



VIT[®]

Vellore Institute of Technology

(Deemed to be University under section 3 of UGC Act, 1956)

School of Computer Science and Engineering

CURRICULUM AND SYLLABI (2026 – 2027)

B. Tech. Computer Science and Engineering (Artificial Intelligence and Machine Learning)



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VISION STATEMENT OF VELLORE INSTITUTE OF TECHNOLOGY

Transforming life through excellence in education and research.

MISSION STATEMENT OF VELLORE INSTITUTE OF TECHNOLOGY

- **World class Education:** Excellence in education, grounded in ethics and critical thinking, for improvement of life.
- **Cutting edge Research:** An innovation ecosystem to extend knowledge and solve critical problems.
- **Impactful People:** Happy, accountable, caring and effective workforce and students.
- **Rewarding Co-creations:** Active collaboration with national & international industries & universities for productivity and economic development.
- **Service to Society:** Service to the region and world through knowledge and compassion.

VISION STATEMENT OF THE SCHOOL OF COMPUTER SCIENCE AND ENGINEERING

To be a world-renowned centre of education, research and service in computing and allied domains.

MISSION STATEMENT OF THE SCHOOL OF COMPUTER SCIENCE AND ENGINEERING

- To offer computing education programs with the goal that the students become technically competent and develop lifelong learning skill.
- To undertake path-breaking research that creates new computing technologies and solutions for industry and society at large.
- To foster vibrant outreach programs for industry, research organizations, academia and society.



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Programme Educational Objectives (PEOs)

1. Graduates will be engineering practitioners and leaders, who would help solve industry's technological problems
2. Graduates will be engineering professionals, innovators or entrepreneurs engaged in technology development, technology deployment, or engineering system implementation in Industry
3. Graduates will function in their profession with social awareness and responsibility.
4. Graduates will interact with their peers in other disciplines in industry and society and contribute to the economic growth of the country.
5. Graduates will be successful in pursuing higher studies in engineering or management.
6. Graduates will pursue career paths in teaching or research.



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School of Computer Science and Engineering **B. Tech. Computer Science and Engineering** **(Artificial Intelligence and Machine Learning)**

Programme Outcomes (POs)

PO_01: Having an ability to apply mathematics and science in engineering applications.

PO_02: Having a clear understanding of the subject related concepts and of contemporary issues and apply them to identify, formulate and analyse complex engineering problems

PO_03: Having an ability to design a component or a product applying all the relevant standards and with realistic constraints.

PO_04: Having an ability to design and conduct experiments, as well as to analyse and interpret data

PO_05: Having an ability to use techniques, skills, resources and modern engineering tools necessary for engineering practice

PO_06: Having problem solving ability- solving social issues and engineering problems

PO_07: Having adaptive thinking and adaptability

PO_08: Having a clear understanding of professional and ethical responsibility

PO_09: Having cross cultural competency exhibited by working in teams

PO_10: Having a good working knowledge of communicating in English

PO_11: Having a good cognitive load management [discriminate and filter the available data] skills

PO_12: Having interest in lifelong learning



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School of Computer Science and Engineering **B. Tech. Computer Science and Engineering** **(Artificial Intelligence and Machine Learning)**

Programme Specific Outcomes (PSOs)

1. Design and develop intelligent automated systems applying mathematical, analytical, programming and operational skills to solve real world problems.
2. Apply machine learning techniques, software tools to conduct experiments, interpret data and to solve complex problems.
3. Implement engineering solutions for the benefit of society by the use of Artificial Intelligence and Machine Learning.



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School of Computer Science and Engineering

**B. Tech. Computer Science and Engineering
(Artificial Intelligence and Machine Learning)**

**Curriculum
B.Tech. (CSE) - AI and ML
(2026 - 2027)**

B. Tech. Computer Science and Engineering (Artificial Intelligence and Machine Learning) - (2026)

Category Credit Detail									
Sl.No.	Description			Credits	Maximum Credit				
1	NC - Non Credit Course			2	2				
2	UCC - University Core Courses			60	60				
3	PCC - Programme Core Courses			40	40				
4	CON - Concentration			20	20				
5	OEC - Open Elective Courses			40	40				
Total Credits				160					

Non Credit Course									
sl.no	Course Code	Course Title	Course Type	Ver sio n	L	T	P	J	Credits
1	BAENG100	Effective English Communication	Lab Only	1.0	0	0	4	0	2.0

University Core Courses									
sl.no	Course Code	Course Title	Course Type	Ver sio n	L	T	P	J	Credits
1	BACHY101	Environmental Sciences	Online Course	1.0	0	0	0	0	2.0
2	BACHY105	Applied Chemistry	Embedded Theory and Lab	1.0	3	0	2	0	4.0
3	BACSE101	Problem Solving using Python	Lab Only	1.0	0	0	4	0	2.0
4	BACSE102	Problem Solving using Java	Lab Only	1.0	0	0	4	0	2.0
5	BACSE191	Basic Multidisciplinary Project	Project	1.0	0	0	0	0	2.0
6	BACSE291	Innovative Design Project	Project	1.0	0	0	0	0	2.0
7	BAEEE101	Basic Engineering	Embedded Theory and Lab	1.0	3	0	2	0	4.0
8	BAENG101	Technical English Communication	Embedded Theory and Lab	1.0	3	0	2	0	4.0
9	BAFLC100	Foreign Language	Basket	1.0	0	0	0	0	2.0
10	BAHSM100	Humanities, Social Science and Management	Basket	1.0	0	0	0	0	3.0
11	BAHUM101	India Studies	Online Course	1.0	0	0	0	0	1.0
12	BAMAT101	Multivariable Calculus and Differential Equations	Embedded Theory and Lab	1.0	3	0	2	0	4.0
13	BAMAT207	Probability and Statistics	Embedded Theory and Lab	1.0	3	0	2	0	4.0
14	BAPHY105	Engineering Physics	Embedded Theory and Lab	1.0	3	0	2	0	4.0
15	BASTS101	Qualitative and Quantitative Skills Practice I	Soft Skill	1.0	3	0	0	0	1.0
16	BASTS102	Qualitative and Quantitative Skills Practice II	Soft Skill	1.0	3	0	0	0	1.0

Programme Core Courses									
sl.no	Course Code	Course Title	Course Type	Version	L	T	P	J	Credits
1	BACSE103	Computation Structures	Embedded Theory and Lab	1.0	3	0	2	0	4.0
2	BACSE104	Structured and Object-Oriented Programming	Embedded Theory and Lab	1.0	2	0	4	0	4.0
3	BACSE105	Data Structures and Algorithms	Embedded Theory and Lab	1.0	3	0	2	0	4.0
4	BACSE106	Operating Systems	Embedded Theory and Lab	1.0	3	0	2	0	4.0
5	BACSE201	Models of Computation	Theory Only	1.0	3	1	0	0	4.0
6	BACSE202	Database Systems	Embedded Theory and Lab	1.0	3	0	2	0	4.0
7	BACSE203	Computer Networks	Embedded Theory and Lab	1.0	3	0	2	0	4.0
8	BACSE204	Software Engineering	Embedded Theory and Lab	1.0	3	0	2	0	4.0
9	BACSE206	Foundations of Artificial Intelligence	Theory Only	1.0	3	1	0	0	4.0
10	BAMAT205	Discrete Mathematics and Linear Algebra	Theory Only	1.0	3	1	0	0	4.0

Concentration									
sl.no	Course Code	Course Title	Course Type	Version	L	T	P	J	Credits
1	BABAI001	Artificial Intelligence and Machine Learning	Basket	1.0	0	0	0	0	20.0

Open Elective Courses									
sl.no	Course Code	Course Title	Course Type	Version	L	T	P	J	Credits
1	BAESP201	Spanish Level II	Embedded Theory and Lab	1.0	2	0	2	0	3.0
2	BAFRE201	French for Engineers: Language and Communication Lab	Embedded Theory and Lab	1.0	2	0	2	0	3.0
3	BAGER201	German Level II	Embedded Theory and Lab	1.0	2	0	2	0	3.0
4	BAHIN101	Prathamik Hindi	Theory Only	1.0	3	0	0	0	3.0
5	BAHIN102	Prayojanmulak Hindi	Embedded Theory and Lab	1.0	2	0	2	0	3.0
6	BAJAP201	Japanese Level II	Embedded Theory and Lab	1.0	2	0	2	0	3.0
7	BOPE001	B.Tech. Open Elective Courses	Basket	1.0	0	0	0	0	40.0
8	ULINK100	Undergraduate Lab Integration for Knowledge & Innovation	Basket	1.0	0	0	0	0	3.0

Course code	Course title	L	T	P	J	C
XXXXX	Effective English	0	0	4	0	2
Pre-requisite	Nil	Syllabus version				
		1.0				
Course Objectives						
1. To develop fluency in basic communication skills at various academic and Social Contexts.						
2. To help students overcome learning difficulties in grammar, vocabulary and pronunciation.						
Course Outcomes						
Upon completion of the course, learners will be able to:						
1. Illustrate listening and reading competence in general and academic contexts						
2. Demonstrate sufficient speaking skills in terms of pronunciation and discourse management						
3. Apply grammar rules in oral and written communication						
4. Employ appropriate vocabulary in diverse situations						
Module:1	Listening	5 hours				
Listening for General Information, Listening for Specific Information -Listening to formal and informal conversations, listening to talks						
Activity: Listening and note-taking						
Module:2	Pronunciation	8 hours				
Reading Aloud - short and long passages, Listen & Repeat Drills - words with common endings, Tongue Twisters, Mute Words, Commonly Mispronounced Words						
Activity: Reading a Passage Aloud						
Module:3	Speaking	8 hours				
Self-Introduction, Situational Role Play – Formal and Informal Situations, Picture Description - Individual and Group work						
Activity: Role Play						
Module:4	Grammar	10 hours				
Parts of Speech – An overview of the eight parts of speech along with the simple and the progressive tense, Types of Sentences: Affirmative Sentences, Negative Sentences, Interrogative Sentences, and Exclamatory Sentences						
Activity: Interactive Worksheets and Pair/Group Activities						
Module:5	Vocabulary	8 hours				
Synonyms, Antonyms, Homophones, Homonyms, Everyday Vocabulary – Words Describing the Weather, People, and Emotions						
Activity: Interactive Worksheets and Pair/Group Activities						
Module:6	Reading	10 hours				
Activity: Reading Comprehension, Reading Newspaper Articles						
Module:7	Writing	11 hours				
Activity: Jumbled Sentences, Parts of the Paragraph, Paragraph Writing - Guided and Unguided						
	Total Lecture hours:					60 hours
Text Book(s)						
1.	Chase, B.T. & Johannsen, K.L. (2018). Pathways: Listening, speaking and critical thinking 1. 2nd ed. National Geographic Learning.					
2.	Douglas, N. & Bohlke, D. (2020). Reading explorer 3. 3rd ed. National Geographic Learning.					

3.	Murphy, R. (2024). Essential English grammar. 2nd ed. Cambridge University Press.
Reference Books	
1.	Elbaum, S.N. & Peman, J.P. (2021). Grammar in context: Basic. 7th ed. National Geographic Learning.
2.	Folse, K. (2014). Great writing 1: Great sentences for great paragraphs. 4th ed. National Geographic Learning.
3.	Redman, S. (2017). English vocabulary in use: Pre-intermediate and intermediate. 4th ed. Cambridge University Press.
4.	Singleton, J. (2005). Writers at work: The paragraph. Cambridge University Press.
Mode of Assessment: Continuous assessment / FAT / Oral examination and others	
Recommended by Board of Studies	
19-02-2025	
Approved by Academic Council	
No. 78	Date
12.06.2025	

Course Code	Course Title	L	T	P	C
BACHY101	Environmental sciences	2	0	0	2
Pre-requisite	nil	Syllabus Version			
		1			
Course Objectives					
To equip themselves with foundational knowledge of environmental systems, sustainability principles, and pollution control methods, to support applications in real-world engineering scenarios. To develop requisite skills related to sustainable practices, environmental protection, and policy frameworks. To make students understand and appreciate the unity of life in all its forms, the implications of life style on the environment.					
Course Outcomes					
Explain key environmental concepts like ecosystems and biodiversity. (CO 1) Interpret the impact of energy usage, pollution, and waste on environmental quality. (CO 2) Apply knowledge of environmental laws and sustainable development goals to achieve practical solutions for environmental protection. (CO 3), 4. Evaluate the human impact on climate change and the role of IT and AI in mitigating environmental issues. (CO 4)					
Module:1	Fundamentals of Environment and Ecosystems	6 hours			
Definition and scope of environmental science, Earth as a life-support system, Ecosystem definition, Components of the environment (biotic & abiotic), Structure and function of ecosystems, Energy flow in an ecosystem, and ecological succession.					
Module:2	Biodiversity and Environmental Quality	6 hours			
Biodiversity definition, levels, significance, and threats. Species interaction, types- extinct, endemic, endangered, and rare species. Conservation strategies and genetically modified crops. Environmental hazards: definition, types, causes, and solutions: Biological (Malaria, COVID-19), chemical (BPA, heavy metals), and disaster management.					
Module:3	Pollution and Its Management Techniques	6 hours			

Types of pollution: air, water, soil, noise, thermal- causes, effects, and control methods, water management, its conservation, circular economy and solid waste management techniques.		
Module:4	Environmental Laws and Sustainable development goals	6 hours
Environmental impact assessment (EIA), Key national and international environmental laws- Environmental protection act (EPA) – Air, Water, forest conservation and wildlife protection acts, Kyoto and Paris Agreement. Introduction to Sustainable development goals (SDGss).		
Module:5	Climate Change and Emerging Environmental Issues	4 hours
Climate change science and global warming, carbon footprint and mitigation strategies, role of AI/IoT in environmental monitoring.		
Module:6	Contemporary topics	2 hours
Lecture on green energy technologies		
Total Lecture Hours:		30 hours
Text Book(s)		
G. Tyler Miller and Scott E. Spoolman, " Environmental Science ", Cengage learning, 15 th Edition, 2020 Erach Bharucha, " Textbook of Environmental Studies for Undergraduate students ", Orient Blackswan Pvt Ltd, 4 th Edition, 2023		
Reference Books		
Richard T. Wright & Dorothy F. Boorse , " Environmental Science: Toward a Sustainable Future ", Pearson Education, 13 th Edition, 2020 Anubha Kaushik & C.P Kaushik , " Perspectives in Environmental Studies ", New Age International Publishers, 7 th Edition, 2021 Benny Joseph, " Environmental Studies ", McGraw Hill Education, 3 rd Edition, 2021		
Mode of Evaluation :Quiz		
Recommended by Board of Studies :		23-05-2025
Approved by Academic Council : No. 78		12-06-2025

Course Code	Course Title	L	T	P	C
BACHY105	Applied Chemistry	3	0	2	4
Pre-requisite	NIL	Syllabus Version			
		1			
Course Objectives					
To enable students to learn fundamental concepts in different branches of chemistry To be well-versed in analytical and computational skills in chemistry To teach practical skills in chemistry and apply knowledge for societal applications					
Course Outcomes					
Apply the concepts of thermodynamics and kinetics Use chemical concepts for the advancement of materials in electrical, magnetic, and energy domains Demonstrate UV Visible spectroscopic and X- ray diffraction techniques Discuss molecular orbitals and its energies through computational chemistry Apply instrumental, wet-chemical, and computational methods to analyze materials, molecules, and ions					
Module:1	Chemical thermodynamics and kinetics	9 hours			
Introduction-Terminologies- Zeroth law- First law of thermodynamics – Enthalpy and heat capacity – Applications of first law of thermodynamics – Second law of thermodynamics – Carnot cycle- Third law of thermodynamics – Gibbs Helmholtz equation. Chemical Kinetics – Rate equation – Order of the reaction – Integral rate equations – Half life time of reactions- Molecularity – Collision theory of reaction rate – Effect of temperature and catalysts on reaction rate -Numericals					
Module:2	Energy devices	8 hours			
Electrochemical and electrolytic cells – electrode materials with examples (semi-conductors), classifications of batteries - chemistry of Li ion secondary batteries, Fuel cells: H ₂ -O ₂ and solid oxide fuel cell (SOFC); Solar cells - photovoltaic cell (silicon based), photoelectrochemical cells and dye-sensitized cells					
Module:3	Functional materials	10 hours			
Electrical materials: Ohm’s law, resistivity, classification - metals, semiconductors (intrinsic & extrinsic - Si), insulators, superconductors. Magnetic materials: para, dia, ferro & anti-ferro magnetism, applications in storage devices. Liquid cooling – types of coolants, thermal conductivity, and applications. Nanomaterials: introduction, top-down and bottom-up approaches for synthesis - bulk vs nano (gold), quantum dots					

Module:4	Spectroscopic and diffraction techniques	6 hours
Fundamental concepts in spectroscopic and diffraction techniques - Principle, instrumentation and applications of UV-Visible and powder XRD (determination of crystallite size, numericals)		
Module:5	Computational Chemistry Basics to applications	10 hours
Introduction-Quantum mechanical calculations. Molecular orbital theory: atomic orbitals, molecular orbitals. Orbital interactions- chemical bonding. Potential energy curve/surface, electrostatic potentials, geometry optimization, frequency, reaction mechanism, Application of AI to screen semiconductors		
Module:6	Contemporary Topics	2 hours
Total Lecture Hours:		45 hours
Text Book(s)		
Theodore E. Brown, H Eugene, LeMay Bruce E. Bursten, Catherine Murphy, Patrick Woodward, Matthew E. Stoltzfus, " Chemistry: The Central Science ", Pearson Publishers, 14 th Edition, 2017 Frank Jensen, " Introduction to computational chemistry ", Wiley, 3 rd Edition, 2017		
Reference Books		
A.R West , " Solid State Chemistry and its Applications ", Wiley, 2 nd Edition, 2014 Lawrence S. Brown and Thomas Holme , " Chemistry for engineering students ", Brooks Cole, 4 th Edition, 2018		
Indicative Experiments		
1. Thermodynamic functions from EMF measurements: Zn – Cu system. Evaluation of properties enthalpy, entropy and free energy		2 hours
2. Determination of reaction rate, order and molecularity - ester hydrolysis (ethylacetate)		2 hours
3. Colorimetric estimation of Ni ²⁺ using conventional and smartphone digital-imaging method		2 hours
4. Analysis of iron in carbon steel by potentiometry		2 hours
5. Preparation of ZnO semiconductor and its characterization		2 hours
6. Estimation of sulfate ion in drinking water by the conductivity method		2 hours

7. Build atoms and molecules, visualization of atomic orbitals and hybridized orbitals - calculating the orbital contributions	2 hours
8. Conformational analysis of cyclohexane and ethane molecules and plotting the potential energy profile	2 hours
9. Application of AI to screen semiconductors, materials, drugs - case study	2 hours
10. Size-dependent colour variation of Cu ₂ O nanoparticles by spectrophotometer	2 hours
11. Laboratory synthesis of hydroxyl apatite and its use for the removal of heavy metals	2 hours
12. Challenging experiment related to evaluation of the state of charge of batteries (SOC)	2 hours
13. Construction of DSSC and its working	2 hours
14. Preparation of Ag metal nanoparticles and their characterization	2 hours
15. Colorimetric estimation of Fe ²⁺ using conventional and smartphone digital-imaging method	2 hours
Total Laboratory Hours:	30 hours
Text Book(s)	
Arthur Vogel and John Mendham, " Vogel's Textbook of Quantitative Chemical Analysis ", Pearson Education, 6 th Edition, 2009	
Mode of Evaluation :Continuous Assessment Test, Quiz, Final Assessment Test, Lab Continuous Assessment, Lab Final Assessment	
Recommended by Board of Studies :	23-05-2025
Approved by Academic Council : No. 78	12-06-2025

Course Code	Course Title	L	T	P	C
BACSE101	Problem Solving Using Python	0	0	4	2
Pre-requisite	NIL	Syllabus Version			
		1			
Course Objectives					
1. To impart algorithmic skills through python programming language fundamentals and constructs. 2. To explore python collections for efficient data handling techniques and to learn modular, recursive programming approaches for developing software applications. 3. To understand python libraries for data analysis and manipulations					
Course Outcomes					
1. Identify appropriate algorithmic approach, data representation, control constructs in developing software solutions for solving real-world problems. 2. Inculcate data handling techniques using python collections and modular programming strategies for developing multi-disciplinary software applications 3. Idealize the importance of python libraries for handling, manipulating and analyzing multi-faceted real world problem domains.					
Indicative Experiments					
1. Subsidy Computation Agricultural subsidies are offered by the Indian government to farmers for improving crop yields and benefiting them. To facilitate the farmers in finding the subsidy amount, develop a Python code to calculate the subsidy based on the crop the farmer grows. The farmers can grow one of these three types of crops: Rice, Wheat, or Maize. The program calculates and displays the type of crop, total subsidy based on the type of crop selected, along with the yield and market rate. Use menu driven approach to implement the same. Each crop has a different formula for calculating the subsidy: Rice: Subsidy= (Yield × Market Rate) +100 Wheat: Subsidy= (Yield × Market Rate) +200 Maize: Subsidy= (Yield × Market Rate) +300 Input Format Press 1/2/3 to compute the Subsidy of Rice/Wheat/Maize Next Line to enter the Market Rate Next Line to enter the Yield Enter either Yes/No .					4 hours

