

RN SHETTY TRUST ®



ESTD.: 2001
An Institute with a Difference

RNS INSTITUTE OF TECHNOLOGY

Autonomous Institution affiliated to Visvesvaraya Technological University, Belagavi

Approved By AICTE, New Delhi. Accredited by NAAC 'A+' Grade

RR Nagar, Dr. Vishnuvardhan Road, Bengaluru - 560 098

Ph: (080) 28611880, 28611881 URL: www.rnsit.ac.in



Dr. R N Shetty
Founder



DEPARTMENT OF CSE - AI & ML

BACHELOR OF ENGINEERING

Scheme and Syllabus of III & IV Semesters

2025 SCHEME



 www.rnsit.ac.in



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.

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An Autonomous Institution, Affiliated to VTU,
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**Department of Computer Science
and Engineering(AI & ML)**

Autonomous Scheme
(Effective from Academic Year 2025 – 26)



Scheme and Syllabus Batch 2025 – 2029

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



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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
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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.



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Program Educational Objectives

The graduates of AI &ML program will be enabled to

- **PEO1:** Process 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 environmental aspects while solving complex engineering problems for its impact on sustainability with reference to economy, health, safety, legal framework, culture and environment. (WK1, WK5, and WK7).
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



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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.



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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	Durati on in Hour s	CIE MARKS	SEE MARKS	TOTAL MARKS	CREDIT S	
					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	2	50	50	100	1	
7	AEC	25BCXAE307	(BUCKET LIST B)	CSE	0	0	30	00	30	2	50	50	100	1	
8	SDC	25BCBPR308	COMMUNITY PROJECT (PROJECT-BASED LEARNING) / SOCIETAL PROJECT	CSE	0	0	0	30	30	2	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	–	100	—	100	PP	
TOTAL										688		600	400	1000	21
# TH/S - TOTAL HOURS PER SEMESTER, TW & SL - TERM WORK & SELF LEARNING															

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								
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	2	50	50	100	1
6	AEC	25BCXAE406X	(BUCKET LIST C)	CSE		0	0	30	00	30	2	50	50	100	1
7	BSC	25BFETH407	BIOLOGY FOR ENGINEERS	TD: chemistry / biotech / cs allied; PSB: CS allied		30	0	0	30	60	3	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
		Physical Education Director													
		YOGA TEACHER													
		MUSIC TEACHER													
TOTAL										660		500	400	900	21
10	NCMC	25BMADP410	ADDITIONAL MATHEMATICS-II	TD - MATHS DEPT		14	0		14	28	—	100	—	100	PP
TOTAL										688		600	400	1000	21
# TH/S - TOTAL HOURS PER SEMESTER, TW & SL - TERM WORK & SELF LEARNING															

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).



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III SEMESTER SUBJECTS

ESTD: 2001

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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 chains and 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 Engineers, 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 Raton, FL, USA: CRC Press, 2019.

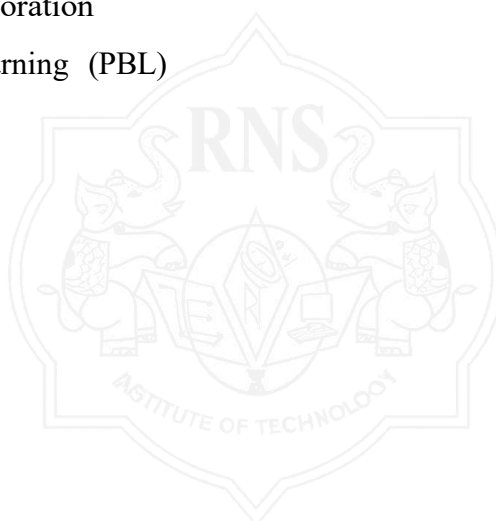
Web Links:

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://slnk.com/rb8fcyk>
7. <https://slnk.com/oo0lb6f>

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	- 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. - 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	- 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 - 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	- 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. - 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	- 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. - 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



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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 Instruction. 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. Vranesic and 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 Architecture: 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](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.



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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



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(Effective from Academic Year 2025 – 26)**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, Segmentation.

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, Directory 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=yK1luBHPdp30>

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:

- push() – Add a parcel ID onto the stack when a new parcel arrives.
- pop() – Remove the last parcel ID from the stack when a parcel is taken out.
- display() – Show all parcel IDs currently stored in the stack.
- 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:

- Add a new call to the queue (enqueue)
- Serve the next call (dequeue)
- 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, Semester and 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:

- Create a Singly Linked List of N student records using front insertion.
- 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, Salary and 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, Preorder and 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 branches and 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, date and 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.



