, 6	8
63	Livestock Health Record and Vaccination Tracker	Develop an application to record cattle and livestock health history and vaccination schedules for farmers.	6	15
64	Soil Testing Appointment & Report Access Portal	Develop a portal letting farmers book soil-testing slots and access digital test reports.	6	15
65	Power Outage Reporting and Tracking App for a Locality	Develop an application allowing residents to report and track power outages to the local utility board.	6	7, 11
66	Community Borewell / Water Tanker Scheduling App	Develop an application to schedule and track water tanker deliveries for water-scarce localities.	6	6, 11
67	Cyber Safety and Digital Fraud Awareness App	Develop an application educating students and senior citizens on common online scams and safe digital practices.	6	16
68	Adult Literacy Program Registration and Progress Tracker	Develop an application to register learners and track attendance and progress in a community adult-literacy drive.	6	4
69	Inclusive Learning Content tool for Differently Abled Students	Develop a tool delivering audio/visual learning content adapted for students with visual or hearing impairments.	5, 6	4
70	School Dropout Tracking and Follow-up System	Develop an application for teachers to record attendance trends and flag/follow up on students at risk of dropping out.	6	4
71	Public Park / Garden Maintenance Complaint Tracker	Develop an application for citizens to report maintenance issues in public parks and gardens and track resolution.	6	11,15
72	Digital Suggestion Box for Local Governance	Develop an application allowing citizens to submit suggestions and feedback to local governing bodies on civic matters.	5, 6	16
73	Community Health Screening Camp Scheduler	Develop an application to schedule and manage attendance for community blood-pressure/diabetes screening camps.	6	3
74	Digital Queue Management System for Health Camps	Develop a token-based appointment and queue management system/app	6	3

		for medical camps or PHCs.		
75	Streetlight Fault Reporting System	Develop an application for citizens to report faulty streetlights using photographs and GPS location.	6	11
76	Village Asset Mapping System	Develop a GIS-enabled or map-based application to document community assets such as schools, hospitals, water tanks, and roads.	6	11
77	Food Waste Reduction & Expiry Management System	Design and develop a web/mobile application to record food items, monitor expiry dates, provide expiry reminders, and maintain food inventory to help reduce food wastage.	6	2, 12
78	Community Hall Booking & Management System	Design and develop a web-based platform to manage community hall bookings, track hall availability, process booking requests, schedule maintenance, and maintain booking records.	6	11
79	Public Infrastructure Asset Monitoring System	Design and develop a web-based platform to maintain records of public infrastructure assets, report maintenance issues, assign maintenance requests, and track their status.	6	9, 11

Teaching Learning Process:

The suggested TLP for Community / Societal Project.

The following structured sequence of activities is to be carried out during the semester.

Week / Phase	Teaching–Learning Activity	Faculty Role	Student Activity	Output / Evidence
1	Course introduction, objectives, ethics, conduct, and assessment briefing	Explain course scope, rules, rubrics, and expected deliverables	Understand course requirements and form teams	Team list, course plan
2	Community problem identification and topic selection	Guide Topic Framing and Feasibility	Identify local issues through discussion and observation	Shortlisted project topic
3	Stakeholder interaction and preliminary survey	Demonstrate survey methods and stakeholder engagement	Collect initial data from community/users	Survey notes, interview record
4	Problem statement and objective formulation	Review and refine problem statement	Prepare problem statement, scope, and objectives	Approved problem statement
5	Literature/case study review and baseline analysis	Suggest relevant references and examples	Study existing solutions and compare approaches	Baseline analysis summary