Press 1/2/3 to compute the Subsidy of Rice/Wheat/Maize Next Line to enter the Market Rate Next Line to enter the Yield Enter either Yes/No Output Format Display "Press 1/2/3 to compute the Subsidy of Rice/Wheat/Maize" Display the Type of Crop, Subsidy, Yield and Market Rate Do you want to continue (Yes/No). If Yes . Press 1/2/3 to compute the Subsidy of Rice/Wheat/Maize Display the Type of Crop, Subsidy, Yield and MarketRate Do you want to continue (Yes/No). If No, display 'Thank you' Climate Change Data Analyzer Scientists track daily temperatures as a string of values separated by spaces (e.g., "30.5 32.1 29.8"). Write a python program that extracts the temperatures, converts them into float values, and finds the highest, lowest, and average temperature. Rules & Constraints: • Input is a string of space-separated float values (e.g., "30.5 31.2"). • All values must be valid floating-point numbers. • The list must have at least two values. • Temperatures must be within a realistic range: -100.0°C to 60.0°C. • The program should round the average to two decimal places. • If the input is invalid (non-numeric, empty, out-of-range), return an error message. Input Format: A single string with space-separated temperature readings (e.g., "25.4 27.8 26.5") Output Format: Highest: Lowest: Average:	
2. Gaming Leaderboard Username Validator In an online game, players choose usernames for the leaderboard. To make sure all usernames are clean and fair, they must follow these rules: • The username must start with a letter (A–Z or a–z). • It can contain letters, numbers, and underscores (_) only. • It cannot start with a number.	4 hours

• No other symbols or spaces are allowed. • The length must be between 5 and 15 characters. Write a python program using regular expressions to check if a username is valid or invalid. If invalid, display a message "Invalid Name" Input Format: A single string – the username to validate. Output Format: Print "valid username" if it follows all rules. Otherwise, print "Invalid Name". Number Game In Numeria, Alchemists must build an arithmetic expression using given numbers and operations to match a target. Use each number once, with +, -, *, or /. If no exact match, return the expression closest to the target. If multiple expressions give the same best result, return "No single solution" Rules: • Use all numbers once. • Only +, -, *, / allowed. • Division must result in integers only. • Left-to-right evaluation only (no brackets) • All numbers must be positive integers. • Return one valid expression, or "No single solution" if ties exist. Input Format: ((num1, num2, ..., numN), target) Output Format: • A string like "2+3*5", or • "No single solution" • Error message for invalid input	
3. Drone Delivery A delivery drone needs to find the shortest path from a warehouse (starting point) to a delivery location (destination) in a grid-based city map. The drone can move up, down, left, or right, but it cannot pass through restricted zones (obstacles). Implement an algorithm (only) using a top-down approach to find the shortest path from the warehouse to the delivery location. Input Format: A 2D grid (N × N) where 0 represents open paths and 1 represents obstacles. The starting position (warehouse) and destination position (delivery location). Top- down Design Approach:	6 hours

If the destination is reached, return the path length. If the current cell is an obstacle or out of bounds, return an invalid path value. Try moving in all four directions (up, down, left, right). Use memoization to store results of already visited paths. Output Format: The minimum number of steps required to reach the destination. The shortest path length or an indication that the delivery is not possible. Task Completion Time A group of students is participating in a coding competition, where they need to solve a set of problems as quickly as possible. Each student has a recorded completion time (in minutes) for each problem. The goal is to identify the student who solved their problems in the shortest total time. Implement an algorithm using Divide and Conquer problem solving approach to determine the student with the lowest total completion time. Input: A list of students with their total completion times. Base Case: If there is only one student, return them as the fastest. Divide: Split the student list into two halves. Conquer: Recursively find the fastest student in both halves. Combine: Compare the two selected students and return the one with the lower total time.	
4. Rental Computation Maya is developing a pricing system for a photography studio that rents out different types of cameras and needs to calculate the rental cost based on the equipment type and duration. The system should apply discounts based on the rental cost thresholds: Video Camera: The rental rate is ₹250 per hour. If the total rental cost exceeds ₹1500, a 12% discount is applied. Drone Camera: The rental rate is ₹300 per hour. If the total rental cost exceeds ₹2000, a 15% discount is applied. Write a Python code to compute the rentalCost for VideoCamera, and DroneCamera and apply the respective discount based on the rental duration and the type of camera. Input Format First line contains the duration of usage of Video Camera Second line contains the rental rate of Video camera per hour Third line contains the duration of usage of Drone Camera Fourth line contains the rental rate of Drone camera per hour. Output Format First line prints the total rental cost of Video Camera Second line prints the discount for Video Camera usage.	4 hours

Third line prints the total rental cost with discount for Video Camera.
 Fourth line prints the total rental cost of Drone Camera
 Fifth line prints the discount for Drone Camera usage.
 Sixth line Prints the total rental cost with discount for Drone Camera.

Leader Selection

In the city of Solaria, a group of n scholars sit in a circle. Each scholar has a number from 1 to n .

The selection for the next Guardian of Harmony works like this:

- Scholar 1 tells Scholar 2 to leave the circle.
- Then the next scholar (still in the circle) tells the person next to them to leave.
- This continues in a circle — each person removes the one next to them — until only one scholar is left.

Determine which scholar will be the last one standing

Input Format:

A single number n — the number of scholars.

Output Format:

A number — the scholar who is left at the end.

5.

Analyze health risk

Analyze health risks based on multiple individuals' BMI (Body Mass Index), blood pressure, and heart rate. Using a loop to collect data for multiple individuals. Calculate BMI using $BMI = \text{weight} / (\text{height} ** 2)$, use conditional statements to classify BMI as low, medium or high.

Low BMI (underweight): Less than 18.5 kg/m^2

Medium BMI (normal weight): $18.5 - 24.9 \text{ kg/m}^2$

High BMI (overweight): 25 kg/m^2 and above

A "low" blood pressure is generally considered to be below 90/60 mmHg, while a "medium" or normal blood pressure is between 90/60 mmHg and 120/80 mmHg, otherwise high. For heart rate, a "low" resting rate is under 60 beats per minute (bpm), and a "medium" or normal resting rate is between 60-100 bpm, otherwise high. Additionally, check if blood pressure (systolic/diastolic) and heart rate fall within healthy ranges, categorizing individuals into Low, Moderate, or High health risk levels. Write a python code to display the BMI, blood pressure and heart rate. If two or more health risks are high, then the risk level is high. If any one of the health risk is high, then the risk level is medium. Otherwise, it is under low risk. Finally, display a summary report showing the number of individuals in each risk category.

Input Format:

First line contains the number of People 'n'

6
hours

Next line contains the Blood pressure(Systolic/Diastolic) of Person1 in mm/hg
 Next line contain heartrate of Person1 in beats per minute(bpm)
 .
 Next line contains the weight of the Person 'n' in Kg
 Next line contains the height of the Person 'n' in meter
 Next line contains the Blood pressure(Systolic/Diastolic) of Person 'n' in mm/hg
 Next line contain heartrate of Person 'n' in beats per minute(bpm)

Output Format

First line Prints the BMI of Person 1(kg/m2)
 Second line prints underweight/normalweight/overweight of Person 1
 Third line Prints the Blood Pressure of Person 1(mm/hg)
 Fourth Line prints Low/Medium/HighBloodPressure of Person 1
 Fifth line prints the Heart rate of Person 1(bpm)
 Sixth line prints low/normal/high heartrate of Person 1
 Seventh line prints low/medium/high risk level of Person 1

.
 Next line Prints the BMI of Person 'n'(kg/m2)
 Next line prints underweight/normalweight/overweight of Person 'n'
 Next line Prints the Blood Pressure of Person 'n'(mm/hg)
 Next Line prints Low/Medium/HighBloodPressure of Person 'n'

Next line prints the Heart rate of Person 'n'(bpm)
 Next line prints low/normal/high heartrate of Person 'n'
 Next line prints low/medium/high risk level of Person 'n'

Next prints the
 Summary:
 High risk level : number of People
 Medium risk level: number of People
 Low risk level: number of People

Process DNA sequence

DNA sequences are primarily analyzed by scientists, researchers, and medical professionals in fields like genetics, molecular biology, and medicine, to understand genetic variations, diagnose diseases. Write a Python program to process and analyze the DNA sequences by performing various operations based on nucleotide sequence rules. The program should perform the following on valid DNA Sequences:

- Accept 'n' DNA sequences from the user.
- Verify whether each sequence contains only the valid DNA bases (A, C, G, T). If so, display as Valid otherwise invalid.
- Search for the specific "TATAAA" sequence within the given DNA sequences. If so Display as match/nomatch
- Count and display the occurrences of base 'A' in each DNA sequence.

• Store the unique bases and their frequency in a dictionary for all sequences combined and display them. • Replace a specific substring in the DNA sequences with 'X' (e.g. replacing "AT" in "TATA" results in "TXA"). • Convert DNA to RNA by replacing 'T' with 'U', and store the RNA sequences in a list. • Search for a specific pattern in the DNA sequences and display its position if found. • Compute and display the complementary strand for each DNA sequence, where A pairs with T, and C pairs with G (e.g., "ATCGA" → "TAGCT"). Input Format First line contains number of DNA sequences Next line contains the DNA sequence 1 Next line contains the DNA sequence 2 . Next line contains the DNA sequence n Next line contains the specific sequence Next line contains the base to find its occurrence: Next line contains the substring to replace: Next line contains the string to replace with: Next line contains the string to replace to convert DNA to RNA Next line contains the string to replace with to convert DNA to RNA Next line contains the pattern to display its position Output Format First Line displays DNA sequence 1 valid/invalid Next Line displays DNA sequence 2 valid/invalid . Next Line displays DNA sequence n valid/invalid Next Line displays DNA sequence 1 Match/No Match Next Line displays DNA sequence 2 Match/No Match . Next Line displays DNA sequence n : Match/No Match Next Line displays DNA sequence 1 count Next Line displays DNA sequence 2 count . Next Line displays DNA sequence n count Frequency of Unique bases: {'A': count, 'T': count, 'G': count, 'C': count} Next Line displays DNA sequence 1: New DNA sequence 1 after replacing Next Line displays DNA sequence 2: New DNA sequence 2 after replacing . Next Line displays DNA sequence n: New DNA sequence n after replacing DNA to RNA:['New Sequenc1', 'New Sequenc2',... 'New Sequencn'] Next Line displays the position of the given Pattern in DNA sequence 1:	
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Next Line displays the position of the given Pattern in DNA sequence 2: . Next Line displays the position of the given Pattern in DNA sequence n: Display the position of the given Pattern in DNA sequence 1: Display the position of the given Pattern in DNA sequence 2: Display the position of the given Pattern in DNA sequence n: Display the complementary strand of DNA sequence 1: Display the complementary strand of DNA sequence 2: . Display the complementary strand of DNA sequence n:	
6. Renewable Energy Grid In the year 2050, the world is powered by solar energy storage units, distributed across three major smart power stations. These stations are: (a) Station 1: Primary source, (b) Station 2: Intermediate (buffer) , (c) Station 3: Final destination. To ensure sustainable and stable energy flow, scientists have developed a precise transfer protocol that moves energy units from Station 1 to Station 3. Transfer Rules (Constraints): • Only one energy unit can be transferred at a time to prevent system overload. • A larger unit can never be placed on top of a smaller unit. • The number of energy units n must be an integer between 1 and 20. • The transfer output must be a sequence of moves: each move is a pair (a, b) meaning "move a unit from Station a to Station b", where a and b are in {1, 2, 3}. • Two consecutive moves must not involve the same pair of stations in opposite directions. For example, (1, 3), (3, 1) back-to-back is not allowed, as it causes unnecessary energy loss and instability. Input Format: An integer n represents the number of energy storage units to be transferred from the primary station to the final station. Output Format: A list of ordered pairs (a,b), where each pair represents a transfer of an energy unit from station a to station b. Rainfall prediction using Sorting Write a Python program to assist meteorologists in forecasting rainfall by analyzing relative humidity based on air temperature (23°C to 28°C) and dew point temperature (7°C to 16°C). Use the given formulas to compute specific humidity, saturation point, and relative humidity: specific humidity = $6.11 \times 10^{\{7.5 \times \text{dew point}\} / \{237.3 + \text{dew point}\}}$ saturation point = $6.11 \times 10^{\{7.5 \times \text{air temp}\} / \{237.3 + \text{air temp}\}}$	4 hours

relative humidity = (specific humidity) / (saturation point) x 100 The chance of rainfall is high when the relative humidity is high and the temperature is dropping. The program should sort the relative humidity values in increasing order and display the highest relative humidity along with its corresponding air temperature and dew point temperature, providing valuable insights for rainfall prediction. Input Format: An integer 'N' representing the number of temperature readings. 'N' lines, each containing: Air Temperature (integer, between 23°C and 28°C) Dew Point Temperature (integer, between 7°C and 16°C) Output Format: Sorted list of relative humidity values in increasing order along with their corresponding air temperature and dew point temperature. Highest relative humidity value with its associated air temperature and dew point temperature. Prediction statement indicating whether the chance of rainfall is High/Low (if humidity is high and temperature is dropping).	
7. Browser Tracking Write a Python program to simulate a web browser's back and forward navigation system using stacks, where visiting a new webpage pushes the URL onto the back stack and clears the forward stack. Implement functions to navigate back by popping the top page from the back stack and pushing it onto the forward stack, and to navigate forward by popping the top page from the forward stack and pushing it onto the back stack. The program should allow users to enter URLs, navigate back and forward, and display the current page along with available navigation options dynamically. Input Format: •An integer N representing the number of webpage visits. •N lines, each containing a URL (string) representing a webpage visit. •User can enter the following commands dynamically after initial webpage visits: - o BACK: Navigate to the previous page. - o FORWARD: Navigate to the next page. - o VISIT : Visit a new webpage, clearing the forward history. - o EXIT: Terminate the program. Output Format: •Display the current page after each operation. •Show available navigation options (Back and Forward stacks). •Display messages when back or forward navigation is unavailable.	6 hours

- Display Browser session ended when Exit.

Customer Orders Queue Processing

In a smart manufacturing unit, automated machines process customer orders in a First-In-First-Out (FIFO) manner to ensure efficiency. Write a Python program using a queue to simulate an order processing system, where customers place orders for different industrial products (e.g., raw materials, electronic components, machinery parts), and each order is stored along with its order placed time. The system should process the orders in the same sequence they were received, record the order completion time, and remove them from the queue upon completion. Finally, display the status of the order queue before and after processing, along with the time taken to complete each order.

Input Format:

An integer 'N' representing the number of orders

N lines, each containing:

Order ID (string)

Product Name (string)

Order Placed Time (HH:MM 24hr -format)

Order Completion Time ((HH:MM format)

Output Format:

Order queue before processing

Processing details, including:

Order ID - Product Name - Order Placed Time - Order Completion Time - Time Taken to Process (in minutes)

Order queue after processing

8.

Smart Building

Elena Vasquez, a futuristic architect, is designing modular smart buildings on a blueprint. Each building is represented as a rectangle with:

- (x, y) — coordinates of the bottom-left corner

- Width and height — horizontal and vertical sizes of the building

To avoid overlap during construction, Elena needs a tool that calculates the exact overlapping area between any two buildings.

Write a python function (collections framework) that takes two building rectangles as input and returns the area of overlap.

If they do not overlap, return 0.

Input Format:

Each rectangle is given as a list of 4 integers:

[x, y, width, height]

6
hours

Output Format:

A single integer — the overlapping area between the two buildings. If no overlap, return 0.

Constraints:

- All coordinates and dimensions are integers.
- Width and height must be positive (greater than 0).
- Input lists must contain exactly 4 integers.
- Coordinates may be negative (to allow buildings in all quadrants).

Analyze Water Quality

Environmental agencies, researchers assess the overall water quality, monitor potential pollution sources, and ensure the water is safe for intended uses like drinking, agriculture, and aquatic life using water pH and dissolved oxygen levels and turbidity. Assist them by developing a Python program using functions and conditional statements to analyse the water quality based on pH, turbidity, and dissolved oxygen levels. The program should take input values for these parameters, check if they are within safe limits, and classify the water as safe or unsafe for consumption.

If pH value is 6.5 and 8.5, Turbidity lesser than 3 NTU(Nephelometric Turbidity Unit) and Dissolved Oxygen between 6.5 and 8 mg/L then the water quality is safe Use conditional statements to give recommendations if the water is safe or unsafe. Allow users to input data for any location and display a summary of safe and unsafe water sources. Locations may include Clean River area, lake near agriculture area, urban storm drain area, Deep Ground water Source etc

Use menu driven approach and functions to compute and display for multiple locations

Input Format

First Line contains the name of the Location 1

Second Line contains the pH value

Third Line contains the Turbidity

Fourth Line contains Dissolved Oxygen

Enter either Yes/No

.

Next Line contains the name of the Location 'n'

Next Line contains the pH value

Next Line contains the Turbidity

Next Line contains Dissolved Oxygen

Enter either Yes/No

Output Format

Safe/unsafe

Do you want to continue (Yes/No). If Yes

.

Safe/unsafe

Do you want to continue (Yes/No). If No, display 'Thank you'

9. Reforestation In a reforestation project, each tree grows a fixed number of saplings every year. These saplings become mature trees starting from the next year and also begin producing saplings. Implement a python program using functions that calculates the total number of mature trees after a given number of years. Input Format: A tuple of three integers: initial_trees – Number of trees at year 0 saplings_per_tree – Number of saplings each tree produces per year years – Number of years to simulate Output Format: A single integer: total number of mature trees after the given number of years. Recurring Character For a given string which is made of uppercase letters (A–Z). Implement a recursive function that finds the first character that appears more than once. The function should return a dictionary with: • The character (key) • A list of two indices: • The index where it first appeared • The index where it reappeared first • If no recurring character is found, or if the input is None or an empty string, return an empty dictionary {}. Rules & Constraints: • Input must be a string containing only uppercase A–Z. • Return the first recurring character based on position. • Ignore later repetitions after the first recurrence. • Use recursion (no loops allowed). • Return an empty dictionary if: • Input is None • Input is an empty string • No character repeats Input Format: A single string: "ABCDAB" Output Format: A dictionary like: {"A": [0, 4]} Or: {} (if no recurring character or invalid input)	6 hours

Tower of Hanoi

In robotic warehouse automation, autonomous robotic arms move stacked containers or pallets between storage locations while following strict stacking rules. Similar to the Tower of Hanoi problem, the system must transfer stacked items from a source rack to a destination rack using an intermediate rack, ensuring that larger items are never placed on smaller ones. Write a Python program using a recursive function to simulate this process, where a set number of stacked containers (disks) must be moved while following the First-In-Last-Out (FILO) principle. The program should determine the optimal sequence of moves, ensuring safe and efficient stacking, and display each step of the movement process to track how robotic arms relocate items.

Input Format:

An integer 'N' representing the number of stacked containers.

Output Format:

A sequence of steps showing how the containers are moved from the Source Rack to the Destination Rack using the Intermediate Rack.

10.

Student Attendance Data Analysis using Numpy

Involve as a team to collect attendance dataset from professors. Design a Python program using NumPy to analyse a student attendance dataset. Compute the total attendance per student, identify the student with the highest attendance, calculate the class average attendance per day, and determine the day with the lowest attendance rate. Finally, compute each student's attendance percentage and display students who have less than 75% attendance.

Input Format:

- An integer N representing the number of students.
 - An integer D representing the number of days.
 - A N x D matrix, where each row corresponds to a student, and each column represents a day.
- o1 indicates present
o0 indicates absent

Output Format:

- Display the original attendance matrix.
- Compute and display the total attendance per student.
- Identify and display the student with the highest attendance.
- Calculate and display the class average attendance per day.
- Determine and display the day with the lowest attendance rate.
- Compute and display each student's attendance percentage.
- Identify and display students who have less than 75% attendance.

4
hours

11.

Student Marks Data Analysis using Pandas

Involve as a team to collect sample archived student marks dataset from professors. Write a Python program using Pandas to analyse students' internal marks, where each student is evaluated based on six internal components and a final component. Create a DataFrame with student names, six internal scores, and final score. Calculate the class average internal score, compute the total marks for each student by summing all components, and determine the student with the highest total marks. Additionally, filter and display students who have scored below 40% indicating the need for improvement.

Input Format:

An integer 'N' representing the number of students.

N lines, each containing:

Student Name (String)

Six Internal Component Scores (Integers from 0 to 100)

Final Component Score (Integer from 0 to 100)

Output Format:

- Display the original DataFrame with student names, internal scores, and final scores.
- Compute and display the class average internal score.
- Calculate and display the total marks for each student.
- Identify and display the student with the highest total marks.
- Filter and display students scoring below 40% of the total (i.e., below 40 out of 100).

4
hours

12.

Restaurant Food Waste Cost

Restaurants throw away a lot of food every day, which affects both costs and the environment. Consider the dataset which contains details of food waste over a month. Write a python program using Pandas to analyze and reduce this waste.

Input Format:

A CSV file with the following columns:

- Date (YYYY-MM-DD) – The day waste was recorded
- Food Item – Name of the food item wasted
- Category – Type of food (e.g., Vegetables, Dairy, Meat)
- Quantity Wasted – Amount wasted (in kg or units)
- Cost per Item – Cost of one unit of the food item

Perform the following:

1. Clean the Data

o Handle missing values in Date, Food Item, Category, Quantity Wasted, or Cost per Item (e.g., fill or remove).

6
hours

2. Calculate Waste Cost

- o Per Day: Total waste cost for each day
- o Per Category: Waste cost for each food category

3. Top 5 Most Wasted Items

- o Find the 5 food items with the highest total quantity wasted
- o Suggest simple strategies to reduce waste for each (e.g., store better, reuse, order less)

4. Trend & Strategy Analysis

- o Spot patterns (e.g., which days waste the most)
- o Recommend ways to reduce waste (e.g., smaller portions, better planning, donation)

Output Format:

- A cleaned DataFrame (after handling missing data)
- Two summary tables:
 - o Total waste cost per day
 - o Total waste cost per category
- A ranked list of top 5 wasted food items, with suggestions
- Trend insights and recommendations for reducing waste.