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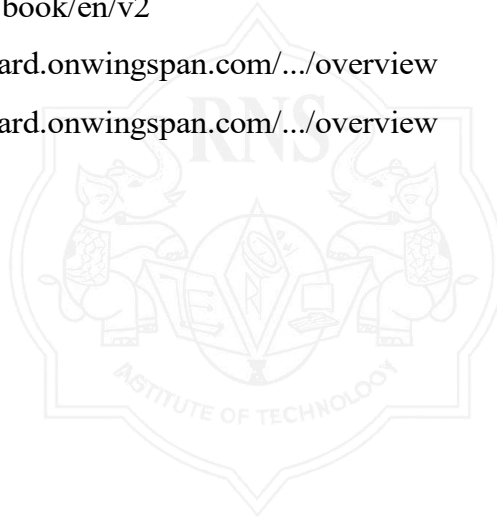
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Accredited with NAAC A+ Grade

Department of Computer Science
and Engineering(AI & ML)
Autonomous Scheme
(Effective from Academic Year 2025 – 26)



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>



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 – 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.

5	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”.																		
	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>	ItemCode	ItemCategory	itemPrice	1001	Electronics	700	1002	Desktop Supplies	300	1003	Office Supplies	350	1004	USB	400	1005	CD Drive	800
ItemCode	ItemCategory	itemPrice																	
1001	Electronics	700																	
1002	Desktop Supplies	300																	
1003	Office Supplies	350																	
1004	USB	400																	
1005	CD Drive	800																	
6	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”.																		
7	Getting Started with Excel: Create a sample Excel sheet and explore different tabs in the Ribbon and their functionalities.																		
8	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.																		
9	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																		

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 $\geq$ 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



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			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:

- 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”)
- 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)
- 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" à Select 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.
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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): <https://platform.openai.com/docs/guides/prompt-engineering>
- [Effective Few-shot prompting examples](https://learnprompting.org/docs/basics/few_shot_prompting) : 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/) :
<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/) : <https://parsons.problemsolving.io/>
- [Edutopia on AI Writing Feedback](https://www.edutopia.org/article/ai-writing-feedback-students/) : <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 Mongoddb.
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. <i>(Bloom's Level: L3 – Apply)</i>
CO2	Explain the structure and advantages of the MERN stack and set up the development environment. <i>(Bloom's Level: L2 – Understand)</i>
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. <i>(Bloom's Level: L3 – Apply)</i>

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.
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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 Approaches.
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, dribbling, 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, Fitness and 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) Sheetal.
- 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, Sheetal) 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.

An Institute with a Difference

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, evolution and 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 awareness and 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 instruments, percussion instruments in both Carnatic and Hindustani Music.		
Module-5		3 Hours
Composers: Biography and contributions 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 vectors. 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 equations, 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.



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An Autonomous Institution, Affiliated to VTU,
Accredited with NAAC A+ Grade

Department of Computer Science
and Engineering(AI & ML)
Autonomous Scheme
(Effective from Academic Year 2025 – 26)



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 Management 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 understand 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, Entity sets and structural constraints, Weak entity types, ER Diagrams, Naming Conventions 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 - Retrieve details of all books in the library – id, title, name of publisher, authors, number of copies in each branch, etc. - Get the particulars of borrowers who have borrowed more than 3 books, but from Jan 2017 to Jun 2017. - Delete a book in BOOK table. Update the contents of other tables to reflect this data manipulation operation. - Partition the BOOK table based on year of publication. Demonstrate its working with a simple query. - 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 - Count the customers with grades above Bangalore's average. - Find the name and numbers of all salesmen who had more than one customer. - List all the salesmen and indicate those who have and don't have customers in their cities (Use UNION operation). - Create a view that finds the salesman who has the customer with the highest order of a day. - 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 - List the titles of all movies directed by 'Hitchcock'. - Find the movie names where one or more actors acted in two or more movies. - List all actors who acted in a movie before 2000 and also in a movie after 2015 (use JOIN operation). - 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. - 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 - List all the student details studying in fourth semester 'C' section. - Compute the total number of male and female students in each semester and in each section. - Create a view of Test1 marks of student USN '1RN25CS100' in all subjects. - Calculate the FinalIA (average of the best two test marks) and update the corresponding table for all students. - 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 - 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. - Show the resulting salaries if every employee working on the 'IoT' project is given a 10 percent raise. - Find the sum of the salaries of all employees of the 'Accounts' department, as well as the maximum salary, the minimum salary and the average salary in this department. - Retrieve the name of each employee who works on all the projects controlled by department number 5 (use NOT EXISTS operator). - 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 functions, Warshall's Algorithm, Floyd's Algorithms, Reliability Design.

Space and Time Trade-offs: Input Enhancement in String Matching: Horspool's algorithm, 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, NP and NP-Complete Problems, 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 Selection 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 problems.
CO5	Analyze computational complexity classes (P, NP, NP-Complete) and implement exact, approximation and backtracking algorithms to solve computationally 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 Algorithms, 2nd Edition 2019.