6	Project planning and role assignment	Help teams organize tasks, timeline, and responsibilities	Plan activities, divide roles, and prepare schedule	Work plan / Gantt chart
7	Feasibility analysis and solution brainstorming	Check technical feasibility and practicality	Generate possible engineering solutions	Solution alternatives sheet
8	Selection of final solution and design approach	Review final concept and design logic	Finalize concept, methods, and expected outcome	Concept note / design outline
9	Data processing / calculations / sizing / mapping	Support Computations and technical review	Analyze data, perform calculations, prepare maps/charts	Technical analysis sheet
10	Prototype / model / audit / DPR / app development	Monitor progress and correct technical issues	Develop the selected output	Working model/draft DPR / map/app
11	Testing, refinement, and implementation planning	Evaluate technical correctness and improvements	Test prototype or validate proposal with users	Test results / revised output
12	Field implementation / demonstration / awareness activity	Facilitate community interaction and documentation	Conduct implementation or demonstration	Photos, attendance, implementation record
13	Documentation of outcomes, feedback, and impact	Review report structure and completeness	Compile findings, stakeholder feedback, and observations	Draft report
14	Presentation preparation and viva practice	Conduct mock presentation and feedback	Prepare slides/poster and rehearse	Presentation deck
15	Final presentation, submission, and reflection	Evaluate performance using rubrics	Present project, submit report, reflect on learning	Final report, presentation, viva

Assessment structure:

A. Continuous Internal Evaluation (CIE) – 50 marks

- Students, in batches of 3–4, shall undertake at least one project (or a combination of two related activities) aiming, as far as possible, at a logical implemented or implementable outcome.
- CIE will be conducted by a departmental committee (HoD/nominee, guide and one senior faculty) using the following rubrics totalling 50 marks:

CIE pass requirement:

A student shall secure a minimum of 20 marks out of 50 in CIE to become eligible to appear for SEE.

- Students who fail to earn the required CIE marks may be given additional opportunities before closure of the semester; no re-doing of CIE is permitted after the end of the semester.

B. Semester End Examination (SEE) – 100 marks (scaled to 50)

- Examination duration: 2 hours.
- Maximum examination marks: 100 (entered as 100 in the VTU portal; the ITI-SMU module automatically scales 100 → 50 for result processing).
- The SEE shall be conducted batch-wise by a committee of three faculty: project guide, one faculty from the same department and one from a different department.

SEE pass requirement and overall passing rule:

- For a pass in SEE, a student shall secure minimum 35 marks out of 100.
- For declaration of a pass grade, the sum of CIE marks (out of 50) and scaled SEE marks (out of 50) shall be ≥ 40; otherwise, the student is awarded grade F (Fail).

CIE Rubric — Continuous Internal Evaluation (Total 50 marks):

Criterion	Weight (marks)	Excellent (Full marks)	Good	Fair	Needs Improvement
Problem identification & relevance to society/environment	8	Problem clearly identified with strong evidence of relevance and well-defined scope. (8)	Relevant problem with clear scope and adequate evidence. (6)	Problem defined but justification is weak. (4)	Problem unclear or not relevant. (2)
Formation of problem statement; engineering approach, innovation & feasibility	10	Precise statement; sound, innovative, feasible approach. (10)	Adequate statement; feasible with minor gaps. (8)	Partial statement; marginal feasibility. (5)	Missing or infeasible. (2)
Interaction with stakeholders; data collection, analysis & interpretation	8	Thorough engagement; comprehensive data and well-interpreted analysis. (8)	Good engagement; adequate data and analysis. (6)	Limited engagement; incomplete data and superficial analysis. (4)	Little or no stakeholder contact; no data/analysis. (2)
Project documentation; clarity, organization & problem-solving demonstrated	10	Complete, well-organized, analytical, and strong problem-solving. (10)	Complete and clear with some analytical content. (8)	Basic with omissions; problem-solving limited. (5)	Missing/poorly organized; no clear problem-solving. (2)

Communication & presentation skills	6	Confident, structured, and answers queries fully; visuals effective. (6)	Clear and satisfactory; responds to most queries. (5)	Acceptable but lacks clarity or confidence; weak responses. (3)	Poor or absent; unable to respond. (2)
Contribution & benefit to society (impact, sustainability)	8	Clear, demonstrable societal benefit and realistic sustainability path. (8)	Benefit plausible; sustainability considered with minor gaps. (6)	Limited or unclear benefit; sustainability weak. (4)	No evident benefit or sustainability. (2)

Notes for CIE rubric:

- Minimum CIE pass requirement: 20/50 to be eligible for SEE. [Use departmental committee (HoD/guide + senior faculty) to apply the rubric and record marks.]