Smart Energy Grid

A smart energy grid tracks hourly electricity usage (in kWh) for a residential building over 30 days. The data is stored in a NumPy array. Write a Python program that analyzes the energy usage using NumPy.

Input Format:

A NumPy array with shape (30, 24):

30 rows = 30 days

24 columns = 24 hours per day

Each value shows the electricity used during that hour.

Perform the following:

1. Calculate Energy Usage

- Daily Consumption: Total energy used per day (output: array of 30 values)
- Monthly Consumption: Total energy used in 30 days (output: one float)

2. Find Peak Hours

For each day, find hours where usage is above that day's average

Output: A dictionary {day_index: [list_of_peak_hours]}

3. Predict Next Day's Usage

Use the last 7 days to predict the next day's total energy usage using simple average of daily totals from the last 7 days

Output Format:

Daily Consumption: NumPy array (30 values)

Monthly Consumption: Float

Peak Hours: Dictionary of peak hour indices per day

Predicted Next-Day Usage: Float (average of last 7 days)

Total Laboratory Hours:		60 hours
Text Book(s)		
John V. Guttag, " Introduction to computation and programming using Python ", The MIT Press, 3 rd Edition, 2021 Eric Matthes , " Python Crash Course. ", No Starch Press, 3 rd Edition, 2022		
Reference Books		
Luciano Ramalho, " Fluent Python ", O'Reilly Media Inc , 2 nd Edition, 2022 Charles R. Severance , " Python for Everybody ", Shroff Publishers, 1 st Edition, 2024		
Mode of Evaluation :Lab Continuous Assessment, Lab Final Assessment		
Recommended by Board of Studies :		21-05-2025
Approved by Academic Council : No. 78		12-06-2025

Course Code	Course Title	L	T	P	C
BACSE102	Problem Solving using Java	0	0	4	2
Pre-requisite	Nil	Syllabus Version			
		1			
Course Objectives					
To introduce the fundamental concepts of object-oriented programming using the Java language, including data types, control structures, and basic programming constructs To enable students to design and implement Java programs utilizing classes, objects, inheritance, polymorphism, and interfaces to build modular and reusable code To equip students with a comprehensive understanding of Java's exception handling and multithreading capabilities. Java's File Object, input/output (I/O) streams and to equip students with the skills to leverage generic programming and the Java Collection Framework with Databases					
Course Outcomes					
Develop basic Java programs utilizing fundamental programming constructs, object-oriented principles such as classes, objects, inheritance, and polymorphism Implement robust and efficient Java applications by applying exception handling techniques, managing concurrent execution using threads, and performing file input/output operations. Utilize the Java Collection Framework, including Lists and Maps, along with generic programming concepts to effectively manage and manipulate data within Java applications.					
Indicative Experiments					
1. a. Calculating Interest for Financing Options, Bobby is a financial analyst working for a construction company. He is tasked with evaluating two financing options for funding a new construction project. Each option involves different principal amounts and annual interest rates. Write a program for him that takes the principal amounts and interest rates for both financing options as input and calculates the respective interests for the financial options. Note: Multiply the principal amount by the annual interest rate and then divide by 100 to find the total interest paid b. Three-Digit Number Analysis: Sum of Digits and Parity Check. Alex is teaching a class on number properties and wants to create an exercise for his students. He needs a program that takes a three-digit number as				2 hours	

input, calculates the sum of its digits, and determines whether the sum is even or odd. Write a program to assist Alex in this task. c. Generating Prime Numbers Within a Specified Range. Arun is tasked with creating a program that prints prime numbers within a given range. The program should take two integers, start and end, as input, and output the prime numbers between these two values (inclusive). Help Arun to complete the task using a 'for' loop.	
2. a. Calculating Total Distance from Merged Daily Step Counts You are given the number of steps a person takes on two consecutive days. Your task is to merge the step counts from both days and calculate the total distance the person covers, assuming that each step covers a fixed distance of 1 unit. Write a program that takes the step counts for the two days as input, merges them, calculates the total distance covered and outputs the result. b. Identifying and Locating Prime Numbers in a 2D Grid Yashna is creating a program to analyse a 2D grid, identifying prime numbers and printing their coordinates. The input consists of the grid's dimensions and elements. The program's output displays the coordinates of each prime number found in the grid, aiding in the exploration of numerical patterns. Can you assist Yashna in creating the program?	2 hours
3. a. Designing a Rectangle Class to Calculate Area and Perimeter. Arun wants to design a program using a class that calculates and prints both the area and perimeter of a rectangle. Define a class named Rectangle to encapsulate the properties and behaviour related to a rectangle. Include two integer variables length and breadth to represent the dimensions of the rectangle. Calculate and print the area and perimeter of the rectangle. Help Arun to design the program b. Developing an ArrayConcatenator Class for Merging Arrays. Help Roshni to complete the program. Input Format The first line of input consists of an integer N, representing the number of elements of the first array. Roshni is tasked with developing a program for concatenating two arrays provided by the user. To accomplish this, she wants to create a class named ArrayConcatenator. The class includes a constructor to concatenate the elements of the input arrays. She wants to print the elements of the resulting array. The second line consists of N space-separated integers representing the first array elements. The third line consists of an integer M, representing the number of elements of the second array. The fourth line consists of M space-separated integers, representing the second array elements. Output Format:	2 hours

The output prints the concatenated array of elements separated by space. Refer to the sample output for the formatting specifications. Constraints: In this scenario, the test cases fall under the following constraints $1 \leq N, M \leq 10$ $1 \leq \text{array elements} \leq 100$	
4. a. Calculating Employee Bonuses Using Hierarchical Inheritance □ Shasha, an HR manager in a multinational corporation, requires a program to compute bonuses for developers and designers using hierarchical inheritance. Three classes: Employee with a base salary attribute; Developer and Designer extending Employee, each with a bonus percentage, work hours, and methods to calculate and display the final income. Shasha inputs the base salary and work hours for a developer and a designer, and the program outputs their respective final incomes. □ Note: For developers, the bonus percentage is 10%, for designers, it is 5% □ Formula: Final income = Base salary + (base salary * bonus percentage * work hours / 100) □ b. Designing a Fantasy Game Character System. Jessica is tasked with designing a fantasy game character system. The system includes an abstract class named GameCharacter with two abstract methods: attack() and defend(). Two subclasses, Warrior and Wizard, extend the GameCharacter class. The program prompts the player to choose a character class (1. Warrior, 2. Wizard) and input their character's strength or magic power. The dynamic calculations involve tripling the strength (strength * 3) for the Warrior's attack and doubling the magic power (power * 2) for the Wizard's attack. Jessica needs your help in completing the program. Help her finish it.	2 hours
5. a. Designing a Washing Machine Control System. Alex and Bob are designing a control system for household appliances, and one of the appliances is a washing machine. You want to create a program to help them that models the washing machine as a motor and calculates its electricity consumption based on its capacity. Define an interface named Motor with the following methods: void run() double consume(double capacity) Create a class called WashingMachine that implements the Motor interface. In the WashingMachine class: Implement the run() method to print "Washing machine is running."	2 hours

Implement a consume() method to print "Washing machine is consuming electricity." Implement the consume(double capacity) method to calculate the electricity consumption (in kWh) of the washing machine based on its capacity. The formula for electricity consumption is (capacity * 0.05). b. Unique Character Extraction.Ashok needs to implement a program using the java.lang package to process a given string. The goal is to create a program that extracts and displays a new string containing only the unique characters from the provided input string. Ashok should efficiently use the java.lang.StringBuilder class and display the output. Help him to complete the program.	
6. a. Validating Student Grade Input with Multi-Catch Exception Handling. Sampad wants to implement a program that takes input for a student's name and grade, validates the input, and then displays the grade for the given student. The grade should be an integer value. The program should validate the grade using the validateGrade() method. The method should throw an IllegalArgumentException if the grade is less than 0 or greater than 100. If the input is invalid due to a non-integer grade, catch the NumberFormatException and print the built-in exception message. If the input is invalid due to an out-of-range grade, catch the IllegalArgumentException and print the built-in exception message. Catch the exceptions using the multi-catch block. Assist Sampad to implement this program. b. Implementing Custom Exceptions for Time Input Validation.Alice is tasked with creating a program that validates user input for time values (hours, minutes, and seconds). The program should check whether the input values are within the valid range. If any value falls outside the valid range, a custom exception, InvalidHourException, InvalidMinuteException, or InvalidSecondException, should be thrown, indicating which part of the time (hours, minutes, or seconds) is invalid. If no exceptions occur, print "Correct Time - " followed by the time in the format "hours:minutes:seconds."	2 hours
7. Synchronizing Producer and Consumer Threads with a Shared Message Buffer.A shared resource, a message buffer, needs to be managed by two threads: a Producer and a Consumer. The Producer thread will generate messages and place them into the buffer. The Consumer thread will retrieve and process messages from the buffer. To ensure proper synchronization and avoid issues like the Consumer trying to read from	2 hours

an empty buffer or the Producer overwriting a message before it's consumed, you need to implement inter-thread communication using wait(), notify(), and synchronized blocks. Create a MessageBuffer class that holds a single message. The Producer thread will put a message into this buffer, and the Consumer thread will take a message from it. Implement the necessary synchronization mechanisms so that: The Consumer waits if the buffer is empty. The Producer waits if the buffer is full (i.e., already contains a message that hasn't been consumed). The Producer notifies the Consumer when a new message is available. The Consumer notifies the Producer after consuming a message, indicating the buffer is now empty. Write a Producer class that generates a sequence of messages (e.g., "Message 1", "Message 2", etc.) and puts them into the MessageBuffer. Write a Consumer class that retrieves and prints the messages from the MessageBuffer. Create a Main class to instantiate the MessageBuffer, a Producer thread, and a Consumer thread, and then start both threads.	
8. Calculating Final Prices with Tax: File Input and Output. Ella is managing her expenses and wants to calculate the final prices after applying a 10% tax to her purchases. She has a list of item prices that she wants to process. Create a file named prices.txt and write the entered item prices to this file. Then, the program should read from prices.txt, apply a 10% tax to each item, write the taxed amounts to a file named tax.txt, and display the taxed amounts. Input Format: The first line of input consists of an integer N, representing the number of items Ella wants to process. The second line consists of N space-separated double values, representing the price of an item. Output Format: The output displays a double value, representing the taxed amounts, each with two decimal places, separated by a space. Refer to the sample output for formatting specifications. Constraints: this scenario, the test cases fall under the following constraints: $1 \leq N \leq 10$.	2 hours
9. Basic Sentiment Analysis: Classifying Sentences from File Input. ☐ Mr. Styles is working on a sentiment analysis program to understand the sentiments conveyed in various sentences. he needs your assistance in developing a program that analyzes the sentiment of a given sentence and classifies it as positive, negative, or neutral. ☐ positive keywords = happy, good, excellent, positive. ☐ negative keywords = sad, bad, terrible, negative. ☐ Anything else is Neutral. ☐ Create a file named input.txt, the input is written into the file input.txt. The program then reads the sentence from input.txt and sentiment analysis is performed based on predefined positive and negative keywords. The classified sentiment (positive, negative, or neutral) is written to a new file named output.txt and displayed.	2 hours

10.	2 hours
Converting Speed Units (km/h to m/s) with File Input and Output: Nick is developing a program to convert speed units from kilometers per hour (km/h) to meters per second (m/s). However, he needs assistance in creating a structured and user-friendly program. Create a file named data.txt to enter the speed in km/h as given in the input. The program reads the speed from data.txt and then converts the speed from km/h to m/s using the formula. The converted speed is written to a new file named converted.txt and then displayed.	
11.	2 hours
Implementing Persistent Bank Account Transactions using Serialization. Sam is managing his bank account and wants to perform various transactions using a program. He wants to deposit and withdraw funds and then save the account details using serialization. Upon restarting the program, he wants to be able to load the serialized data and continue with his banking transactions. Write a program to assist Sam in managing his bank account, create a BankAccount class, and Serialize the BankAccount object to a file named bankAccount.ser after the transactions. Deserialize the BankAccount object from the file when the program restarts. Display the final balance after the transactions in a formatted manner with two decimal places.	
12.	2 hours
Serializing and Deserializing Savings Data to Determine Savings Category. Alice is managing her expenses and wants to create a simple program to track her savings she wants to categorise her savings as "Poor savings," "Good savings," or "High savings" using a serialization mechanism. Design a program to create an object of the SavingsData class with the provided salary and savings data. Serialize the created object to a file named savings.ser. Deserialize the SavingsData object from the savings.ser file. Display the category determined by the program after deserialization. Note: "Poor savings", if the savings percentage is between 1% (inclusive) and 10%. "Good savings", if the savings percentage is between 10% (inclusive) and 20%. "High savings", if the savings percentage is greater than or equal to 20%. "Invalid input", if none of the above conditions are met.	
13.	2 hours

Implementing a Generic Record Holder for Academic Data. A university needs a system to manage different types of academic records, such as student grades and course enrollments. To create a flexible and type-safe system, they want to use generic classes. Design a generic class named <code>RecordHolder</code> that can hold any type of academic record. This class should have the following functionalities: A private instance variable to store the record. A constructor that takes an object of the specific record type and initializes the instance variable. A method named <code>getRecord()</code> that returns the stored record. A method named <code>displayRecordInfo()</code> that prints some relevant information about the record. The implementation of this method will depend on the specific type of record being held. Create two concrete classes to represent different types of academic records: <code>GradeRecord</code>: This class should have private instance variables for <code>studentName</code> (String) and <code>grade</code> (Double). It should have a constructor to initialize these variables and a <code>displayRecordInfo()</code> method that prints: "Grade for [studentName]: [grade]". <code>EnrollmentRecord</code>: This class should have private instance variables for <code>courseName</code> (String) and <code>studentId</code> (Integer). It should have a constructor to initialize these variables and a <code>displayRecordInfo()</code> method that prints: "Student [studentId] is enrolled in [courseName]". In your Main class, demonstrate the use of the <code>RecordHolder</code> generic class with both <code>GradeRecord</code> and <code>EnrollmentRecord</code> objects. Create instances of <code>RecordHolder</code> to hold a <code>GradeRecord</code> and an <code>EnrollmentRecord</code>, and then call the <code>getRecord()</code> and <code>displayRecordInfo()</code> methods on these <code>RecordHolder</code> instances.	
14. Student Registration System using ArrayList in Java. Raman is a computer science teacher who is responsible for registering students for his programming class. He wants to streamline the registration process using a simple program. The program should allow him to input the names of students and later retrieve a student's name based on the index entered. Raman has decided to use an ArrayList to store the names.	2 hours

15.	2 hours
Calculating Median Temperature from City Data using HashMap. As a data analyst for a weather forecasting agency, you have a HashMap storing temperature data for various cities. Each city's entry consists of temperature readings. Your task is to find and report the median temperature, providing a more representative measure of the overall temperature patterns over a specific period. Note: To calculate the median, sort the numbers in ascending order. If the count is odd, the median is the middle number. If the count is even, the median is the average of the two middle numbers.	
16.	2 hours
You are tasked with developing a simple Employee Management System using Java and JDBC. The system should allow users to perform the following operations on employee records stored in a MySQL database Develop a menu-driven program (EmployeeApp.java) that allows users to: 1. Add Employee 2. View Employees 3. Update Employee Salary 4. Delete Employee 5. Exit	
Total Laboratory Hours:	
60 hours	
Text Book(s)	
Marc Loy, Patrick Niemeyer and Daniel Leuck, , "Learning Java", , O Reilly Media, 5th Edition, 2020 Herbert Schildt and Dr. Danny Coward, " Java: The Complete Reference", McGraw Hill, 13th Edition, 2024	
Reference Books	
Kathy Sierra, Bert Bates and Trisha Gee,, " Head First Java", O Reilly Media, 3rd Edition, 2022 Dhruti Shah, "100+ Solutions in Java: A Hands-On Introduction to Programming in Java", , BPB Publications, 1st Edition, 2020	

Mode of Evaluation :Lab Continuous Assessment, Lab Final Assessment	
Recommended by Board of Studies :	21-05-2025
Approved by Academic Council : No. 78	12-06-2025

Course Code	Course Title	L	T	P	C
BACSE191	Basic Multidisciplinary Project	0	0	4	2
Pre-requisite	Nil	Syllabus Version			
		1			
Course Objectives					
Enable students to collaborate effectively in diverse groups by integrating multidisciplinary engineering knowledge to develop practical solutions. Enhance students' skills in project planning, execution, documentation, and technical communication through hands-on engineering activities. Encourage ethical and innovative practices to design sustainable solutions for society and environmental challenges.					
Course Outcomes					
Apply multidisciplinary engineering concepts and techniques to design a sustainable working model. Utilize appropriate technological tools, effective time management to design and document the prototype as an individual or team member. Demonstrate the societal impact, and cost-effectiveness of the developed product with ethics.					
Module:1	Project Duration First and Second Semesters	20 hours			
Projects can be an experimental setup/model to realize the conceptual prototype, and validate its performance. Each project team should have 3 to 5 students from at least three different disciplines. The team must submit both the prototype and a technical report that explains each member's individual contribution.					
Total Lecture Hours:				20 hours	
Text Book(s)					
Reference Books					
YouTube , "https://www.youtube.com/watch?v=y4drM0vz3us ", University of Sydney, 1st Edition, 2020 YouTube, "https://uwaterloo.ca/engineering-ideas-clinic/about/engineering-design-days/first-year-design-days ", Waterloo Engineering, 1st Edition, 2017 YouTube, "https://www.youtube.com/watch?v=et6E7hWyS0g", University of UTAH, 1st Edition, 2015					

YouTube, " <https://www.youtube.com/watch?v=hbNTI1NGQ40>", Johns Hopkins University, 1st Edition, **2017**
 YouTube, "<https://www.youtube.com/watch?v=lnxl84LBRd0> ", University of Colorado Boulder, 1st Edition, **2017**
 YouTube, "<https://www.youtube.com/watch?v=uljTK226rsU> ", Olin College of Engineering, 2nd Edition, **2021**
 YouTube, " <https://www.youtube.com/watch?v=rHAzpXiO1bg>", Olin College of Engineering , 1st Edition, **2019**

Mode of Evaluation :

Recommended by Board of Studies :

23-05-2025

Approved by Academic Council : No. 78

12-06-2025

Course Code	Course Title	L	T	P	C
BACSE291	Innovative Design Project	0	0	4	2
Pre-requisite		Syllabus Version			
		1.0			
Course Objectives					
1. To apply engineering design principles to real-world problems. 2. To develop engineering models and prototypes using appropriate tools. 3. To conduct testing, validation, and optimization of designs. 4. To prepare technical reports and deliver professional presentations.					
Course Outcomes					
1. Apply engineering design methodology to solve practical problems, integrating creativity with technical feasibility. 2. Develop skills in modeling, simulation, prototyping, and testing, while evaluating solutions for performance, safety, cost-effectiveness, and sustainability. 3. Develop strong teamwork and project management skills 4. Communicate engineering solutions effectively through reports and presentations.					
Module	One Year Project				120 hours
Engineering design process, encompassing problem identification, research, modeling, prototyping, and testing. It concludes with the development of optimized prototypes, comprehensive technical documentation, and professional presentations, enabling graduates to integrate creativity with technical practicality and effectively communicate engineering solutions.					
Each project team should be minimum of 2 to 3 students.					
	Total hours:				120 hours
Text Books					
1	Jack, Hugh. Engineering design, planning, and management. Academic press, 2021.				
Reference Books					
1.	Ulrich, Karl, and Steven Eppinger. <i>EBOOK: Product Design and Development</i> . McGraw Hill, 2011.				
Mode of Evaluation: Reviews and Report Writing					
Recommended by Board of Studies					
Approved by Academic Council			No.	Date	

Course code	Course title	L	T	P	C
BAEEE101	Basic Engineering	3	0	2	4
Pre-requisite	NIL	Syllabus version			
		1.0			
Course Objectives					
- To introduce fundamental principles of major engineering disciplines. - To create awareness of interdisciplinary engineering systems and their applications					
Course Outcomes					
At the end of the course students will be able to					
- Analyse the electrical circuits, electrical motors and the role of power electronics in industrial applications. - Acquire foundational knowledge of electronic devices and communication systems. - Apply BIS standards to create basic 2D and 3D representations of engineering components. - Explain the fundamental principles and applications of manufacturing processes, energy conversion systems, and mechanical automation technologies. - Analyse real-world examples where bio-inspired solutions have led to breakthroughs in engineering.					
Module:1	Principles of Electrical Engineering: Circuits and Power conversion equipment	12 hours			
Electric circuit components, Mesh current analysis, Node voltage analysis, Thevenin's and Superposition theorems, Single phase AC circuits- RL, RC, RLC, Power and Energy Calculations, Power Factor, Basics of Electrical Safety and Earthing.					
Introduction to electro mechanical energy conversion, principle of operation of Electrical Machines - DC Motor, Induction motors, BLDC Motor and single phase Transformer, Concepts of Power Electronics and Industrial Applications of Electrical Drives (Qualitative Analysis)					
Module:2	Foundations of Electronics and Communication systems: Devices, Circuits, and Systems	8 hours			
Characteristics of PN Junction Diode, Zener Diode, BJT and MOSFET. Rectifiers and Voltage Regulators. Introduction to Operational Amplifiers. Electromagnetic Specturm. Elements of Communication Systems. Overview of cellular communication. Fundamentals of Satellite Communication and Radar.					
Module:3	Engineering Graphics and CAD	9 hours			
Introduction to Engineering Drawing – Importance and scope of engineering graphics, BIS standards for lines, lettering and dimensioning. Orthographic Projections – Principles of projection, first angle and third angle projections. Introduction to Projection of Solids- Isometric Projections and perspective projections. Freehand Sketching – Sketching of simple machine components and objects. Drawing of a simple residential floor plan as per IS SP7, Introduction to CAD.					
Module:4	Manufacturing Processs, Energy conversions and Mechanical Automation	9 hours			
Basic Metal Casting, Forming, Joining and Cutting Processes - Introduction to CNC Machining. Additive Manufacturing (3D Printing): Principles and Applications.					