Reference Books:

1. Thomas H Cormen, Charles E Leiserson, Ronald L Rivest, Clifford Stein Introduction 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, Naïve 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 Reinforcement 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/>

**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 operations.
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 permissions 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 redirection, 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, identifies 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 control 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 operations.
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: <i>The purpose of the course is to facilitate the learner to:</i> 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: <i>The purpose of the course is to facilitate the learner to:</i> 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 $P + P \times r/100$. 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: $y=x^2$ (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: <pre>{ orderId, customerName, items: [{ productId, quantity, price }], orderDate, status }</pre>
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: <i>The purpose of the course is to facilitate the learner to:</i> 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 an 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:

- Append a string to the collection
- Insert a string at a specified position
- Search for a string
- 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:

- Display a message on the screen using suitable GUI components.
- 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: <i>The purpose of the course is to facilitate the learner to:</i> 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:

- Create a table page_views containing:
 - page_name
 - views (COUNTER)
- Increment the views of the Home page by 1.
- Increment the views of the About page by 5.
- Display all page view counts.
- Decrement the Home page count by 1.

Experiment 5. Create a database "**Library**" and perform the following operations:

- Create a table book_reservation.
- Insert reservation details with a TTL of 120 seconds.
- Retrieve the TTL value of the reservation.
- Verify the record before expiry.
- Observe the deletion of data after TTL expires.

Experiment 6. Create a database "**Hospital**" and perform the following operations:

- Create a table patient.
- Insert 5 patient records.
- Add a new column blood_group.
- Change the datatype of age.
- Delete the column address.
- Describe the modified table.

Experiment 7. Problem Statement:

Create a database "**Bank**" and perform the following operations:

- Create a table customer.
- Insert 5 records.
- Display all records.
- Remove all records using the TRUNCATE command.
- Verify that the table is empty.
- Drop the table.
- Drop the keyspace

Experiment 8. Create a database "**Store**" and perform the following operations:

- Create a table product.
- Insert 5 product records.
- Export the table contents into a CSV file.
- Delete all records.
- Import the data back from the CSV file.
- Display the imported records.

Experiment 9. Create a database "**Transport**" and perform the following operations:

- Create a table bus_details.
- Insert records through STDIN.
- Display all records.
- Export the table contents to STDOUT.
- Verify the exported output.

Experiment 10. Create a database "ECommerce" and perform the following operations:

- Create a table orders.
- Insert order details using consistency level ONE.
- Read the records using consistency level QUORUM.
- Insert another record using consistency level ALL.
- Compare the behavior of different consistency levels.
- Record your observations.

Experiment 11. Create a database "EventManager" and perform the following operations:

- Create a table events containing:
 - event_id (UUID)
 - event_name
 - event_date (TIMESTAMP)
 - venue
- Insert details of 5 events.
- Retrieve all event details.
- Display events conducted after a specific date.
- Update the venue of an event.

Experiment 12. Create a database "Attendance" and perform the following operations:

- Create a table student_attendance with attributes:
 - student_id
 - student_name
 - subject
 - attendance_count
- Insert attendance details of 5 students.
- Retrieve attendance information of a specific student.
- Update attendance counts.
- Delete the attendance record of a student.
- Display all records.
- 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	3

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 applications, 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 Three Internal Assessment Tests each of 50 marks, 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 should 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 out of allotted 50 marks to appear for SEE, with minimum 40% scored in every component of CIE.			

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, Methods and 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))
Outcome Based Education (OBE) and Choice Based Credit System (CBCS)
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.			



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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 – 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 zone and 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 zone and finishing, along with basic skills of javelin throw.
CO2	Apply the fundamental techniques of triple jump, including approach run, take-off, hop, step, jump, flight and landing.
CO3	Develop and perform javelin throw techniques, including grip, carry, impulse stride, release and recovery with proper coordination.
CO4	Exhibit fundamental skills of cricket, including batting, bowling, fielding, wicket keeping and understand rules and duties of officials.
CO5	Demonstrate basic skills and techniques in baseball, including player stances, grip, batting, pitching and 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, Fitness and 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, scope and importance of Yoga, including its physical, mental and spiritual benefits and misconceptions.
CO2	Demonstrate Suryanamaskara (12 counts, 8 rounds) with correct technique, prayer and understanding of its need and benefits.
CO3	Perform sitting and standing Asanas (Bakasana, Hanumanasana, Yogamudra in Vajrasana, Vatayanasana, Garudasana) with proper technique, precaution and benefits.
CO4	Execute prone, supine and balancing Asanas (Bhujangasana, Shalabhasana, Utthita Dvipadasana, Ardha Halasana, Sheershasana) with correct body alignment and safety measures.
CO5	Practice Pranayama techniques (Kapalabhati, Bhastrika, Bhramari) with proper method, breathing control and understanding of their importance and health benefits.

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



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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.

**B.E. (Computer Science and Engineering (AI & ML))
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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 instrunents 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	Compare 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 Subramaniam, Classical Music of India: A Practical Guide, Tranqueber 2018.
2. 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))
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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. Students 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.

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