SEE Rubric — Semester End Examination (Enter marks out of 100; scaled to 50 later):

			Fair		
Problem identification & relevance to society/environment	16	Clearly articulated with strong evidence and context. (16)	Clear with reasonable evidence. (12)	Problem stated but evidence/context weak. (8)	Poorly defined or irrelevant. (4)

Formation of problem statement; engineering approach, innovation & feasibility	20	Precise; demonstrates engineering depth, novelty and feasibility. (20)	Technically sound and feasible with minor limitations. (15)	Basic; limited technical depth or feasibility concerns. (10)	No viable engineering approach or infeasible plan. (5)
Interaction with stakeholders; data collection, analysis & interpretation	16	Excellent engagement; rigorous data collection and insightful analysis. (16)	Good engagement and acceptable analysis. (12)	Superficial data collection and limited analysis. (8)	Inadequate or no data; poor analysis. (4)
Project documentation; clarity, technical rigor & problem-solving demonstrated	20	Comprehensive, technically rigorous, and systematic. (20)	Complete and technically correct with minor gaps. (15)	Lacks technical depth or has notable omissions. (10)	Missing key elements or technically incorrect. (5)
Communication, presentation & viva-voce responses	12	Presents expertly, defends work persuasively and answers all queries correctly. (12)	Good presentation and satisfactory answers to most queries. (9)	Adequate but fails to answer some technical questions. (6)	Poor presentation and unable to defend work. (3)

Contribution & benefit to society; impact assessment & sustainability	16	Clear, evidence-based impact assessment with scaling recommendations. (16)	Reasonable impact discussion and sustainability considerations. (12)	Limited evaluation of impact or sustainability. (8)	No coherent assessment of impact or sustainability. (4)

SEE pass rule:

- Student must secure at least 35/100 in SEE itself to be eligible for pass consideration.
- Final passing is based on CIE (out of 50) + SEE (scaled to 50) >= 40. Otherwise, grade F (Fail) is awarded.

Suggested implementation notes (for BoS / exam committees):

- Use numerical scores from the rubric and keep brief evaluator comments for each criterion.
- For team projects: record individual contribution within the documentation and adjust individual marks using a peer-evaluation sheet or guide's assessment.
- Maintain evidence (field notes, photos, questionnaires, DPRs, reports) as annexures for SEE moderation.
- Use standardized score sheet (spreadsheet) mapping rubric items to columns for easy aggregation and archival.

- Awareness Campaign on Single-Use Plastic and E-Waste Management

Suggested Learning Resources:

Reference Books:

1. Phadke, N. D., Community Engagement and Social Innovation, Oxford University Press, New Delhi.
2. Garg, N. R., Project-Based Learning in Engineering Education, Pearson India Education Services, Noida.
3. Gupta, A. and P. Singh, Service Learning and Community Projects, McGraw-Hill Education (India), New Delhi.
4. Wilson, G., Practical Guide to Community Development Projects, Routledge, London.

Web links and Video Lectures (e-Resources):

1. VTU e-Learning Centre: http://elearning.vtu.ac.in
2. NPTEL courses on Project-Based Learning and Social Innovation.
3. SWAYAM courses on community engagement and sustainability.
4. UN Sustainable Development Goals portal.
5. MyGov India and local civic body portals for community initiatives.
6. YouTube resources on design thinking, social innovation, and community service learning.
7. NGO and government field-action case studies related to sanitation, water, health, education, and environment.

Assessment Structure:

Continuous Internal Evaluation (CIE) shall be conducted by the Departmental Project Review Committee consisting of a Senior Professor, the Project Guide, and one additional faculty member nominated by the Head of the Department. Semester End Evaluation (SEE) shall be conducted by university-appointed examiners. The evaluation shall be based on rubrics designed to assess the attainment of NBA-defined graduate attributes, including problem analysis, investigation, design of solutions, communication, teamwork, and professionalism**.**

The weightage of marks for CIE and SEE is 50% each.