Fundamentals of Thermal engineering systems, Internal Combustion Engine. Introduction to Power Plants. Introduction to Refrigeration and Air Conditioning. Basics of Fuel Cells and Sustainable Energy Technologies. Introduction to Mechanisms - Four-bar mechanism and its inversions- Hexapod mechanisms. Mechanical Components and Motion Control in mechanical systems. Introduction to Robotics and Automation – Pneumatic and hydraulic actuators.		
Module:5	Bio-Inspired Design in Engineering	5 hours
Introduction to Biomimicry- Core principles. Case Studies Across Disciplines: Velcro inspired by burrs, self-healing materials based on skin regeneration -Termite mound-inspired ventilation systems in green buildings-Insect-inspired drones and soft robotics-Neural networks based on the human brain -Identify a problem and brainstorm a bio-inspired solution.		
Module: 6	Contemporary Topics	2 hours
Lectures by Industry or Research experts		
	Total Lecture hours:	45 hours
Text Book(s)		
1.	Allan R. Hambley, “Electrical Engineering -Principles & Applications”, 2019, 6th Edition, Pearson Education	
2	R.L. Boylestad and L. Nashelsky, “Electronic Devices and circuit theory”, 11 th Edition, person Publications	
3	Louis E Frenzel Jr, “Principles of Electronics Communication Systems”, 2016, McGraw Hill Education.	
4	Bhatt N. D., Engineering Drawing, Charotar Publishing House Pvt. Ltd, 2019.	
Reference Books		
1.	John bird, “Electrical Circuit Theory and Technology”, 4th edition, Newnes Publications, Elsevier, 2010	
2.	George Kennedy,Brendan Davis, Srm Prasanna “Electronic Communication Systems”, McGraw Hills, 2011	
3.	Serope Kalpakjian, and Steven Schmid, Manufacturing Engineering and Technology, 2020, 8th edition, Pearson education.	
4.	Nag P. K., Basic & Applied Thermodynamics, 2009, 2nd Edition, McGraw Hill Education.	
5.	Rattan S. S, Theory of Machines, Tata McGraw Hill, 2019	
6.	Craig, John. J. (2008), Introduction to Robotics: Mechanics and Control, Second Edition, Pearson Education, New Delhi.	
List of Lab Experiments (Electrical and Electronics Engineering)		
1. Verification of KCL and KVL in an Electrical Circuit		
2. Verification of Mesh and Nodal Analysis in an Electrical Circuit		
3. Time domain analysis of a single phase series RL Circuit		
4. Measurement of Power and power factor in a single phase RL Circuit using 3- volt meter method		
5. Speed Control of a PMDC Motor with DC-DC Buck Converter		
6. Measurement of Earth Resistance using an Meggar		

7. Analysis of a Zener Diode Voltage Regulator
8. Single-Phase Full-Wave Diode Rectifier with Resistive Load
9. Design and Testing of a Light Dimmer Circuit Using a Darlington Pair.
10. Create a 2D profile using basic sketch tools and apply appropriate geometric and dimensional constraints.
11. Develop a simple 3D solid model using features such as extrude, revolve, cut, fillet, chamfer, and shell.
12. Generate detailed 2D engineering drawings of simple parts from 3D solid models, including multiple views, dimensions, and annotations.

Mode of Evaluation: CAT, Assignment, Quiz, Seminar, Project, FAT

Recommended by Board of Studies	23-05-2025		
Approved by Academic Council	No. 78	Date	12-06-2025

Course Code	Course Title	L	T	P	C
BAENG101	Technical English Communication	3	0	2	4
Pre-requisite	NIL	Syllabus Version			
		1			
Course Objectives					
To enable learners to decipher the tenets of general and interpersonal communication To facilitate application of grammar skills in academic and general situations To help foster learning of productive skills for communicative competence					
Course Outcomes					
Enhance writing skills for better publication Identify the basic concepts related to various aspects of communication Apply grammatical rules in academic and real-life contexts Demonstrate analytical reading skills in terms of deciphering research articles Illustrate qualitative writing skills by drafting emails and academic documents					
Module:1	Introduction to Technical Communication	6 hours			
The Nature of Technical Communication Taxonomy of Technical Writing-Scientific Writing, Technical Reporting Business Communication 5Cs of Technical Writing Activity: Applying these concepts to answer conceptual questions					
Module:2	Grammar	9 hours			
Concord Tense Conditionals Voice Transitions and Linking words Activity: Error Detection					
Module:3	Reading	10 hours			
Analysing definitions – Types of definitions, Methods for Expanding Definitions Reading Comprehension – Drawing Inferences from Scientific Texts					

Structure of a Research Article Analysing a Research Article Activity: Reading a research article		
Module:4	Writing	12 hours
Research Writing: Structure of a Review Paper Types of Reviews Literature Review Referencing Style - IEEE, APA Activity: Writing a literature review		
Module:5	Interpersonal Communication	6 hours
Cross-cultural Communication Interpersonal Communication Leadership Styles Belbin's Team Roles Negotiation Skills Thomas-Kilmann Modes of Conflict Management Statement of Purpose Activity: Case study Analysis		
Module:6	Contemporary Topics	2 hours
Activity: Guest lectures from Industry and, Research and Development Organizations		
Total Lecture Hours:		45 hours
Text Book(s)		
Lannon, J.M. & Gurak, L.J., " Technical communication ", Pearson, 7 th Edition, 2025 Shoba, K.N. & Sam, P., " Technical English: A workbook ", Cambridge University Press, 2018		
Reference Books		
Alfred, G.J., Brusaw, C.T., & Oliu, W.E., " Handbook of technical writing ", Bedford St Martins, 11 th Edition, 2015		

Gross, A., Hamlin, A., Merck, B., Rubio, C., Naas, J., Savage, M., & Desilva, M. ,
"Technical writing." , Open Oregon Educational Resources, **2017**
 Laplante, T.A. , **"Technical writing: A practical guide for engineers, scientists, and nontechnical professionals."**, CRC Press, 2nd Edition, **2019**
 Markel, M. & Selber, S.A. , **"Technical communication."**, Bedford St Martins , 12th Edition, **2018**

Indicative Experiments

1. Vocabulary and Proof Reading

Verbal Traps in Technical Communication: Cliches- Malapropisms-
 Erroneous Heterographs- The Laziness of “very”

Proofreading Symbols

Proofreading a Short Passage

Activity: Interactive Worksheets, Proof Reading

4 hours

2. Intensive Listening

Listening to Podcasts

Viewing Documentaries

Activity: Listening and Note-taking/ Summarising

8 hours

3. Speaking

Role Play

Storytelling

Group Discussion

Video Resume

Presentations

Activity: Individual and group presentations

8 hours

4. Reading

Elements of Fiction-Plot-Character-Setting-Theme-Point of View

Appreciation of a text-The Ant and the Grasshopper by Somerset Maugham

Activity: Story/ Book Review

6 hours

5. Writing

Blog Writing

Transcoding

4 hours

Statement of Purpose		
Creating a Portfolio Activity: Blog/ Portfolio Design		
Total Laboratory Hours:		30 hours
Mode of Evaluation : Continuous Assessment Test, Digital Assignment, Quiz, Final Assessment Test, Lab Continuous Assessment, Lab Final Assessment		
Recommended by Board of Studies :		16-05-2025
Approved by Academic Council : No. 78		12-06-2025

Course Code	Course Title	L	T	P	C
BAHUM101	India Studies	1	0	0	1
Pre-requisite	Nil	Syllabus version			
		1.0			
Course Objectives					
1. To introduce students to the foundations of India’s traditional knowledge systems, cultural heritage, and civilizational values.					
2. To develop an understanding of India’s scientific, technological, and philosophical traditions, and their relevance to contemporary policy frameworks like NEP 2020.					
3. To provide a conceptual and structural understanding of the Indian Constitution, its principles, governance mechanisms, and contemporary significance.					
Course Outcome					
On completion of this course the students will be able to:					
1. Explain the core concepts of India’s traditional knowledge systems, culture, civilization, and their historical significance.					
2. Analyse India’s scientific, technological, and philosophical traditions and their influence on the development of the Indian Constitution and governance structures.					
3. Evaluate the contemporary relevance of Indian knowledge systems and constitutional provisions in addressing modern societal challenges.					
Module:1	Traditional Knowledge, Culture & Civilization	3 hours			
Traditional Knowledge: definition, nature, characteristics, scope and importance - Kinds of traditional knowledge: Vedas, Upanishads, Śāstras - Traditional knowledge vs. Indigenous knowledge vs. Western knowledge - Introduction to culture and civilization -Features of Indian culture.					
Module:2	Science, Technology & Knowledge Traditions in India	3 hours			
Scientific and technological developments in Ancient, Medieval, and Modern India - Importance of biodiversity in India - <i>Arthashastra</i> , <i>Sukraniti</i> , <i>Kamandaka Niti</i> - Contemporary need for incorporating Indian knowledge systems (IKS) - Indian Knowledge System in NEP 2020.					
Module:3	Introduction to the Indian Constitution	3 hours			
Meaning, nature, and significance of the Constitution - Historical background: Colonial period, freedom struggle & Constituent Assembly - Salient features of the Indian Constitution - Preamble: Philosophy, ideals, and values - Sources of the Indian Constitution.					
Module:4	Rights, Duties & Governance Structure	3 hours			
Fundamental Rights - Directive Principles of State Policy - Fundamental Duties - Union Government: President, Prime Minister, Parliament - State Government: Governor, Chief Minister, State Legislature - Federalism.					
Module:5	Constitutional Processes	2 hours			
Amendments to the Constitution - Judicial System - Constitutional bodies - Social justice provisions: Reservations, welfare policies.					
Module:6	Contemporary relevance	1 hours			
Total Lecture Hours		15 hours			
Text Book(s)					

1.	Shikha Jain, Parul G. Manjul & Somya Joshi (2020). <i>Traditional Knowledge Systems and Cultural Heritage</i> . Aryan Books International.		
2.	Durga Das Basu (2018). <i>Introduction to the Constitution of India</i> (23rd ed.). LexisNexis.		
Reference Books			
1.	Bidyut Chakraborty & Rajendra Kumar Pandey (2008). <i>Indian Government and Politics</i> . SAGE Publications.		
2.	Amit Jha (2024). <i>Traditional Knowledge System in India</i> . Atlantic Publishers & Distributors.		
3.	Granville Austin (1966). <i>The Indian Constitution: Cornerstone of a Nation</i> . Oxford University Press.		
Mode of Evaluation: Quiz and FAT.			
Recommended by Board of Studies		03-11-2025	
Approved by Academic Council		No. 80	Date 20-11-2025

Course Code	Multivariable Calculus and Differential Equations	L	T	P	C
BAMAT101		3	0	2	4
Pre-requisite		Syllabus Version			
		1.0			
Course Objectives					
1. To provide essential foundational knowledge in engineering mathematics, supporting engineers and scientists in mastering advanced mathematical concepts relevant to their field 2. To enhance problem-solving skills for engineers and scientists by mastering vector calculus principles, including gradient, divergence, curl, and fundamental theorems, for real-world engineering applications. 3. To develop expertise in solving differential equations through various techniques, enabling engineers and scientists to address complex challenges in system modeling and simulations.					
Course Outcomes					
At the end of the course, the student is able to: 1. evaluate partial derivatives and solve optimization problems involving several variables with or without constraints. 2. solve multiple integrals in cartesian, polar, cylindrical and spherical coordinates. 3. understand gradient, directional derivatives, divergence, curl, Green’s, Stokes and Gauss Divergence theorems. 4. utilize different solution methods to obtain the solution for second-order ordinary differential equations. 5. demonstrate proficiency in solving linear and nonlinear first-order partial differential equations.					
Module:1	Functions of Several Variables	8 hours			
Functions of two variables- Partial derivatives –total differential -Jacobian and its properties , Taylor’s expansion for two variables–maxima and minima–constrained maxima and minima Lagrange’s multiplier method. Applications: <i>Jacobian matrix for feature sensitivity analysis. Constrained optimization in Cloud computing.</i>					
Module:2	Multiple Integrals	9 hours			
Evaluation of double integrals–change of order of integration–change of variables between Cartesian and polar co-ordinates, - Evaluation of triple integrals - change of variables between Cartesian and cylindrical and spherical co-ordinates, Applications: <i>Change of variables for object recognition. Multiple integrals in Image analysis for density and moments.</i>					
Module:3	Vector Differentiation and Integration	10 hours			
Scalar and vector valued functions – gradient, directional derivative, divergence, and curl – scalar and vector potentials. Line, surface and volume integrals - Statement of Green’s, Stoke’s and Gauss divergence theorems - Verification and evaluation of vector integrals using them, Applications: <i>Vector derivatives for Electromagnetic simulation in Computer Aided Design. Vector integrals in Antenna design.</i>					
Module:4	Ordinary Differential Equations	8 hours			
Linear second-order ordinary differential equations with constant coefficients – Solutions of ODE by Method of undetermined coefficients – Method of variation of parameters – Solutions of Cauchy-Euler and Cauchy-Legendre differential equations – Applications of linear second-order differential equations.					

Applications: <i>Steady-state response of input signal in Digital Signal Processing, Differential equations for LCR Circuit Simulation.</i>			
Module:5		Partial Differential Equations	
		8 hours	
Formation of PDE- solution of first order partial differential equation of the forms: $F(p,q)=0$, $F(z,p,q)=0$, $F(x,p)=G(y,q)$ and Clairaut's form - Lagrange's equation: $Pp+Qq = R$, Solution of a linear first order partial differential equation by separation of variables, Applications: <i>Lagranges equation for flow modelling, Separation of variables for Analyzing CPU temperature.</i>			
Module:6		Contemporary Topics	
		2 hours	
		Total Lecture hours:	
		45 hours	
Text Books			
1	Erwin Kreyszig, Advanced Engineering Mathematics, 10 th Edition, Wiley India, 2015.		
2	B.S. Grewal, Higher Engineering Mathematics, 44 th Edition, Khanna Publishers, 2020		
Reference Books			
1.	George B. Thomas, D. Weir and J. Hass, Thomas' Calculus, 15 th edition, Pearson, 2023.		
2.	Dennis G. Zill, Advanced Engineering Mathematics, 6th Edition, Jones & Bartlett Publishers, 2018.		
Mode of Evaluation: Quizzes, Assignments, CATs and FAT			
List of Experiments (Indicative)			
1.	Introduction to Calculus through MATLAB – Symbolic Computations		
2.	Plotting and visualizing curves and surfaces		
3.	Evaluating maxima and minima of functions of several variables		
4.	Applying Lagrange multiplier optimization method		
5.	Evaluation of volume under a surface by double Integral		
6.	Evaluating triple integrals		
7	Demonstration of gradient, divergence and curl		
8	Evaluating line integrals in vectors		
9	Solution of Linear differential equations		
10	Solution of Partial differential equations		
		Total Lab hours:	
		30 hours	
Text Book			
1	Ronald L. Lipsman , Jonathan M. Rosenberg, Multivariable Calculus with MATLAB with applications to Geometry and Physics, Springe, 2017.		
Reference Book			
1	Dean G. Duffy, Advanced Engineering Mathematics with MATLAB, CRC Press, 2022.		
Mode of Evaluation: Assignments and FAT			
Recommended by Board of Studies		14-May-2025	
Approved by Academic Council		No.	Date

Course Code	Course Title	L	T	P	C
BAMAT207	Probability and Statistics	3	0	2	4
Pre-requisite	BAMAT101	Syllabus version			
		1			
Course Objectives					
1. Apply probability and statistical methods to solve engineering problems, including system reliability, risk assessment, and quality control. 2. To develop predictive models and analyze data using probability distributions correlation, regression, and hypothesis testing for engineering applications. 3. To design experiments and interpret variability using ANOVA and structured experimental designs to optimize engineering systems and innovations.					
Course Outcomes					
At the end of the course, the students will be able to:					
1. Apply probability concepts, including axioms, conditional probability, and Bayes' theorem, to solve real-world problems. 2. Implement probability distributions to model random variables and analyze statistical properties. 3. Utilize hypothesis testing methods to evaluate statistical significance in experiments. 4. Demonstrate correlation and regression techniques for data analysis and predictive modeling. 5. Analyze ANOVA methods and experimental designs to interpret variability in datasets.					
Module: 1	Probability and Random Variables	11 hours			
Basic Probability- Axioms, probability spaces, conditional probability, Bayes' theorem. Random Variables and Distributions - Discrete and Continuous random variables, probability mass functions, probability density functions. Joint Distributions - Joint, marginal, and conditional distributions. Expectation and Variance – Moments, variance, covariance, statistical independence. Functions of one-dimensional random variables. Spam filtering, password strength estimation, disease prediction, and network packet loss analysis.					
Module: 2	Probability Distributions	9 hours			
Bernoulli, Binomial, Poisson, Geometric, Negative Binomial, Uniform, Normal, Exponential, Gamma, and Weibull distributions. Central limit theorem, Sampling Distributions – t, F, Chi-square (Concept Only). Modelling software bug occurrences, estimating download failure rates, and analysing system response times.					
Module: 3	Testing of Hypothesis	8 hours			
Formulating and testing hypotheses, Simple and composite hypotheses, Type I and Type II errors. Parametric Tests – Z-test, <i>t</i> -test and paired sample <i>t</i> -test for single and two population means and <i>F</i> -test for difference of two population variances, Chi-square test for Goodness of fit and independence of attributes. Confidence Intervals - Constructing and interpreting confidence intervals. Testing software performance, comparing algorithm accuracies and validating sensor data quality.					
Module: 4	Correlation and Regression	9 hours			
Pearson's correlation and Spearman's rank correlation coefficient. Multiple and partial correlation. Simple and Multiple linear regression: model, assumptions, estimation and interpretation of regression coefficients. Model diagnostics and validation. Predicting software defect counts, estimating CPU load from system parameters, and forecasting user traffic in web applications.					
Module: 5	Analysis of Variance (ANOVA)	6 hours			

One-way and Two-way Analysis of Variance – CRD, RBD and LSD. Comparing classification model accuracies across datasets, evaluating the effect of hyperparameter settings on model performance and analysing query response times across different database indexing strategies.		
Module: 6	Contemporary topics	2 hours
Total Lecture hours		45 hours
Text Book(s)		
1	Introduction to Probability and Statistics for Engineers and Scientists, Sheldon M. Ross, 6 th Edition, Academic Press Inc., ISBN-978-0128243466, 2021.	
2	Richard Arnold Johnson, Irwin Miller, John E. Freund- Probability and Statistics for Engineers, Pearson Education Ltd., 9 th Edition, 2018.	
Reference Book(s)		
1	An Introduction to Probability and Statistics, V. K. Rohatgi and A. K. Md. Ehsanes Saleh, John Wiley & Sons, 3 rd Edition, 2015.	
2	Applied Statistics and Probability for Engineers" by Douglas C. Montgomery and George C. Runger, 7 th Edition, John Wiley & Sons, 2018.	
3.	Michael Baron, Probability and Statistics for Computer Scientists, 3rd Edition, CRC Press / Chapman & Hall, 2019.	
Mode of evaluation: CAT / Quiz / Case study/Study-oriented Project / Final Assessment Test.		
Embedded Lab – Indicative Experiments		
1	Introduction, understanding data types, importing and exporting data sets.	2 hours
2	Exploratory Data Analysis - Tabulation and Data Visualization - Create histograms, box plots, and scatter plots to visualize the data distributions and relationships.	2 hours
3	Exploratory Data Analysis - Simulation and Descriptive Statistics - Summarize data using central tendency, variability, skewness and kurtosis.	2 hours
4	Fitting of Probability Distributions – Discrete and Continuous	2 hours
5	Testing of Hypothesis and Confidence Intervals – Z and t-test of hypothesis	2 hours
6	Testing of Hypothesis and Confidence Intervals – F and Chi-square test of hypothesis	2 hours
7	Simple linear Regression and Correlation Analysis – Modelling, Estimating and Interpreting correlation and regression coefficients.	4 hours
8	Multiple Linear Regression and Correlation Analysis – Modelling, Estimating and interpreting correlation and regression coefficients.	4 hours
9	Performing One-way ANOVA – CRD - Modelling, Estimation and interpretation of Coefficients.	4 hours
10	Performing Two-way ANOVA –RBD & LSD- Modelling, Estimation and interpretation of Coefficients.RBD and LSD.	4 hours
Total Lecture hours		30 hours
Text Book(s)		
1	Probability and Statistics with R, Maria Dolores Ugarte, Ana F. Militino, and Alan T. Arnholt, 2 nd Edition, Chapman and Hall/CRC, 2016.	
Reference Book(s)		
1	The Book of R: A First Course in Programming and Statistics, Tilman M. Davies, No Starch Press, 1 st Edition, 2016.	
2	Applied Statistics: Theory and Problem Solutions with R, Dieter Rasch, Rob Verdooren,	

	and Jürgen Pilz, Wiley, 1 st Edition, 2019.		
Mode of evaluation: Lab Continuous Assessment and Lab Final Assessment Test.			
Recommended by Board of Studies	14.05.2025		
Approved by Academic Council	No. 78	Date	12.06.2025