Pass Criteria: A candidate shall secure a minimum of 40% of the total marks prescribed for Project Work, subject to the required minimum in Continuous Internal Evaluation and Semester End Evaluation as per VTU regulations.

B.E. (Computer Science and Engineering (AI & ML))
Outcome Based Education (OBE) and Choice Based Credit System (CBCS)
SEMESTER – III

COURSE TITLE	AUTOMATION LAB (RPA & APA)		
Course Code	25BCISL001	CIE MARKS	50
(L: T: P)+SL	0:0:2	SEE MARKS	50
Credits	01	EXAM HOURS	03

COURSE LEARNING OBJECTIVES:

The purpose of the course is to facilitate the learner to:

1. Understand the fundamentals of Robotic Process Automation (RPA) and its role in automating repetitive and rule-based business processes.
2. Develop software bots using Automation Anywhere by applying variables, conditions, loops, recorders, and other automation commands.
3. Apply RPA techniques to automate real-world tasks involving files, folders, Excel, web applications, and data processing.
4. Design and implement end-to-end automation workflows and explore the integration of RPA with Artificial Intelligence for intelligent automation.

Program 1 – Basic Task Bot

Familiarize with Automation Anywhere Control Room, Task Bot Creator, and Task Bot Runner. Create, execute, and verify a basic Task Bot using Actions and Variables.

Program 2 – Desktop Process Automation

Create and use String, Number, and Boolean variables. Apply Assign and Delay actions to develop and execute a simple sequential desktop automation workflow.

Program 3 – Decision Making and Loops

Develop an automation workflow using If/Else decision-making, While and For Each loops, and Break and Continue actions.

Program 4 – Universal Recorder and Object-Based Automation

Configure a target desktop or web application and use Universal Recorder to capture UI actions. Identify UI elements and develop, execute, and test an object-based automation workflow.

Program 5 – Object Properties and Web Element Identification

Capture application and web elements, inspect and customize Object Properties, handle dynamic properties and wildcard attributes, and identify web elements using DOMXPath for reliable UI automation.

Program 6 – Table Variables and String Operations

Extract structured table data and store it using Table variables. Perform row and column operations, sorting, and value manipulation, and apply String package operations for text extraction and processing.

Program 7 – Event-Driven Automation using Triggers

Create a Trigger Loop and configure Hotkey, UI/Interface, and File/Folder Watch triggers. Develop and demonstrate an event-driven Task Bot.

Program 8 – Exception Handling and Debugging

Implement Try, Catch, Finally, and Throw actions for exception handling. Use debugging techniques such as breakpoints, Step Over, and Step Into. Log errors, capture screenshots, and debug and resolve execution faults.

Mini Project List

The following are some suggested mini-project options for the Automation Anywhere 360 practical course. Students may select any one of the given projects or propose their own mini-project, provided it is relevant to Automation Anywhere 360 and incorporates appropriate automation concepts.

1. **College Event Registration and Confirmation Bot:** Automate the registration of students for a college event by reading participant details from Excel, validating mandatory information, entering the details into a practice web form, submitting valid registrations, and generating a registration status report.
2. **Library Book Issue and Return Processing Bot:** Automate library transactions by processing book issue and return records, checking book availability, identifying overdue books, calculating applicable fines, and generating a summary of issued, returned, and overdue books.
3. **Student ID Card Data Verification Bot:** Automate the verification of student information by validating USN, name, email and other mandatory details, identifying duplicate or invalid records, and generating separate valid and error reports.
4. **College Event Registration and Confirmation Bot:** Automate student registration for a college event by reading participant details from Excel, validating mandatory information, entering the details into a practice web form, submitting valid registrations, and generating a registration status report.
5. **Library Book Issue and Return Processing Bot:** Automate library transactions by processing book issue and return records, checking book availability, identifying overdue books, calculating applicable fines, and generating a summary of issued, returned, and overdue books.
6. **Student ID Card Data Verification Bot:** Automate the verification of student information by validating USN, name, email, and other mandatory details, identifying duplicate or invalid records, and generating separate valid and error reports.
7. **College Fee Payment and Receipt Organization Bot:** Process student fee payment records, classify transactions as paid, pending, or failed, organize sample receipt files into appropriate folders, and generate a fee payment summary report.
8. **Student Placement Eligibility Screening Bot:** Automate the preliminary screening of students for placement eligibility based on CGPA, attendance, backlogs, programming score, and aptitude score, and generate eligible, non-eligible, and review-required student lists.
9. **Faculty Workload Allocation Assistant Bot:** Automate the allocation of courses to faculty by processing faculty workload and course requirement data, checking workload availability, assigning courses, updating workloads, and identifying unassigned courses.
10. **Laboratory Equipment Inventory Management Bot:** Automate laboratory inventory monitoring by