Course Code	Course Title	L	T	P	C
	Engineering Physics	3	0	2	4
Pre-requisite		Syllabus Version			
		1.0			
Course Objectives					
1. Understand the origin and importance of quantum mechanics. 2. To study the principles of quantum mechanics 3. To apply quantum mechanics for the understanding of quantum computing					
Course Outcomes					
At the end of this course, the student will be able to 1 Identify limitations of classical physics through experimental observations. 2 Apply matrix algebra and Dirac notation for the understanding of quantum mechanical problems involving linear operators, eigenvalues and eigenvectors. 3 Solve the particle in 1-D and 3-D potential box problem using the principles of quantum mechanics. 4 Apply fundamental concepts of quantum states and operators to understand the principles of quantum computing. 5 Demonstrate quantum and optical phenomena through experiments and quantum operations through simulations.					
Module:1	Wave-Particle Duality				8 hours
Dual nature of radiation – Young’s double slit experiment – Blackbody radiation – Planck’s hypothesis – de Broglie hypothesis – Wavefunction – Stern-Gerlach experiment.					
Module:2	Mathematical Foundations of Quantum Mechanics				10 hours
Introduction to linear vector space – Basis vectors – Orthonormal sets – Hilbert space – Representation of quantum states using Dirac notation – Inner and outer products – Tensor product of vector spaces – Linear operators – Matrix algebra – Hermitian, Unitary and Projection operators – Eigenvalues and eigenvectors – Pauli matrices – Commutation relations.					
Module:3	Postulates of Quantum Mechanics				8 hours
Observables $\propto$ Expectation values $\propto$ Measurement in Quantum Mechanics – Sequential Stern-Gerlach Experiment – Time-dependent and time-independent Schrödinger equations.					
Module:4	Applications of Quantum Mechanics				7 hours
Particle in a one-dimensional potential well – Extension to three-dimensional potential wells – Energy eigenvalues and eigenfunctions – Degeneracy of energy levels – Quantum tunneling phenomenon – Tunneling probability					
Module:5	Elements of Quantum Computing				10 hours
Introduction to qubits – Single qubit states and the Bloch Sphere – Two-qubit systems – Quantum entanglement and Bell states – Single-qubit gates: Pauli and Hadamard – Two-qubit gates: CNOT – Generation of entangled states.					
Module:6	Contemporary Topics				2 hours
	Total Lecture hours:				45 hours
Text Books					
1	D. J. Griffiths, Introduction to Quantum Mechanics, 2018, 3rd Edition, Cambridge University Press, India.				
2	A. C. Philips, Introduction to Quantum Mechanics, 2014, Wiley India.				
Reference Books					

1.	Robert Eisberg and Robert Resnick, Quantum Physics, 2004, 2nd Edition. Wiley India.		
2.	Michael A. Nielsen and Isaac L. Chuang, Quantum Computation and Quantum Information, 2010, Cambridge Universities Press, India.		
Mode of Evaluation: Quiz, Assignment, CAT and FAT			
List of Challenging and Mini Projects - CHAMP (Indicative)			
1.	Exploring the wave nature of electrons through diffraction.		
2.	Determine the fundamental quantum constant through the analysis of semiconductor junction characteristics.		
3.	Elemental analysis through photoelectron spectroscopy.		
4.	Unveiling stellar composition through quantum simulations of hydrogen spectral lines.		
5.	Modeling time dependent behaviour of quantum wave packets.		
6.	Designing a solar cell based renewable energy device circuits for electric power generation.		
7.	Analyze photodiode I–V characteristics under different light intensities to extract device parameters.		
8.	Visualize the uncertainty principle by simulating position-momentum evolution of quantum wave packets.		
9.	Simulate the Schrödinger equation to demonstrate quantum superposition and state collapse.		
10.	Model tunneling through barriers of different profiles and study dependence on particle energy.		
11.	Visualize the Bloch sphere representation of a single qubit through simulation.		
12.	Demonstrate the fundamental operations of single-qubit quantum gates via simulation.		
13.	Simulating a 2-Qubit Quantum Gate (CNOT or Bell State Creation)		
14.	Simulate the superposition state of a single qubit using the Hadamard.		
15.	Generate and analyze Bell states using quantum circuit simulation.		
Total Laboratory Hours			30 hours
Text Book(s)			
1	Michael A. Nielsen & Isaac L. Chuang, Quantum Computation and Quantum Information, 2010, Cambridge University Press, India		
Reference Books			
1	Aurthur Beiser, Concepts of Modern Physics, 2009, McGraw - Hill, 6th Edition, India		
Mode of assessment: Continuous assessment, FAT, Oral examination			
Recommended by Board of Studies		DD-MM-YYYY	
Approved by Academic Council		No. xx	Date DD-MM-YYYY

Course Code	Course Title	L	T	P	C
BASTS101	Qualitative and Quantitative Skills Practice I	3	0	0	1
Pre-requisite	Nil	Syllabus Version			
		1			
Course Objectives					
1. To enhance students' quantitative, reasoning, verbal, and life skills through problem-solving and critical thinking.					
Course Outcomes					
1. Apply quantitative and logical reasoning techniques such as speed math, data arrangement, and analytical problem-solving to solve aptitude and reasoning-based problems efficiently. 2. Demonstrate effective life skills, including profile building, decision making, critical thinking, and communication skills for personal and professional growth in placement and career contexts.					
Module:1	Speed Math	8 hours			
Addition and Subtraction of Bigger Numbers - Square and square roots-Cubes and cube roots-Vedic Math - Multiplication Shortcuts -Multiplication of 3 and higher digit numbers-Simplifications - Comparing fractions – Calculation Shortcuts - Divisibility rules					
Module:2	Percentages, Simple and Compound Interest	6 hours			
Percentage -Increase and Decrease – Dealing with Fractions and Decimals - Simple Interest -Compound Interest - Relation between Simple and Compound Interest					
Module:3	Profit and Loss, Partnership, Time, Speed and Distance	10 hours			
Profit and Loss – Partnership- Averages and Weighted Averages- Mixtures and Allegations-Basics- Relative Speed- Average Speed- Problems on Trains -Problems on Boats and Streams- Problem on Races					
Module:4	Data Arrangements, Blood relations, Cryptarithmic and Attention to detail	10 hours			
Linear Arrangement -Circular Arrangement-Multi-dimensional Arrangement- Blood relations - Crypt Arithmetic Type: Addition, Multiplication - Attention to detail					
Module:5	Reading Comprehension and Vocabulary	6 hours			
Types of questions - Comprehension Strategies - Synonyms – Antonyms – Analogy - Confusing words					

Module:6	Profile Building, Professional Networking and Resume writing	5 hours
Profile building-Learn how to create a strong personal and professional profile - Identify elements of a resume, portfolio, and LinkedIn profile, Importance of professional networking		
Total Lecture Hours:		45 hours
Text Book(s)		
Dr R. S. Aggarwal," Quantitative Aptitude for Competitive Examinations ", Chand & Company Ltd, ISBN 978-9358705010, Revised Edition, 2024-25		
M. Tyra, " Magical Book on Quicker Maths ", BSC Publishing Co. Private. Ltd, ISBN 978-8190458924,5th Edition, 2024		
Reference Books		
Stephen R. Covey," The 7 Habits of Highly Effective People ", Simon & Schuster, ISBN 978-1982137274, 30th Anniversary Edition, 2020		
Stella Cottrell, " Critical Thinking Skills: Effective Analysis, Argument and Reflection ," Bloomsbury Academic (Palgrave Macmillan), ISBN 978-1350322585, 4th Edition, 2023		
Mode of Evaluation: Continuous Assessment Test, Quiz, Final Assessment Test		
Recommended by the Board of Studies:		
Approved by Academic Council:		

Course Code	Course Title	L	T	P	C
BASTS102	Qualitative and Quantitative Skills Practice II	3	0	0	1
Pre-requisite	Nil	Syllabus Version			
		1			
Course Objectives					
1. Equip learners with key life skills and problem-solving, while preparing them for career opportunities through training in quantitative aptitude, logical reasoning, verbal ability and resume building.					
Course Outcomes					
1. Apply time management techniques, write professional emails, and prepare well-structured reports to enhance productivity and communication. 2. Solve quantitative problems involving time and work, probability, and logical reasoning with accuracy and confidence.					
Module:1	Permutation and Combinations, Probability	6 hours			
Fundamentals of Counting Principle, Computation of Permutations – Computation of Combinations – Circular Permutation and Probability					
Module:2	Time and Work, Logarithms, Progression	8 hours			
Work with different efficiencies - Pipes and Cisterns - Work equivalence - Division of wages - Advanced application problems with complexity in calculation - Logarithms, Arithmetic Progression - Geometric Progression and Harmonic Progression					
Module:3	Logical Reasoning	9 hours			
Coding and decoding - Visual Reasoning – Clocks – Calendars - Direction Sense - Cubes					
Module:4	Number System and Algorithmic Thinking	10 hours			
Power Cycle - Reminder Cycle - Applications of number system- Introduction to Algorithmic Thinking and Problem-solving, thinking with numbers, thinking with visuals and finding the shortest path, Branching and repetitive problems					
Module:5	Verbal Ability	7 hours			
Sentence Correction - Subject Verb agreement – Modifiers – Parallelism - Pronoun Antecedent Agreement - Verb Time sequence – Comparisons – Prepositions - Determiners					

Module:6	Grooming, Impression Management and Personal Interview	5 hours
Grooming- Dressing Etiquette-Impression Management - Building a Positive Personal Brand - Body Language & Non-Verbal Cues -Types of Interviews – HR Interview, Telephonic Interview, Panel Interview		
Total Lecture Hours:		45 hours
Text Book(s)		
R.S. Aggarwal, " Quantitative Aptitude for Competitive Examinations ", S. Chand Publishing, ISBN 978-8121924624, Revised Edition, 2024-25		
John Sonmez, " Soft Skills: The Software Developer's Life Manual ", Manning Publications, ISBN 978-1617292392, 1st Edition, 2014		
Reference Books		
R.S. Aggarwal., " A Modern Approach to Logical Reasoning ", S. Chand Publishing, ISBN 978-9352833227, 1st Edition, 2018		
Richard Paul & Linda Elder, " Critical Thinking: Tools for Taking Charge of Your Professional and Personal Life ", Pearson ISBN 978-0132180915, 2nd Edition, 2014		
Mode of Evaluation: Continuous Assessment Test, Quiz, Final Assessment Test		
Recommended by the Board of Studies:		
Approved by Academic Council:		

Course Code	Course Title	L	T	P	C
BACSE103	Computation Structures	3	0	2	4
Pre-requisite		Syllabus Version			
		1.0			
Course Objectives					
1. To Understand and design of digital logic systems ranging from simple combinational circuits to sequential designs. 2. To impart the knowledge of data representation and to understand the implementation of arithmetic algorithms in a typical computer. 3. To introduce and explore the fundamental concepts of microcontrollers and techniques of parallel processing.					
Course Outcomes					
1. To design and optimize minimal combinational circuits. 2. To analyze and design sequential circuits utilizing various types of flip-flops. 3. To analyze different instruction formats, addressing modes and validate efficient algorithms for fixed-point arithmetic operations. 4. To understand the concept of memory organization and I/O fundamentals 5. To understand the microcontroller architectural designs and parallel computing systems.					
Module:1	Digital Systems and Combinational Circuits	7 hours			
Introduction to Digital systems: Number system, Data representation: Fixed and Floating point, Logic Gates, Simplification of Boolean function using K-Map, Design of combinational circuit: Adder, Carry look-ahead adder, Encoder and Decoder, Multiplexer and Demultiplexer.					
Module:2	Sequential Circuits	9 hours			
Flip Flops, Sequential circuit design and Analysis: Finite State Machines-Mealy and Moore, Registers, and Counters: Synchronous and Asynchronous, Timing Sequences.					
Module:3	Computer Architectures and Arithmetic Algorithms	10 hours			
Introduction to Von Neumann machine and Harvard architecture, Fixed point arithmetic operations: Multiplication (Booths, Modified Booths), Division (restoring and non-restoring). Instruction set architecture, Instruction formats, Instruction types, addressing modes, Instruction cycle, Single cycle Datapath design, Multicycle Datapath design.					
Module:4	Memory and I/O Peripherals	8 hours			
Memory Organization, Memory Hierarchy, Memory Design, Cache Memory-Mapping Policies, Replacement Algorithms, I/O Fundamentals- programmed I/O and Interrupt driven I/O, Direct Memory Access, Shared Memory Architectures.					
Module:5	Advanced Architecture	9 hours			
Introduction to Microcontroller, ARM Architecture Versions– Instruction Set – Stacks and Subroutines. Parallel processing Techniques: Instruction Level parallelism, and Thread Level Parallelism.					
Module:6	Contemporary Issues	2 hours			
		Total Lecture hours: 45 hours			
Text Books					

1.	M. Morris Mano, Digital Logic and Computer Design, Fifth Edition, Pearson India Education Publishers, 2019
2.	Patterson, David A., and John L. Hennessy, Computer organization and design ARM edition: the hardware software interface, First Edition, Morgan kaufmann, 2016.
Reference Books	
1.	William Stallings, Computer Architecture and Organization-Designing for Performance, Eleventh edition, Pearson Education series, 2022.
2.	Ananth Grama, Anshul Gupta, George Karypis and Vipin Kumar, Introduction to Parallel Computing, 2nd Edition, Pearson, 2008.
Mode of Evaluation: Quiz, Assignment, CAT and FAT	
List of Experiments (Indicative)	
1	Combinational Circuit Design - Full Adder, Full Subtractor, Binary Parallel Adder. Consider there are two counter circuit employed in a food mall one at the front door near the staircase and another beside the elevator, to count the number of customers. At time 't' the number of customers entered through staircase and elevator are counted by the two counter circuits as 2 and 3 respectively. Design a suitable combinational circuit to find the sum of these two-counter output at time 't'.
2	Combinational Circuit Design - Decoder, Encoder. Build a decoder with three input lines but with only six output lines. If the value of the input corresponds to 6 or 7, then all output lines should be asserted to signal an error.
3	Combinational Circuit Design - MUX, DMUX. You are required by your manager to design a 4-bit prime number checker – you want to output 1 if the binary number is primer else 0 (note 0 and 1 are not prime numbers). a. Show the truth table for the primer number checker. b. Design the circuit using single 4x1 MUX and a minimal number of extra AND, OR or NOT gates if needed (i.e., no NAND, NOR, XOR or XNOR, etc.). Show your work including any simplifications done. You must show the logic diagram with all the pins of the mux labeled properly. State any assumptions that you make.
4	Sequential Circuit Design - Flipflop, Shift Register. Use a SIPO shift register to display a binary counter on 8 LEDs. Each second, the counter increments by 1, and the value is sent serially to the register.
5	Sequential Circuit Design - Synchronous and Asynchronous Counters. A bank queuing system has a capacity of 5 customers which serves on first come first served basis. A display unit is used to display the number of customers waiting in the queue. Whenever a customer leaves the queue, the count is reduced by one and the count is increased by one if a customer joins a queue. Two sensors (control signals) are used to sense customers leaving

	and joining the queue respectively. Design a circuit that displays the number of customers waiting in the queue in binary format using LEDs. Binary '1' is represented by LED glow and '0' otherwise.		
6	Introduction to Microcontroller -To design and implement a simple calculator		
7	Interfacing with GPIO - To interface with GPIO pins by controlling an LED and detecting a button press using a microcontroller.		
8	Interfacing Bluetooth module with microcontroller - Connect a Bluetooth module (e.g., HC-05) to the microcontroller and send/receive simple text messages using serial window.		
9	Introduction to parallel programming using OpenMP - Write a OpenMP program to find the largest of three numbers and smallest of three numbers using explicit thread identification.		
10	OpenMP work sharing constructs - Write a program to perform matrix operations and compare the sequential and parallel execution time.		
11	OpenMP synchronization constructs- Demonstrate an example by using Single, Master, Barrier, and critical constructs of OpenMP.		
12	Using Performance Analyzer tools find the execution time and memory usage of a parallel program.		
Total hours:			30 hours
Mode of Evaluation:			
Recommended by Board of Studies			
Approved by Academic Council		No.	Date

Course Code	Course Title	L	T	P	C
BACSE104	Structured and Object-Oriented Programming	2	0	4	4
Pre-requisite	NIL	Syllabus Version			
		1			
Course Objectives					
1. To foster a strong foundation in structured programming using C and object-oriented programming using C++, with a focus on memory management, pointers, and dynamic memory allocation for real-world applications					
2. To facilitate modular, reusable, and efficient software development through functions, user-defined data types, and object-oriented design principles, emphasizing best programming practices.					
3. To build hands-on programming skills and structure problem-solving abilities by designing and implementing applications addressing real-world scenarios.					
Course Outcomes					
1. To analyze and implement basic programming constructs, decision-making statements, and loops in C/C++					
2. To apply modular programming techniques by utilizing functions, structures, and files for efficient problem-solving in real-world applications.					
3. To apply pointers and dynamic memory allocation techniques to manage data efficiently in C/C++ programs.					
4. To demonstrate object-oriented principles (encapsulation, inheritance, and polymorphism) to design structured and scalable applications.					
5. To develop efficient and scalable solutions and to apply advanced programming paradigms, including exception handling and the Standard Template Library (STL) with set, list, and map.					
Module:1	Fundamentals of C Programming	6 hours			
Structure of C Program, Compiler Vs Interpreter, Variables, Reserved words, Data types, Operators - precedence and associativity, Type conversions, I/O statements, control structures - conditional and looping statements, 1-D and 2-D Arrays, String operations, Functions – user defined functions - call by value and call by reference - recursion, storage classes - scope- visibility - lifetime of variables.					
Module:2	Pointers Structures and File Handling in C	7 hours			
Pointers - pointer arithmetic, Pointers with Arrays and functions, function pointers, Dynamic Memory Allocation, Structures- array of structures - nested structures - structures with functions - self-referential structures - bit fields - pointers to structures, Unions- comparison with structures, File operations- handling text and binary files – read - write - seek, command-line arguments.					
Module:3	Introduction to Object Oriented Programming	5 hours			

Features of object-oriented programming, classes and objects, access specifiers, constructors and destructors, <i>this</i> pointer, Static: data members - member functions -objects, constant member functions, inline member functions, friend functions and friend classes, scope resolution operator, lambda expression		
Module:4	Inheritance and Polymorphism in CPP	6 hours
Types of inheritance - single, multiple, multilevel, hierarchical, multipath inheritance, ambiguity in multipath inheritance, Constructors under inheritance, Function overloading, Operator overloading, Function overriding in Dynamic Polymorphism, Virtual functions, Virtual destructors, Pure virtual functions - Abstract classes.		
Module:5	Exceptions Templates and STL in CPP	4 hours
Exception handling - try, catch, throw constructs, handling runtime errors, custom exception, re-throwing exceptions for hierarchical error management, Function templates and Class templates, Introduction to type parameters and basic template specialization, Standard Template Library (STL) containers - vector, list, set, and map. Iterators for traversing containers - application of standard STL algorithms		
Module:6	Contemporary Issues	2 hours
Total Lecture Hours:		30 hours
Text Book(s)		
Paul Deitel and Harvey Deitel , " C How to Program ", Pearson Education, 9 th Edition, 2023 Herbert Schildt, " C++: The Complete Reference ", McGraw Hill Education, 4 th Edition, 2017		
Reference Books		
Yashavant Kanetkar, " Let Us C ", BPB Publications, 20 th Edition, 2024 Herbert Schildt, " The Complete Reference C ", McGrawHill Education, 4 th Edition, 2017 Reema Thareja , " Programming in C ", Oxford University Press, 2 nd Edition, 2016 Paul Deitel and Harvey Deitel, " C++ How to Program ", Pearson Education, 10 th Edition, 2023		
Indicative Experiments		
1. Domestic Electricity Bill Computation In urban households, electricity consumption is monitored monthly. To promote energy conservation and fair usage, electricity boards apply slab-wise billing based on units consumed. You are tasked to write a C program that helps households to compute their monthly electricity bill based on actual		4 hours

domestic usage. The bill is calculated based on the number of units consumed using a slab system as follows: 0–100 units: Rs. 1.50 per unit 101–300 units: Rs. 2.00 per unit Above 300 units: Rs. 3.00 per unit The code should: Prompt the user to enter the number of units consumed Calculate the bill based on slabs Display the units consumed and the total bill amount Ask the user if they wish to compute another bill Exit gracefully with a thank-you message	
2. Fuel Cost Estimator for Road Trips Planning a road trip requires estimating travel expenses, especially fuel costs. With fluctuating fuel prices and varying mileage across vehicles, travelers often struggle to predict their trip cost accurately. To aid this, design a program to estimate fuel cost based on distance, mileage, and fuel price. Write a C program to help a user estimate the total fuel expense for a road trip. The user needs to enter the total distance of the trip (in kilometers), the vehicle's mileage (in km/l), and the current fuel price (in Rs. per litre). The program should: accept trip distance, mileage, and fuel cost as inputs Calculate: Litres Needed = Distance / Mileage Fuel Cost = Litres Needed × Fuel Price Display the calculated values Allow repeated estimation based on user input (Yes/No) Exit gracefully with a thank-you message	4 hours
3. Student Marks Analyzer for Internal Assessment A college faculty member wants to automate the process of analyzing internal marks of students for a subject. Instead of manually reviewing each score, a program is needed to accept marks for multiple students, calculate the class average, and identify the highest and lowest scorers. Write a C program that	4 hours

helps an instructor analyze internal marks of students in a subject. The program should: Ask the user to enter the number of students in the class. Accept individual marks (out of 100) for all students Calculate and display: Average marks of the class Highest and lowest marks scored Allow the user to repeat the process for a different class Exit gracefully with a thank-you message	
4. Smart Grocery Billing System with Limited-Time Offers A local grocery store is offering limited-time discounts on selected items for a day. The store manager wants a billing assistant that can: Take product names, prices, and quantities for a customer's purchase. Calculate total price and display an item-wise summary Apply a one-time discount only for the first bill generated in a day. Provide a running total for customers. Develop using C program for a smart grocery billing system that performs the following: For each product, input: Product name Quantity Unit price Calculate: Total price for each item Grand total If it's the first customer of the day, apply a 10% discount on the bill. Store and display the summary in a structured format. Repeat the process for the next customer based on user choice Exit with thanks note.	4 hours
5.	4 hours