checking equipment quantity, minimum stock level, condition, and maintenance information, and generate procurement and maintenance reports for items requiring attention**.**

11. **Online Course Certificate Verification Bot:** Automate the preliminary verification of student online-course certificates by reading certificate details, checking certificate information on an approved practice verification webpage, comparing the results, and generating a verification report**.**
12. **College Notice Distribution and Tracking Bot:** Automate the processing of student notice distribution by reading student and section details, identifying the appropriate notice, processing the communication records, tracking the status, and generating a section-wise report**.**
13. **Student Scholarship Application Pre-Screening Bot:** Automate the preliminary screening of scholarship applications by checking academic details, income, attendance, backlog status, and required documents, and classify applications as eligible, not eligible, incomplete, or requiring review

COURSE OUTCOMES:

After successfully completing the course, the student will be able to:

CO1	Explain the fundamentals of Robotic Process Automation (RPA), its components, benefits, and applications in automating repetitive tasks.
CO2	Develop software bots using Automation Anywhere by applying commands, variables, conditions, loops, and recording techniques.
CO3	Apply RPA techniques to automate tasks involving files, folders, spreadsheets, web applications, and data processing.
CO4	Design end-to-end automation workflows using Automation Anywhere for real-world business and academic use cases.
CO5	Create intelligent automation solutions by integrating RPA with Artificial Intelligence and emerging automation technologies.

ASSESSMENT AND EVALUATION REGULATIONS OF SKILL LAB

Assessment Type	Maximum Marks	Minimum Passing Marks	Evaluation Details
CIE Practical (A)	20	–	Marks Awarded for weekly Conduction of Laboratory Experiments and Submission of records, scaled to 20 marks
CIE Practical Test+ Mini project(B)	20 +10	-	Average marks of Two tests, each conducted for 100. Marks covering all experiments, scaled to 20 + Mini Project (10 marks)
Total CIE Practical (A+B)	**50**	**20**	Sum of marks obtained in **Experiments, Record, and Test** shall constitute the CIE marks, with a maximum of 50 marks.
SEE (C)	**50**	**20**	SEE is a **laboratory examination** conducted for 100 marks and scaled down to 50 marks. The examination duration shall be **3 hours**.
CIE + SEE (A+B+C)	**100**	**40**	Final marks shall be the **sum of marks obtained in Components A, B, and C**.
Note: The minimum marks required to be secured in CIE are **20 (40%) out of the allotted 50 marks** to appear for SEE.			

Text Book:

1) **Vaibhav Srivastava, "Getting Started with RPA using Automation Anywhere: Automate Your Day-to-Day Business Processes using Automation Anywhere," 1st Edition, BPB Publications, 2021. https://bpbonline.com/products/getting-started-with-rpa-using-automation-anywhere?utm_source=chatgpt.com**

2) **The No-Code –Playbook** by **Katherine Kostereva | Burley Kawasaki** **https://www.creatio.com/sites/default/files/static-site/The-No-Code-Playbook.pdf**

Web links and Video Lectures (e-Resources):

- **https://www.youtube.com/watch?v=G0gVfi7ri7w**
- **https://www.youtube.com/watch?v=MBl-3Yb30FA**
- **https://www.youtube.com/watch?v=T3gssUSHonI**

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

- Quizzes
- Assignments
- Seminar

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

- Quizzes
- Assignments
- Seminar



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- Promoting excellence in Teaching, Research and Consultancy that galvanizes academic consciousness among Faculty and Students.
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