Health Tracker: BMI Analyzer with Memory-Saving Feature A digital health startup is developing a lightweight health tracking tool to help users calculate and monitor their Body Mass Index (BMI). In order to reduce memory usage and allow efficient access, the system is required to operate with minimal variables and use references wherever it is necessary. You've been asked to simulate the logic of this core functionality. Develop a C program that computes the Body Mass Index (BMI) for multiple individuals and classifies them based on health categories. The program should: Accept the number of users to track For each user: Input name Weight in kilograms Height in meters Compute BMI using the formula: $\text{BMI} = \text{weight} / (\text{height} * \text{height})$ Classify as: BMI < 18.5: Underweight $18.5 \leq \text{BMI} < 25$: Normal $25 \leq \text{BMI} < 30$: Overweight BMI ≥ 30: Obese	
6. Conference Registration System with Dynamic Allocation An academic institute is organizing a national-level technical conference. Participants from various colleges register online, but the number of registrants isn't fixed in advance. To efficiently manage memory, the system needs to allocate space dynamically based on the actual number of registrations. Write a C program to develop a conference registration system where: The user inputs the number of participants registering for the event. For each participant, input:	4 hours

Full Name Institution Name Email ID Dynamically allocate memory to store participant details using malloc() or calloc(). After all entries: Display the registered list in a tabular format. Free the dynamically allocated memory after use. Ask whether the user wants to proceed to register a new batch. Exit with a thank-you message.	
7. Digital Payment Ledger System A local cooperative society is planning to digitize the ledger for tracking payments made by its members. The system should support entering new transactions, storing them in files, retrieving records, and displaying summaries. Since the number of transactions varies, memory and data handling must be dynamic. Develop a C program that simulates a digital payment ledger system with the following features: Accept the number of transactions for the day and dynamically allocate memory. For each transaction, input: Member Name Transaction ID Payment Amount Payment Method (UPI/Cash/Card) Store these entries in a structure using dynamic memory allocation. Display the transactions in a summary table. Write all transactions to a file named ledger.txt. Allow the user to read and display the full ledger history from the file. Ask the user whether to continue or exit.	4 hours
8.	4 hours

Hospital Patient Record Tracker A small clinic wants to keep track of patients' visit information. For different types of patients (in-patient and out-patient), certain information is handled differently. Use structures and unions to design a memory-efficient system. Write a C program to: Use a structure named Patient with common fields: Name Age Gender Patient Type (I for in-patient, O for out-patient) Include a union inside the structure to hold: For in-patients: number of days admitted and room number. For out-patients: consultation fee and doctor's name. Accept n patients' details from the user. Store their information in an array of structures. Display a summary for all patients, handling the union properly.	
9. Faculty Feedback Archiver System Your college wants to digitize the storage of semester-wise faculty feedback. Each feedback entry consists of the following information: Faculty Name Course Code Student Registration Number Feedback Score (out of 10) Feedback Comments Each feedback should be written to a text file named feedback.txt. Later, the system should allow retrieval of all feedback for a specific faculty. Write a C program to: Accept the number of feedback entries from the user. Dynamically collect data for each feedback entry using a structure.	4 hours

Write each entry to feedback.txt in append mode. After data entry, ask for a faculty name and return the entire feedback given to that faculty.	
10. Library Book Management System A college library wants to maintain its book inventory digitally. The system should allow librarians to add new books, store them in a file, retrieve the complete catalog, and manage dynamic memory allocation as the number of books may vary. The system should also leverage C++ features like classes, constructors, and file streams. Develop a C++ program to simulate a Library Book Management System with the following features: Specifications: Create a class Book with the following attributes: title (string) author (string) ISBN (string) price (float) Dynamically allocate memory for storing multiple books (preferably using vector) Allow the user to: Add new books to the catalog. Display the current book list in tabular format. Choose to continue or exit.	4 hours
11. Student Admission Record System An engineering college is developing a software module to automate its student admission process. The system should handle new student entries, display current records, count the number of students admitted so far, and store all details persistently. The system must manage memory dynamically, ensure data encapsulation, and clean up resources properly once the program ends.	4 hours

Develop a C++ program for the Student Admission Record System with the following features: Specifications: Each student record should include: Student Name Admission Number (auto-generated or input) Department Fees Paid Track the total number of students admitted using friend function (across program runs in a session). Dynamically store and display student records in a table. Ensure resource cleanup when records are no longer needed .	
12. Library Book Cataloging and Serial Number Generator A school library is digitizing its book catalog. Every time a new book is added, it should automatically be assigned a unique serial number. The librarian will enter book details, and the system should display all books with their assigned serials. The serial numbers must be generated internally and incremented automatically starting from 1001. Each book has: Title Author Publisher Year of Publication The system must: Use a class to represent a book Assign and manage serial numbers automatically using a static data member Use dynamic memory allocation inside the constructors to initialize book entries Display details of each book added On exit, confirm that memory is released (implicitly show destructor effect)	4 hours

Write a C++ program that: Accepts the number of books to enter. For each book, accepts title, author, publisher, and year. Assigns a unique serial number internally starting from 1001. Displays the full catalog. Demonstrates the constructor and destructor calls Expected Features to Implement: Static data member for serial number generation Parameterized constructor to initialize book details Destructor to display a message when book objects are destroyed Optionally overload a function to display different formats	
13. Fitness Tracker - Personal Health Metrics System A fitness center wants to offer its members personal health metrics tracking software. Each member should be able to record their health data like height, weight, and activity level. The system should calculate and display health indicators like BMI (Body Mass Index) or calorie burn. Members may record partial or complete information depending on availability. Develop a C++ program for the Personal Health Metrics System with the following features: For each member, collect: Member Name Height (in meters) Weight (in kg) Activity Level (optional) — Low / Moderate / High The system should: Calculate and display BMI. Optionally calculate the daily calorie burn estimate, if activity level is provided Handle different types of calculations using multiple versions of functions. Allow repeated entry for multiple members.	4 hours
14.	4 hours

Event Registration and Access System A college is organizing a multi-track tech fest. Participants can register as attendees, presenters, or organizers. Each category has different access rights and information to record. The system should manage participant entries, display details based on roles, and provide a report showing individual access rights in the event. Develop a C++ program to simulate an event registration and access system with the following features: Specifications: Create a base class Participant with: Name, Registration ID, and a virtual function showAccess() Derive three classes from it: Attendee: Can attend sessions Presenter: Can present papers Organizer: Can access all areas For each entry, the system should: Accept type of participant Create objects dynamically and store them (polymorphic array/pointer list) Display a report with role-specific access info using runtime polymorphism	
15. Digital Certificate Verification System A university is issuing digital certificates for different types of achievements — like academic excellence, sports achievements, and community service. The system should manage certificates, verify their authenticity, and prioritize verification based on issuance year or recipient name. Since the certificates vary in type, you'll use class templates to generalize the design, function templates for comparing and searching, and STL containers to store them dynamically. Write a C++ program to design a system with the following requirements:	2 hours

Class Template: Certificate Template parameter T refers to the type of achievement (e.g., string for sports, academic discipline, or service type) Data Members: - recipientName (string) - certificateID (string) - categoryInfo (T) → type-specific detail like "CSE", "Basketball", "Blood Donation" - issuedYear (int) Member Functions: - display() – show certificate details - verifyYear(int) – return true if issuedYear matches given year Function Template: compareCertificates() Accepts two Certificate objects Returns the one issued earlier, or based on name lexicographically STL Usage - Use std::vector to store certificate entries dynamically - Use iterators to: - Display all certificates - Search by issued year - Filter by recipient name	
16. Bank Loan Eligibility Checker A cooperative bank is developing a loan eligibility checker. The system collects basic customer details and validates them against a set of criteria. If any of the eligibility rules are violated, the system must throw an appropriate error and display a meaningful message without crashing the program. Develop a C++ program that: Collects: - Customer Name - Age - Monthly Income - Requested Loan Amount Validates:	2 hours

Age must be between 21 and 60 Monthly income must be $\geq ₹15,000$ Loan amount must be ≤ 10 times the monthly income If any rule is violated, throw a specific exception Catch and handle all exceptions gracefully Display success message only for eligible customers Allow processing of multiple customers (say, 3) Features to Implement: Use custom exception classes (e.g., InvalidAgeException, LowIncomeException, LoanLimitExceeded) Use try-catch blocks Input validation inside constructors or dedicated functions Clean and readable class design	
Total Laboratory Hours:	60 hours
Reference Books	
Stanley Lippman and Josee Lajoie, " C++ Primer ", Addison Wesley publishers, 5 th Edition, 2012 John Horton, " Learn C++ by Example ", Manning Publications, 1 st Edition, 2023 Ken Youens-Clark, " Tiny C Projects ", Manning Publications, 1 st Edition, 2021	
Mode of Evaluation :Continuous Assessment Test, Digital Assignment, Quiz, Final Assessment Test, Lab Continuous Assessment, Lab Final Assessment, Seminar	
Recommended by Board of Studies :	21-05-2025
Approved by Academic Council : No. 78	12-06-2025

Course Code	Course Title	L	T	P	C
BACSE105	Data Structures and Algorithms	3	0	2	4
Pre-requisite	NIL	Syllabus Version			
		1			
Course Objectives					
1. Analyze algorithm efficiency using asymptotic notation to compare the complexities in various problem-solving scenarios.					
2. Understand and implement core data structures and their applications in solving computational problems					
3. Design and apply appropriate algorithmic strategies and data structures to solve real-world problems using suitable techniques					
Course Outcomes					
1. Design and analyze efficient algorithms using complexity analysis and formal development techniques					
2. Implement and utilize linear and non-linear data structures for effective data management and algorithmic problem-solving					
3. Apply various design strategies to solve real-world problems efficiently					
4. Analyze and solve complex computational problems using advanced algorithmic techniques and optimization methods					
5. Demonstrate the ability to implement and apply fundamental and advanced algorithms using various data structures to solve computational problems					
Module:1	Algorithm Analysis	8 hours			
Importance of algorithms and data structures - Fundamentals of algorithm analysis: Space and time complexity of an algorithm, Types of asymptotic notations and orders of growth - Algorithm efficiency – best case, worst case, average case - Analysis of non-recursive and recursive algorithms - Asymptotic analysis for recurrence relation: Iteration Method, Substitution Method, Master Method and Recursive Tree Method, Proof of Correctness of the algorithm.					
Module:2	Data Structures Linear and Non Linear	14 hours			
Arrays: 1D and 2D array- Stack, Queue - Types of Queue: Circular Queue, Double Ended Queue (deQueue), List: Singly linked lists, Doubly linked lists, Circular linked lists. Binary Tree: Definition and Properties - Tree Traversals- Binary Search Trees, Application, Balanced Binary Trees-AVL Tree, Graphs: representation, Traversal: BFS & DFS, Hashing					
Module:3	Algorithm Strategies Divide Conquer Back tracking Branch and Bound	7 hours			
Divide and Conquer: Quick sort, Merge Sort, Karatsuba faster integer multiplication algorithm					

Backtracking: N-Queens problem, Graph Coloring, 0/1 knapsack		
Branch & Bound: LIFO-BB and FIFO BB methods: Job Selection problem, Subset Sum		
Module:4	Algorithm Strategies Greedy and Dynamic Programming	7 hours
Greedy Technique: Huffman Coding, Minimum Spanning Tree: Prim's & Kruskal's, Shortest Path : Dijkstra's, Dynamic programming: Matrix Chain Multiplication, Longest Common Subsequence		
Module:5	Classes of Complexity and Approximation Algorithms	7 hours
The Class P - The Class NP - Reducibility and NP-completeness – SAT (Problem Definition and statement), 3SAT, Independent Set, Clique, Approximation Algorithm – Vertex Cover, Set Cover and Travelling salesman		
Total Lecture Hours:		43 hours
Text Book(s)		
Cormen, T. H., Leiserson, C. E., Rivest, R. L., & Stein, C., " Introduction to algorithms ", MIT press, 4 th Edition, 2022		
Reference Books		
Kleinberg, J., & Tardos, E, " Algorithm design ", Pearson Education India, 1 st Edition, 2006 Mark A. Weiss, " Data Structures & Algorithm Analysis in C++ ", Pearson Education, 4 th Edition, 2013 Horowitz, Sahni and S. Anderson-Freed, " Fundamentals of Data Structures in C ", Universities Press, 2 nd Edition, 2008 Karumanchi, N, " Data Structures and Algorithms Made Easy: Data Structures and Algorithmic Puzzles ", VISIONIAS, 5 th Edition, 2017		
Indicative Experiments		
1. Arrays: 1D,2D, functions Tentative Scenario: Assume that you are a game developer designing a multiplayer battle game called " Battle of Legends". This game involves five players in real time. Each player has the following score : Health score (starts from 1000), Magic score (starts from 50) and Status (A-Active, KO-Knocked Out, D-Disconnected). Write a program to to perform / monitor: Health score and Magic score of each player, Update the values during the game play, Display the current statistics.		2 hours

2. Pointers Tentative Scenario: A college auditorium is used for various events like workshops, seminars, and fests. For each event, the seating arrangement may vary in terms of Number of rows, Number of seats per row, Dynamic seat availability (booked vs. empty). The administration needs a flexible program to configure the seat layout dynamically and simulate real-time seat booking and cancellation. Use the pointers to design this dynamic seat management system.	2 hours
3. Stacks and Applications: a) Infix to postfix conversion, b) Expression Evaluation c) Tower of Hanoi Tentative Scenario: In programming languages, expressions and code blocks often use grouping symbols like (), {}, and []. Ensuring these symbols are properly nested and balanced is crucial for: Compiling code correctly, Preventing runtime or syntax errors, Assisting with code auto-completion and formatting in IDEs. This checking is performed during lexical and syntactic analysis in compilers and interpreters — a task that is ideally solved using stacks due to their LIFO (Last-In, First-Out) nature. Write a C program that checks whether all opening and closing brackets in an input expression are correctly matched and properly nested.	2 hours
4. Queue: Bounded Queue, Priority Queue Tentative Scenario: In a busy call center, incoming customer calls are handled in the exact order they arrive to ensure fairness and efficiency. When all agents are occupied, incoming calls wait in a queue until an agent becomes available. Since the call center has a limited number of agents and finite queue capacity, calls may have to wait or sometimes be rejected when the queue is full. Demonstrates the concept of a bounded queue where the queue has a maximum size to implement this scenario.	2 hours

5. Linked list: Polynomial Manipulation Tentative Scenario: In mathematical computing, polynomials are often represented as a series of terms, each consisting of a coefficient and exponent. The number of terms and their order may vary dynamically based on operations like addition, multiplication, or simplification. Create a program to represent two polynomials using singly linked lists and perform addition / multiplication.	4 hours
6. Trees: Binary Search tree: Expression trees, Finding Kth Min and Max element, Binary tree traversals Tentative Scenario: Design a program that parses and analyzes a mathematical expression using both Expression Trees and Binary Search Trees (BSTs). The goal is to build an expression tree from an arithmetic expression, evaluate it, and store all constants in a BST to perform analysis like finding the K-th smallest and largest constants.	2 hours
7. AVL trees – Rotations Tentative Scenario: Imagine you're building a real-time leaderboard system for a competitive coding platform like HackerRank or Codeforces. Thousands of participants submit solutions, and their scores keep changing dynamically. The leaderboard must: Insert new users quickly, Update scores efficiently, Maintain ranking in sorted order, Always provide balanced search performance. A regular binary search tree may become imbalanced after multiple insertions, leading to inefficient lookups ($O(n)$ time).	2 hours

To prevent this, we use AVL Trees — a type of self-balancing binary search tree. Create a program that builds an AVL Tree for storing user scores. Each node stores a user ID and their score. After each insertion, apply necessary rotations to keep the tree height-balanced.	
8. Graphs Tentative Scenario: You are tasked with designing a water-pipeline system for a town. The town layout is represented by an undirected, weighted graph $G = (V, E)$, where: $V = n$ represents pipeline junctions, $E = m$ represents possible pipe segments, each edge $(u, v) \in E$ has a weight $w(u, v)$ indicating the pipe installation cost or distance. Tasks: Traverse the Network (a) Use Breadth-First Search (BFS) starting from a given junction s to determine if all junctions are reachable and record the order of discovery. (b) Use Depth-First Search (DFS) from the same source s to produce a traversal order. (Algorithms should run in $O(n + m)$ time.) (c) Compute Shortest Pipeline Routes Apply Dijkstra's algorithm from source s to calculate the minimum-cost path from s to every other junction. Specify the resulting distance and predecessor arrays. (Assume non-negative edge weights; the time complexity is $O(m + n \log n)$.) Design the Overall Pipeline Network Construct a Minimum Spanning Tree (MST) of the graph using Kruskal's or Prim's algorithm.	6 hours

Provide the set of edges chosen and the total installation cost of the MST. (Highlight that MST ensures full connectivity with minimal total weight.)	
9. Use Dynamic Programming to solve Matrix Chain Multiplication, LCS, 0/1 Knapsack problems.	4 hours
10. Demonstrate the following sorting techniques: Quick Sort, Merge Sort, Heap Sort.	2 hours
11. Write a program to solve the subset sum problem using the branch & bound strategy.	2 hours
Total Laboratory Hours:	30 hours
Text Book(s)	
Horowitz, Sahni and S. Anderson-Freed, " Fundamentals of Data Structures in C ", Universities Press, 2 nd Edition, 2008	
Reference Books	
Mark A. Weiss, " Data Structures & Algorithm Analysis in C++ ", Pearson Education, 4 th Edition, 2013 Karumanchi, N, " Data Structures and Algorithms Made Easy: Data Structures and Algorithmic Puzzles ", VISIONIAS, 5 th Edition, 2017	
Mode of Evaluation :Continuous Assessment Test, Digital Assignment, Quiz, Final Assessment Test, Lab Continuous Assessment, Lab Final Assessment, Seminar, Presentaion	
Recommended by Board of Studies :	21-05-2025
Approved by Academic Council : No. 78	12-06-2025

Course Code	Course Title	L	T	P	C
BACSE106	Operating Systems	3	0	2	4
Pre-requisite	NIL	Syllabus Version			
		1			
Course Objectives					
1. To introduce the fundamental concepts, design issues, and core functionalities of operating systems. 2. To build skills in managing processes, memory, files, devices, and ensuring protection and security, using algorithms and practical simulations. 3. To introduce modern developments like virtualization, distributed operating systems, and cloud-based systems.					
Course Outcomes					
1. Understand the structure, functionalities, and foundational concepts of operating systems. 2. Apply process scheduling algorithms and analyze thread models and deadlock-handling methods. 3. Implement synchronization mechanisms and solve concurrency problems in multi-process systems. 4. Evaluate memory management and file system strategies used in operating systems. 5. Analyze device management, protection mechanisms, and virtualization techniques in operating systems.					
Module:1	Operating Systems and Structure	6 hours			
Operating system basics - History of operating systems - OS structure: Monolithic, Layered, Microkernel, Modular - OS services - System calls and types - Interrupts - OS design issues – Building and booting an OS.					
Module:2	Process, Scheduling, Threads and Deadlocks	10 hours			
Process concepts and states - Process Scheduling - Operation on Processes: Creation, Termination and Cooperation - Threads and multithreading models - Scheduling criteria - CPU scheduling: Non-preemptive (FCFS, SJF, Priority), Preemptive (Round Robin, SRTF, Preemptive Priority), Multi-level Queue, Multi-level Feedback Queue - Deadlock characterization - Resource Allocation Graphs (RAG) – Deadlock handling methods.					
Module:3	Process Synchronization	9 hours			
IPC: Shared memory, message passing - Race condition – Critical section problem - Peterson's solution – Bakery Algorithm - Hardware synchronization: Test-and-Set, Swap - Mutex locks - Semaphores – Classical synchronization problems: Bounded buffer, Readers-Writers, Dining Philosophers – Monitors.					
Module:4	Memory and File Management	10 hours			

Address binding - Logical and physical address space - Contiguous memory allocation - Fragmentation - Placement Algorithms: First Fit, Best Fit, Worst Fit – Paging: Structure with TLB - Segmentation - Virtual memory: Demand paging - Page replacement: FIFO, Optimal, LRU – Thrashing and Working Set - File system concepts - File access methods - Directory structures and implementation - File allocation methods.		
Module:5	Managing Devices, Security and Protection and Virtualization	8 hours
I/O device management basics: RAID structure, Disk structure, Disk Scheduling Algorithms (FCFS, SSTF, SCAN, C-SCAN, LOOK, C-LOOK), Program and network threats – Cryptography as a security tool – Domains of protection – Access matrix – Capability based systems - Need for virtualization - Virtual machines and architectures – Hypervisors - Virtualization Technologies: Para Virtualization, Full Virtualization - OS-Level Virtualization: Containers, Docker Basics, Containers vs Virtual Machines.		
Module:6	Contemporary Issues	2 hours
Total Lecture Hours:		45 hours
Text Book(s)		
Abraham Silberschatz, Peter B. Galvin, Greg Gagne, " Operating System Concepts ", Wiley, 10 th Edition, 2018		
Reference Books		
Remzi H. Arpaci-Dusseau, Andrea C. Arpaci-Dusseau, " Operating Systems: Three Easy Pieces ", Arpaci Dusseau Books, 1 st Edition, 2023 Andrew S. Tanenbaum, Herbert Bos, " Modern Operating Systems ", Pearson Education, 4 th Edition, 2015 William Stallings, " Operating Systems: Internals and Design Principles ", Pearson, 9 th Edition, 2018		
Indicative Experiments		
1. Study of basic Linux commands and shell scripting		2 hours
2. Implementation of Bootloader		2 hours
3. Process creation using fork(), Orphan and Zombie processes		2 hours
4. Thread Creation		2 hours
5. CPU scheduling algorithms (FCFS, SJF, Priority)		2 hours
6. CPU scheduling algorithms (Round Robin, SRTF, Pre-emptive Priority)		2 hours

7. Banker's Algorithm for Deadlock Avoidance (Safe state checking and additional resource request granting)	2 hours
8. Shared Memory Creation and sharing contents between processes	2 hours
9. Implementation of Producer-Consumer/Readers Writers using Semaphore	2 hours
10. Implementation of Dining Philosophers using Semaphore	2 hours
11. Memory Allocation Strategies: First Fit, Best Fit, Worst Fit	2 hours
12. Page Replacement Algorithms: FIFO, LRU, Optimal	2 hours
13. Disk Scheduling Algorithms: FCFS, SSTF, SCAN	2 hours
14. Disk Scheduling Algorithms: C-SCAN, LOOK, C-LOOK	2 hours
15. File system operations using system calls	2 hours
Total Laboratory Hours:	30 hours
Mode of Evaluation : Continuous Assessment Test, Digital Assignment, Quiz, Final Assessment Test, Lab Continuous Assessment, Lab Final Assessment	
Recommended by Board of Studies :	21-05-2025
Approved by Academic Council : No. 78	12-06-2025

Course Code	Course Title	L	T	P	C
BACSE201	Models of Computation	3	1	0	4
Pre-requisite	NIL	Syllabus Version			
		1			
Course Objectives					
1. To introduce the fundamental concepts of formal languages, grammars, and automata theory to provide a foundation for the theoretical understanding of computation 2. To explore the design and analysis of finite automata, regular expressions, context-free grammar, pushdown automata, and Turing machines, emphasizing their role in language recognition and parsing 3. To analyze problems related to decidability, reducibility, and undecidability, and to understand the limitations of algorithmic computation					
Course Outcomes					
1. Apply various proof techniques such as induction, contradiction, and contraposition in the context of formal languages and automata 2. Design and analyze finite automata and regular expressions to solve lexical analysis problems and recognize regular languages 3. Construct and simplify context-free grammar and apply parsing algorithms to determine syntactic structure in languages 4. Develop pushdown automata and understand parsing strategies such as LL(1) and LR for context-free languages 5. Understand and evaluate the computational power and limitations of Turing machines, and distinguish between decidable, semi-decidable, and undecidable problems					
Module:1	Foundations of Formal Languages and Proof Techniques	5 hours			
Proof techniques: Induction, Contradiction, Contrapositive, Introduction to formal languages and operations - Types of grammars - Chomsky hierarchy- Overview of models of automata					
Module:2	Finite Automata and Regular Languages	9 hours			
Deterministic and Non-Deterministic Finite Automata (DFA & NFA) - ϵ -moves in NFA - NFA to DFA conversion - Minimization of DFA - Regular expressions - Lexical Analysis using FA and Regular Expression, Program Constructs using Regular Expression, Equivalence of finite automata and regular expressions - Regular languages - Pumping Lemma					
Module:3	Context Free Grammars and Languages	9 hours			

Context-Free Grammars (CFG) - Context-Free Languages - Derivations – Ambiguous and Unambiguous grammars - First and Follow - Left Recursion and Left Factoring – Simplification of CFG: Chomsky Normal Form – Greibach Normal Form - CYK Algorithm		
Module:4	Parsing and Pushdown Automata	11 hours
Introduction to parsing: Top-down and Bottom-up - LL (1) Parsing - SLR Parsing - Pushdown Automata (PDA) - Deterministic and Non-deterministic PDA - Interpretation of syntactic statements using PDA.		
Module:5	Turing Machines and Undecidability	9 hours
Turing Machines (acceptors and transducers) - Universal Turing machine and encoding - Church Turing Thesis - Recursive Enumerable Languages -Recursively Enumerable Languages -Non Recursive Languages -Reducibility - Undecidability: Halting Problem - Post Correspondence Problem – Tools: JFLAP, REGEX, LEX, YACC		
Module:6	Contemporary Issues	2 hours
Total Lecture Hours:		45 hours
Tutorial Hours:		15 hours
Text Book(s)		
John E. Hopcroft, Rajeev Motwani, Jeffrey D. Ullman, " Introduction to Automata Theory, Languages, and Computation ", Pearson Education, 3 rd Edition, 2020		
Reference Books		
Peter Linz, Susan H. Rodger, Jones, " An Introduction to Formal Languages and Automata ", Bartlett Publishers, 7 th Edition, 2022 Dan A. Simovici, " Introduction to the Theory of Formal Languages ", World Scientific, 2024 Alfred V. Aho, Monica S. Lam, Ravi Sethi, Jeffrey D. Ullman, Sorav Bansal, " Compilers: Principles, Techniques, and Tools, Updated ", Pearson India, 2 nd Edition, 2006		
Indicative Experiments		
Total Laboratory Hours:		0 hours
Mode of Evaluation :Continuous Assessment Test, Digital Assignment, Quiz, Final Assessment Test, Seminar		
Recommended by Board of Studies :		21-05-2025
Approved by Academic Council : No. 78		12-06-2025

Course Code	Course Title	L	T	P	C
BACSE202	Database Systems	3	0	2	4
Pre-requisite	NIL	Syllabus Version			
		1			
Course Objectives					
1. To familiarize with database concepts and entity relationship modeling. 2. To impart knowledge on relational database design, normalization, physical database design, query optimization and distributed databases. 3. To equip with the strategies for handling transactions, concurrency control and database recovery.					
Course Outcomes					
1. Understand the role of database management systems in organizations and design relational data models and their operations. 2. Analyze and apply indexing structures for efficient data access and query optimization. 3. Gain insight into transaction management, concurrency control, and recovery mechanisms in databases. 4. Demonstrate the knowledge on distributed databases and NoSQL databases. 5. Apply database design principles to create scalable and maintainable data models for real-world systems.					
Module:1	Database Systems and Data Models	7 hours			
Introduction to database systems - Characteristics of database approach - Advantages of using DBMS approach - Actors on the scene - Classification of DBMS - Data Models - Schemas and Instances - Three-Schema Architecture - Database System Environment - Introduction to relational, semi structured, graph, vector, time series, distributed and unstructured databases - Relational model concepts: characteristics of relations - Relational model constraints and relational database schemas: domain constraints - key constraints and constraints on null values - entity integrity, referential integrity, and foreign Keys - dealing with constraint violations.					
Module:2	ER Modeling and Relational Database Design	10 hours			
Entity Relationship Model: Types of attributes, relationship types and sets, roles, structural constraints, weak entity -Mapping ER model to a relational schema - Extended ER Model: generalization - specialization – aggregations Guidelines for relational schema - Functional dependencies: inference rules, equivalence, and minimal cover - axioms on functional dependencies - Normalization: first, second and third normal forms - boyce codd normal form, multi-valued dependency and fourth normal form - join dependency and fifth normal form.					
Module:3	Physical Database Design and Query Processing	9 hours			

File structures: operations on files - files of unordered and ordered records - hashing techniques: static and dynamic - indexing: single level indexing, multi-level indexing, dynamic multilevel indexing - B+ tree indexing – LSM trees and its variants - Relational Algebra: operators - translating SQL queries into relational algebra - Tuple Relational Calculus - Query Optimization: query trees and heuristic optimization of query trees.		
Module:4	Transaction Processing, Concurrency Control and Database Recovery	10 hours
Introduction to transaction processing and concepts: ACID properties of transactions, transaction states - serial and serializable schedules - schedules based on recoverability - schedules based on serializability - conflict serializability - concurrent transactions – need of concurrency control - Concurrency control techniques: two phase locking techniques – guaranteeing serializability by two-phase locking – dealing with deadlock and starvation – concurrency control based on timestamp ordering: timestamp ordering algorithm – granularity of data items and multiple granularity locking - Recovery Concepts: categorization of recovery algorithms - recovery based on deferred update and immediate update.		
Module:5	Distributed and NOSQL Databases	7 hours
Distributed Database: introduction - architectures - data fragmentation, replication, and allocation techniques - transaction management, concurrency control and recovery - query processing and optimization - NoSQL Databases: introduction - characteristics of NoSQL Systems, CAP theorem, ACID vs BASE properties, NoSQL modeling techniques - aggregate data models, distribution models, map reduce, types of NoSQL databases: key-value databases, document based databases, column based databases and graph databases.		
Module:6	Contemporary Issues	2 hours
Total Lecture Hours:		45 hours
Text Book(s)		
R. Elmasri and S. B. Navathe, " Fundamentals of Database Systems ", Pearson India Education, 7 th Edition, 2021		
Reference Books		
A. Silberschatz, H. F. Korth and S. Sudarshan, " Database System Concepts ", McGraw Hill India, 7 th Edition, 2021 Mark L. Gillenson and Pradeep Singh, " Fundamentals of Database Management Systems - An Indian Adaptation ", Wiley, India, 3 rd Edition, 2025 M. Tamer Özsu , Patrick Valduriez, " Principles of Distributed Database Systems ", Springer Nature, 4 th Edition, 2020 Gerardus Blokdyk, " NoSQL Databases A Complete Guide ", 5STARCooks, 1 st Edition, 2021		
Indicative Experiments		

1. Design an ER / EER diagram for any real-world data requirements (E.g.: Bank Database) using any suitable drawing tool.	2 hours
2. Translate the ER diagram into the corresponding relational databases.	2 hours
3. Apply the Normalization concept and normalize the given table into 1NF, 2NF and 3NF.	2 hours
4. Populate the relational database with real world Customer and Transaction data (refer to Kaggle or any open data sources for real world datasets) using Data Manipulation Languages. Use Data Control Language and Transaction Control Language commands.	2 hours
5. Apply retrieval of data using operators, functions like arithmetic, comparison, logical and like Operators.	2 hours
6. Apply the single row functions and group functions on the normalized tables.	2 hours
7. Retrieve the data from the relational database using sub queries, Joins and Views.	4 hours
8. Use features of PL/SQL like control structures, conditional statements, user defined functions and procedures, cursors and triggers to retrieve or modify data.	6 hours
9. Interface the database with Front Ends using ODBC and JDBC. Perform the retrieval and DML operations from the Front End.	2 hours
10. Implementation of database creation, deletion, insertion, updation, view and retrieval of documents in a NoSQL database environment. Implement a scale in / scale out operation on NoSQL database.	2 hours
11. Implementation of database replication, backup and restore of files in a NoSQL database environment. Demonstrate how data is shared in NoSQL environment.	2 hours
12. Create and configure cloud resources, then perform CRUD operations. Integrate the database with a sample application to demonstrate real-world usage.	2 hours
Total Laboratory Hours:	30 hours
Mode of Evaluation : Continuous Assessment Test, Digital Assignment, Quiz, Final Assessment Test, Lab Continuous Assessment, Lab Final Assessment	
Recommended by Board of Studies :	21-05-2025
Approved by Academic Council : No. 78	12-06-2025

Course Code	Course Title	L	T	P	C
BACSE203	Computer Networks	3	0	2	4
Pre-requisite	NIL	Syllabus Version			
		1			
Course Objectives					
1. To foster students' understanding of the core concepts of computer networking, including protocols, architectures, and their applications.					
2. To empower students with the knowledge to design, implement, and analyze the performance of OSI and TCP/IP architectures effectively.					
3. To identify appropriate application layer protocols for specific applications and their corresponding security mechanisms.					
Course Outcomes					
1. Interpret the different building blocks of networks.					
2. Analyze the error and flow control mechanisms for connecting a network.					
3. Design and configure efficient networks using switching, IP, routing, NAT multicast, and IPv6, to optimize scalability and performance					
4. Examine the essential factors for reliable transport layer services, flow control, connection management and analyze the consequences of congestion on their performance.					
5. Assess the significance of application layer services and their associated protocols for seamless network communication and functionality					
Module:1	Networking Foundations	8 hours			
Layering and Protocols-Network Topology - Encapsulation -Multiplexing and De-multiplexing - OSI Model, TCP/IP model- Basics of Physical Layer-Internet Architecture-Application Programming Interface (Sockets) - Performance Metrics (Throughput, Bandwidth, Delay and Latency) - High-Speed Networks.					
Module:2	Direct Links	9 hours			
Connecting to a Network - Encoding – Framing: Byte-Oriented Protocols (PPP), Bit-Oriented Protocols (HDLC); Ethernet (IEEE 802.3); Error Detection: Internet Checksum Algorithm, Cyclic Redundancy Check –Error Correction- Hamming Code; Reliable Transmission: Stop-and-Wait, Sliding Window - Multiple-access Networks: Access Protocol, Wireless Networks: 802.11/Wi-Fi, Bluetooth (802.15.1) - Access Networks, Cellular Network.					
Module:3	Internetworking	10 hours			
Switching Basics – Datagrams, Virtual Circuit Switching, Virtual LANs (VLANs); Internet (IP) – Internetwork, Service Model, Global Addresses, Datagram Forwarding in IP, Classful addressing, Subnetting and Classless Addressing, Address Resolution Protocol (ARP), Dynamic Host Configuration Protocol (DHCP), Error Reporting-ICMP, Network Address Translation (NAT), Routing - Network as a Graph, Distance-Vector-RIP, Link State-OSPF, Metrics, Implementation-Performance Analysis- Packet Tracer; Global Internet - Routing					

Areas, Interdomain Routing -BGP; IP Version 6 - Addresses and Routing, Packet Format, Advanced Capabilities; Multicast - Multicast Addresses, Multicast Routing -DVMRP		
Module:4	End to End Protocols	8 hours
Simple Demultiplexer (UDP), Reliable Byte Stream (TCP) - End-to-End Issues, Segment Format, Connection Establishment and Termination, Sliding Window, Triggering Transmission, Adaptive Retransmission, Record Boundaries, TCP Extensions, Performance, Alternative Design Choices-SCTP. Remote Procedure Call (RPC)- Fundamentals, Quality of Service -Allocating Resources - Issues in Resource Allocation; Queuing Disciplines - FIFO, Fair Queuing; TCP Congestion Control; Advanced Congestion Control, Quality of Service		
Module:5	End to End Data	8 hours
Security Attacks - Trust and Threats, IP Security (IPsec), Firewalls; Applications - Electronic Mail (SMTP, MIME, POP3), World Wide Web (HTTP), FTP, Telnet, Infrastructure Applications-DNS, SNMP; Software Defined Network (SDN)- introduction.		
Module:6	Contemporary Issues	2 hours
Industry practices like Netconf and Telemetry		
Total Lecture Hours:		45 hours
Text Book(s)		
Larry L. Peterson, Bruce S. Davie, " Computer Networks : A Systems Approach ", The Morgan Kaufmann Series in Networking, 6 th Edition, 2021		
Reference Books		
Behrouz A. Forouzan, " Data communication and Networking ", McGraw Hill Education, 6 th Edition, 2022 James F. Kurose and Keith W.Ross, " Computer Networking: A Top-Down Approach ", Pearson Education, 9 th Edition, 2025 William Stallings, " Data and Computer Communication ", Pearson India Education Services Pvt Ltd, 10 th Edition, 2022		
Indicative Experiments		
1. Study of Basic Network Commands, Demonstration of all networking hardware and their functionalities.		2 hours
2. Error detection and Correction mechanisms (CRC, Checksum, Hamming Code)		2 hours
3. Flow control mechanisms (Stop and Wait, Sliding Window)		4 hours
4. IP Addressing and Subnetting		2 hours
5. Cisco Packet Tracer Simulation – LAN, Static routing, VLANs		4 hours
6. Socket programming – UDP, TCP, multi-client chatting		4 hours

7. Adaptive Retransmission- Nagle's Algorithm, Karn's Patridge Algorithm, Jacobson/Karels algorithm	4 hours
8. Remote Procedure Call	2 hours
9. Hands on WireShark - Capture filter, Display filter, simple attacks	2 hours
10. Implementing basic SDN topology with Mininet	4 hours
Total Laboratory Hours:	30 hours
Mode of Evaluation : Continuous Assessment Test, Digital Assignment, Quiz, Final Assessment Test, Lab Continuous Assessment, Lab Final Assessment, Seminar, Group Discussion, Presentaion	
Recommended by Board of Studies :	21-05-2025
Approved by Academic Council : No. 78	12-06-2025

Course Code	Course Title	L	T	P	C
BACSE204	Software Engineering	3	0	2	4
Pre-requisite	NIL	Syllabus Version			
		1			
Course Objectives					
1. To provide a comprehensive overview of software engineering principles, lifecycle models, and development methodologies for systematic software design and implementation. 2. To impart knowledge on project management frameworks and applying best strategies for planning, executing, and controlling software projects. 3. To apply effective testing and maintenance techniques and implement quality assurance practices for developing reliable software.					
Course Outcomes					
1. Demonstrate the ability to select appropriate software development methodologies for different project requirements. 2. Develop a comprehensive software project plan incorporating key project management activities. 3. Ability to model system requirements, design and apply testing strategies to ensure software reliability. 4. Comprehend the software maintenance practices and quality management techniques that support the long-term sustainability of software products. 5. Implement software development life cycle for real time projects.					
Module:1	Introduction	5 hours			
Nature of Software, Software Engineering. Software process, Software Engineering Practice, Generic Process Model, Perspective Process models, Specialized Process Model, Unified Process, Introduction to Agility - Agile Process-Extreme programming, Scrum, Other Agile Process Models ,Agile Tools, System Engineering.					
Module:2	Software Project Management	10 hours			
The Management Spectrum, People, Product, Process, Project, Process and Project metrics, Estimation for software project- Project Planning Process- Milestones and Deliverables, Software Scope and Feasibility, Resources, Decomposition Techniques- Work breakdown structure, Empirical Estimation Models, Project Scheduling, RISK management, CASE Tools.					
Module:3	Requirements Modeling and Design	12 hours			
Requirement Engineering process - Eliciting Requirements - Functional and Non Functional Requirements - Requirements Traceability Matrix - Validating Requirements - Requirement Analysis and Modeling: Data Modeling, Flow Oriented Modeling - Transaction, Transformation, Behavioral Modeling - Structured Language Specification - Formal Specification - Design concepts and principles,					

Modularity: Cohesion, coupling, Architectural design, Architectural styles, Detailed Design- Object-oriented analysis and design- Design patterns, User Interface Design.		
Module:4	Software Testing and Metrics	8 hours
Software Implementation guidelines – Testing - Unit Testing - Integration Testing - Validation Testing - System Testing - Acceptance Testing and its Types – Static testing – Dynamic testing – Black Box Testing – Boundary value analysis, Equivalence partitioning- Decision Tables - White Box Testing – Structural Testing, Computation of Logical Complexity – Cyclomatic Complexity- Testing Mobile applications – Testing Web applications - Regression Testing – Debugging - Automation tools-Selenium, Appium- Software Metrics – Requirements Metrics - OO design metrics – Testing and SCM metrics		
Module:5	Maintenance and Quality Management	8 hours
Software Maintenance, Types of Maintenance, Re-Engineering, Reverse Engineering, Software Configuration Management (SCM) Overview, SCM Process, Quality management – Software quality, Software quality assurance- Elements of software quality assurance, Statistical software quality assurance, Software reliability- Process improvement models - CMM and CMMI.		
Module:6	Contemporary Issues	2 hours
Total Lecture Hours:		45 hours
Text Book(s)		
Roger S. Pressman and Bruce R. Maxim, " Software Engineering: A Practitioner's Approach ", McGraw Hill Education, 9 th Edition, 2023		
Reference Books		
Rajib Mall, " Fundamentals of software engineering ", PHI Learning Pvt Ltd, 5 th Edition, 2018 Ian Somerville, " Software Engineering ", Addison Wesley, 10 th Edition, 2017 William E. Lewis, " Software Testing and Continuous Quality Improvement ", Auerbach Publications, 3 rd Edition, 2017		
Indicative Experiments		
1. Analysis and identification of a suitable process model based on a selected business application. Sample Scenario: A university intends to develop an online examination platform to facilitate internal assessments and semester-end exams. The system should include features such as secure user authentication, randomized question paper generation, automated grading for objective-type questions, manual evaluation support for subjective		3 hours

responses, and comprehensive report generation. The project will be piloted with a small user group prior to full deployment. The development timeline is five months, with built-in flexibility to incorporate feedback during testing. Ongoing collaboration with faculty and IT staff is expected throughout the development life cycle.	
2. Develop a Work Breakdown Structure (WBS) using Process-Based, Product-Based, Geographical-Based and Role-Based approaches for a business application of your choice. Sample Scenario: A startup plans to launch a food delivery platform similar to Swiggy or Zomato. The app should allow users to browse restaurants, place orders, make payments, and track deliveries in real time. It must also support restaurant onboarding, delivery partner management, and customer feedback. The system should be scalable and secure, with a user-friendly interface.	3 hours
3. Requirement modeling using Entity Relationship Diagram (Structural Modeling) Sample Scenario: A company wants to develop an online bookstore where users can browse books, place orders, and make payments. The system should also allow authors and publishers to manage their book listings. The bookstore must track inventory, customer details, and order history	3 hours
4. Requirement modeling using Context flow diagram, DFD (Functional Modeling) Sample Scenario: A restaurant chain wants to develop an online food ordering system where customers can browse menus, place orders, and make payments. The system should also allow restaurant staff to manage orders and delivery personnel to track assigned deliveries.	3 hours
5. Requirement modeling using State Transition Diagram (Behavioral Modeling) Sample Scenario : Develop a state machine diagram for an e-commerce application where customers can create service requests such as querying goods, purchasing items, and managing accounts (open, close, deposit, receive payment, reopen, resume). Account operations follow specific rules: opening requires an initial deposit, purchases are restricted by balance limits, and accounts can be suspended or permanently closed based on overdue payments. Design the state transitions based on these conditions.	3 hours
6. Story Boarding and User Interface design Modeling Sample Scenario	3 hours

You are tasked with designing a mobile banking application. Create a storyboard depicting the process of a user logging in, viewing their balance, transferring money, and receiving confirmation. Accompany your storyboard with user interface mockups for each step.	
7. OO design – Use case Model, Class Model Sample Scenario A university wants to develop an online platform where students can register for courses each semester. The system should allow students to log in, view available courses, register or drop courses, and view their schedules. Faculty members should be able to manage course offerings, approve enrollments, and communicate with students. Administrators will oversee the system, manage user roles, and generate reports.	3 hours
8. OO design – Interaction Models Sample Scenario A healthcare provider plans to develop an online appointment booking system that allows patients to register, search for doctors by specialty, book appointments, receive confirmations, and reschedule or cancel them as needed. Doctors should be able to manage availability, view schedules, and approve or reject appointments. The system must also notify patients via email or SMS. Design a UML interaction model that captures key interactions—such as 'Book Appointment' and 'Cancel Appointment'—involving users, system components, and external services.	3 hours
9. OO design – Package, Component and deployment models Sample Scenario A national bank is developing an online banking platform that allows customers to perform transactions such as checking balances, transferring funds, paying bills, and managing accounts. The system must also support admin operations like fraud detection, user management, and audit logging. It should be accessible via web and mobile apps, with secure backend services and integration with third-party payment gateways.	3 hours
10. Design and demonstration of test cases. Functional Testing and Non-Functional Testing Sample Scenario A national railway service is developing an online ticket booking platform. The system allows users to search for trains, check seat availability, book tickets, make payments, and receive e-tickets. It also supports cancellation, refund processing, and real-time updates on train status. The platform must be accessible via web and mobile, and should handle high traffic during peak hours.	3 hours

Total Laboratory Hours:		30 hours
Mode of Evaluation : Continuous Assessment Test, Digital Assignment, Quiz, Final Assessment Test, Lab Continuous Assessment, Lab Final Assessment, Seminar, Presentaion		
Recommended by Board of Studies :		21-05-2025
Approved by Academic Council : No. 78		12-06-2025

Course Code	Course Title	L	T	P	C
BACSE206	Foundations of Artificial Intelligence	3	1	0	4
Pre-requisite	NIL	Syllabus Version			
		1			
Course Objectives					
To provide a foundational understanding of the principles, techniques and approaches used in Artificial Intelligence (AI). To develop an understanding of reasoning and knowledge representation based on mathematical logic. To equip with techniques for solving complex problems using search algorithms and probabilistic reasoning in the context of modern AI advancement.					
Course Outcomes					
Demonstrate the fundamental components of an AI system, such as agents, environments and problem-solving architectures. Analyze and illustrate the significance of search algorithms in problem-solving. Apply logic-based methods for representing knowledge and drawing inferences in AI systems. Design appropriate reasoning frameworks for various real-world AI scenarios. Design and evaluate planning systems that incorporate constraints related to time, schedules and resource management.					
Module:1	Introduction to Artificial Intelligence	6 hours			
Artificial and Natural Intelligence - History of AI - Applications of AI - Types of AI- Intelligent Agents - Nature of Environment - Structure of Agents – Classification of Agents - Designing Agents - Agent Architectures - Autonomous and Multi-Agent Systems.					
Module:2	Problem Solving by Search	13 hours			
State Space Search - Uninformed Search Strategies - Breadth First Search , Depth First Search , Iterative Deepening , Bi-directional , Uniform Cost - Heuristic - Informed Search Strategies, Greedy Best First , A* Search, Iterative Deepening A* Search - Adversarial Search - Minimax Algorithm, Alpha-Beta Pruning - Constraint Satisfaction Problem - Local Search Algorithms - Hill-climbing, Simulated Annealing, Genetic algorithms - Problems involving Search - Board Games, Graph Colouring Problem- Job-Shop Scheduling- Travelling Salesman Problem					
Module:3	Knowledge Representation and Inference	8 hours			

Knowledge Based Systems - Propositional Logic - Syntax, Semantics, Inference - Forward Chaining(FC) - Backward Chaining(BC) - Modus Ponens(MP) - First-Order Predicate Logic - Syntax, Semantics, Inference - Unification, FC, BC, MP, Horn Clause, Resolution by Refutation - Problems on Inference - Knights and Knaves, Curiosity-Cat problem		
Module:4	Reasoning under Uncertainty	8 hours
Uncertainty - Representation, Basic Probability Notation, Probability axioms, Full Joint Distributions, Conditional Independence, Bayes' Rule, Anterior and Posterior Probabilities and its Use - Bayesian Belief Networks – Exact Inference- Approximate Inference - Problems involving Uncertainty- Coloured Ball Problem - Burglar / Earthquake Alarm Problem		
Module:5	Automated Planning	8 hours
Classical Planning - Algorithms for Classical Planning - Heuristics for Planning - Hierarchical Planning - Planning graphs, Planning in Nondeterministic Domains - Time, Schedules and Resources- Analysis of Planning Approaches- Problems in Planning- Blocks World Problem – Tour Planning problem.		
Module:6	Contemporary Issues	2 hours
Total Lecture Hours:		45 hours
Tutorial Hours:		15 hours
Text Book(s)		
Stuart J. Russell and Peter Norvig, " Artificial Intelligence: A Modern Approach ", Pearson, 4 th Edition, 2022		
Reference Books		
David L. Poole and Alan K. Mackworth, " Artificial Intelligence: Foundations of Computational Agents ", Cambridge University Press, 3 rd Edition, 2023 Deepak Khemani , " A First Course in Artificial Intelligence ", Tata McGraw Hill Education, 1 st Edition, 2013		
Mode of Evaluation :Continuous Assessment Test, Digital Assignment, Quiz, Final Assessment Test, Seminar, Group Discussion, Presentation		
Recommended by Board of Studies :		21-05-2025
Approved by Academic Council : No. 78		12-06-2025

Course Code	Course Title	L	T	P	C
BAMAT205	Discrete Mathematics and Linear Algebra	3	1	0	4
Pre-requisite	Multivariable Calculus and Differential Equations	Syllabus Version			
		1.1			
Course Objectives					
1. To develop logical reasoning and problem-solving skills by understanding mathematical logic, inference theory, and predicate calculus for engineering applications. 2. To apply counting techniques, algebraic structures, and lattice theory to optimize combinatorial problems and system designs in engineering. 3. To utilize vector spaces, linear transformations, and inner product spaces for efficient representation, computation, and analysis in engineering modeling and simulations.					
Course Outcomes					
At the end of this course, the student is able to 1. apply proof techniques in solving logical problems 2. solve engineering problems involving counting principles. 3. relate algebraic structures to enhance problem-solving techniques. 4. understand the concepts of vector space, subspaces and linear transformations. 5. apply vector normalization techniques to generate orthonormal basis.					
Module:1	Mathematical Logic	9 hours			
Statements and Notation-Connectives–Tautologies-Equivalence - Implications–Normal forms - The Theory of Inference for the Statement Calculus - Predicate Calculus – Inference Theory of the Predicate Calculus. Applications: <i>Validity of Algorithms by Inference</i>					
Module:2	Counting Techniques	8 hours			
Basics of counting-Pigeonhole principle- Permutations and combinations-Inclusion-exclusion principle-Recurrence relations - Solving recurrence relations-Generating functions. Applications: <i>Analyzing Recursive Functions, Complexity of Algorithms</i>					
Module:3	Algebraic Structures and Lattices	8 hours			
Groups – Subgroups – Lagrange’s Theorem Homomorphism –Properties- Partially Ordered Relations -Lattices as Posets – Hasse Diagram – Properties of Lattices. Boolean Algebra. Applications: <i>Coding Theory -Error Correction and Detection in Communication.</i>					
Module:4	Vector Spaces and Linear Transformations	10 hours			
The Euclidean space R^n Vector space and subspace, linear combination, span, linear dependence and independence, basis and dimension. Row space, column space, null space, and Rank-Nullity Theorem. Linear transformations – definition, properties, matrix representation, invertibility, and change of basis. Applications: <i>Computer Graphics - Rotation, Scaling and Translations, JPEG & MPEG Compression.</i>					
Module:5	Inner Product Spaces	8 hours			
Dot and inner products, length of a vector, angle between vectors, and matrix representation of inner products. Gram-Schmidt orthogonalization, orthonormal basis. Quadratic forms and their nature – positive definite, negative definite, and indefinite forms. Applications: <i>Modeling Signals with Orthonormal Basis, Computer Vision.</i>					

Module:6	Contemporary Topics			2 hours
		Total Lecture hours:		45 hours
		Total Tutorial hours:		15 hours
Text Book(s)				
1.	J.P.Trembley and R. Manohar, Discrete Mathematical Structures with Applications to Computer Science, 2017, 35 th Reprint, Tata Mc Graw Hill, New Delhi.			
2.	Stephen Andrilli and David Hecker, Elementary Linear Algebra, 5th Edition, Academic Press, 2016			
Reference Books				
1.	Kenneth H. Rosen, Discrete Mathematics and its applications, 2019, 8th Edition, Tata McGraw Hill, Noida.			
2.	Gilbert Strang, Introduction to Linear Algebra, 2023, 6th Edition, Wellesley- Cambridge Press.			
Mode of Evaluation: Quizzes, Assignments, CATs and FAT				
Recommended by Board of Studies			14-May-2025	
Approved by Academic Council				Date

Course Code	Course Title	L	T	P	C
BACSE301	Exploratory Data Analysis	3	0	2	4
Pre-requisite	NIL	Syllabus Version			
		1			
Course Objectives					
1. To explain the methods for data preparation and data understanding to build solid foundation for data analysis. 2. To apply essential techniques for analyzing multivariate data by summarizing through statistical and graphical methods. 3. To summarize the role of predictive analytics, data science and data visualization in extracting insights from the data.					
Course Outcomes					
1. Analyze real world data sets by selecting and applying appropriate data analysis methods. 2. Apply data preprocessing techniques and detect outliers to prepare data for analysis. 3. Develop comprehensive statistical summaries and visual dashboards to communicate data insights. 4. Implement dimensionality reduction techniques and perform time series analysis techniques. 5. Create advanced visualizations and Develop Comprehensive Exploratory Data Analysis report for the real-world problems.					
Module:1	Introduction to Exploratory Data Analysis	6 hours			
Importance of EDA in Data Science- Overview of the EDA process- Data Collection: Sources (Databases - CSV- APIs - web scraping) - Understanding dataset structure- Metadata and feature selection. Data collection and handling - Biased datasets.					
Module:2	Data Preprocessing	11 hours			
Data Cleaning: Removing duplicates - Correcting inconsistencies. Handling Missing Values: Missing Completely at Random (MCAR) - Missing at Random (MAR) - Missing Not at Random (MNAR) - Imputation techniques - mean- median- mode- MICE. Data Type Conversion: Handling categorical and date time variables. Feature Engineering: Creating new features - binning - encoding categorical variables. Feature scaling - Min-Max-Standardization. Normalization techniques: Log-square root-power transformations. Handling imbalanced datasets”dealing with skewed distributions. Outlier Detection: Z-score- IQR method - Isolation Forest.					
Module:3	Descriptive Statistics and Visualization	9 hours			
Descriptive Statistics: Measures of central tendency and dispersion (mean- median- mode- variance- IQR - skewness- kurtosis).					

Visualization Techniques: Univariate: Histograms- Boxplots - Bar charts. Bivariate: Scatter plots- Correlation Heatmap. Multivariate: Pair plots - Parallel Coordinate Plots - Andrews Curves - Heatmap. Effective data storytelling using visualizations.		
Module:4	Dimensionality Reduction and Time Series Analysis	9 hours
Dimensionality Reduction: Filter - Wrapper - Embedded and Hybrid methods - PCA - SVD- t-SNE- Local Linear Embedding. Time Series Analysis: Time based indexing- Linear regression - Identifying trends - Seasonality and cyclic patterns. Case studies in Finance- Healthcare and Retail industries.		
Module:5	Advance Visualization Techniques	8 hours
Automated EDA Tools: Introduction to tools like Pandas Profiling- Sweetviz and D-Tale. Generating automated reports and quick insights. Advanced Visualization Techniques: Sankey diagrams - Violin plots - Radial plots. Network graphs for data relationships. EDA for Unstructured Data: Text Data - Image Data.		
Module:6	Contemporary Topics	2 hours
Total Lecture Hours:		45 hours
Text Book(s)		
1. Suresh Kumar Mukhiya and Usman Ahmed, " Hands-On Exploratory Data Analysis with Python ", Packt Publishing, 1 st Edition, 2020		
Reference Books		
1. Michael Jambu, " Exploratory and Multivariate Data Analysis ", Academic Press Inc, 1 st Edition, 1991 2. Craig K. Enders, " Applied Missing Data Analysis ", The Guilford Press, 1 st Edition, 2010		
Indicative Experiments		
1. The Titanic dataset contains passenger demographics and voyage information; performs data cleaning and handle missing values to produce a cleaned dataset suitable for a survival prediction model. Dataset can be referred from Kaggle/UCI like public repositories.		4 hours
2. A retail sales dataset contains historical transactions and product attributes; apply data transformation and feature-engineering techniques to prepare the data for a sales prediction model. Dataset can be referred from Kaggle/UCI like public repositories.		4 hours
3. The Wine Quality dataset contains physicochemical measurements and quality scores; perform multivariate analysis to explore relationships among		4 hours

features and quality. Dataset can be referred from Kaggle/UCI like public repositories.	
4. A credit card transactions dataset contains labeled fraud and legitimate transactions; develop a suitable model to detect outliers for identifying fraudulent transactions. Dataset can be referred from Kaggle/UCI like public repositories.	4 hours
5. Modified National Institute of Standards and Technology (MNIST) is handwritten digit data represented as images; reduce the dimensionality of the images using PCA and t-SNE methods for digit recognition. Dataset can be referred from Kaggle/UCI like public repositories.	4 hours
6. The Iris dataset contains measurements for different iris species; perform exploratory data analysis and present the results using visualizations. Dataset can be referred from Kaggle/UCI like public repositories.	4 hours
7. An airline passenger dataset records monthly passenger counts; apply time series analysis to capture shifts and patterns in the data. Dataset can be referred from Kaggle/UCI like public repositories.	4 hours
8. A product review dataset contains customer reviews and metadata; perform exploratory data analysis on the review text to prepare for sentiment prediction. Dataset can be referred from Kaggle/Hugging Face/UCI like public repositories.	2 hours
Total Laboratory Hours:	
	30 hours
Mode of Evaluation: Continuous Assessment Test, Quiz, Final Assessment Test, Lab Continuous Assessment, Lab Final Assessment	
Recommended by Board of Studies :	16-10-2025
Approved by Academic Council : No. 80	20-11-2025

Course Code	Course Title	L	T	P	C
BACSE302	MACHINE LEARNING AND OPTIMIZATION	3	0	2	4
Pre-requisite	NIL	Syllabus Version			
		1			
Course Objectives					
To introduce core paradigms and theoretical principles of machine learning. To develop the skills to design, implement and evaluate machine learning models for data driven applications. To build expertise to optimize and fine-tune machine learning systems for efficiency and generalization.					
Course Outcomes					
Understand and apply various learning paradigms and principles to evaluate and design machine learning models. Implement supervised learning models for real-world applications and evaluate their performance using suitable metrics. Analyze unknown data patterns using appropriate clustering techniques. Apply ensemble learning techniques by combining base learners to address real-time problems effectively. Optimize machine learning models through hyperparameter tuning and performance improvement methods.					
Module:1	Introduction	7 hours			
Introduction - Learning Paradigms - Information Theoretic Learning - Version Spaces - Finite and Infinite Hypothesis Spaces - PAC Learning - VC Dimension - Inductive Bias - Occam's Razor - Empirical Risk Minimization - Structural Risk Minimization.					
Module:2	Supervised Learning	12 hours			
Regression - Linear, Multiple Linear - Model Calibration and Uncertainty Estimation - Classification - Logistic Regression, KNN, Naive Bayes, Decision Tree - ID3, CART - Neural Network - Multi-Layer Perceptron - Gradient-Based Methods - Stochastic Gradient Descent, Momentum, Nesterov, Adam, RMSProp - Support Vector Machine(SVM) - Linear and Nonlinear - Loss Functions and Regularization - LASSO, RIDGE, Elastic Net, Huber - Evaluation Metrics.					

Module:3	Unsupervised Learning	11 hours
Clustering - Partitional - K-Means, K-Mode - Hierarchical - AGNES, DIANA - Density-Based - DBSCAN - Model-Based - Expectation Maximization, Gaussian Mixture Models, Self-Organizing Map - Principal Component Analysis (PCA) - Contrastive Self-Supervised Learning - SimCLR, BYOL, Manifold Learning and Spectral Clustering - Evaluation Metrics- Silhouette, Dunn, Davies, Bouldin.		
Module:4	Ensemble Learning	5 hours
Ensemble Learning - Bagging - Random Forests - Boosting- AdaBoost, XGBoost, LightGBM - Calibration and Confidence Estimation in Large Models - Expected Calibration Error and Maximum Calibration Error - Bias and Variance Trade-off.		
Module:5	Hyperparameter Tuning and Optimization	8 hours
Convex and Non-Convex Optimization - Optimality Conditions - Unconstrained and Constrained Optimization - Optimization Variants - Trust Region Methods - Stochastic Approximation - Mini-batch Stability - Hyperparameter Tuning - Grid Search, Random Search, Bayesian Optimization.		
Module:6	Contemporary Topics	2 hours
Total Lecture Hours:		45 hours
Text Book(s)		
Ethem Alpaydin, " Introduction to Machine Learning ", MIT Press, 4 th Edition, 2020 Aurélien Géron , " Hands-On Machine Learning with Scikit - Learn, Keras, and TensorFlow ", O Reilly Media, 3 rd Edition, 2023 Singiresu S. Rao, " Engineering Optimization: Theory and Practice ", John Wiley and Sons, 4 th Edition, 2020		
Reference Books		
Tom M. Mitchell, " Machine Learning ", McGraw Hill, 3 rd Edition, 1997 Jiawei Han, Jian Pei, and Hanghang Tong, " Data Mining: Concepts and Techniques ", Morgan Kaufmann, 4 th Edition, 2022 Amir Beck. , " First-Order Methods in Optimization ", MOS SIAM Series on Optimization , 2 nd Edition, 2023		
Indicative Experiments		
1.		2 hours

High-precision and reliable wind speed forecasting remains a major challenge for meteorologists. Severe winds caused by convective storms can result in significant damage. Convective events such as thunderstorms, tornadoes, and large hail are natural hazards that can disrupt daily life, especially over complex terrain that favors convection. Task: Develop a predictive model for the meteorological department to forecast wind speed and reduce potential damage. Dataset can be obtained from Kaggle or UCI like public repository.	
2. Unwanted spam messages are a nuisance and pose privacy and security risks. A company wants to automatically classify incoming messages as spam or ham (not spam). Task: Build a classification model using Naive Bayes (MultinomialNB, GaussianNB, and BernoulliNB) to detect spam messages. Compare its performance with other baseline models. Dataset can be obtained from Kaggle or UCI like public repository.	2 hours
3. The Human Resources department of a mid-sized company is facing a high employee attrition rate, leading to increased recruitment and training costs, loss of institutional knowledge, and decreased morale. Task: Apply a Decision Tree Classifier to identify employees likely to leave the company. Dataset can be obtained from Kaggle or UCI like public repository.	2 hours
4. Customer reviews provide valuable insights that help improve product quality, boost sales, and increase profit. Task: Apply a Support Vector Machine (SVM) to determine whether the review given is positive or negative. Dataset can be obtained from Kaggle or UCI like public repository.	2 hours
5. A company collects data about employees' years of experience and annual salary (in \$¹). The HR department wants to predict the salary of a new employee based on his/her experience. Task: Build a Support Vector Regressor (SVR) model and optimize its performance. Compare the model's performance using R², MSE, and RMSE metrics. Dataset can be obtained from Kaggle or UCI like public repository.	2 hours

6. A retail company aims to segment its customers to design targeted marketing strategies. The dataset includes customer attributes such as age, annual income, and spending score. Task: Apply the K-Nearest Neighbors (KNN) algorithm to classify customers into distinct groups using appropriate distance metrics (e.g., Euclidean distance). Dataset can be obtained from Kaggle or UCI like public repository.	2 hours
7. Detecting fraudulent financial transactions is crucial for preventing financial losses from disputes and chargebacks. Task: Develop an automated system using Logistic Regression to detect fraudulent transactions. Dataset can be obtained from Kaggle or UCI like public repository.	2 hours
8. The house price dataset includes multiple numerical and categorical features that may be correlated or skewed, leading to overfitting with standard linear regression. Task: Preprocess the data, implement regularized regression models, tune hyperparameters, and apply k-fold cross-validation to evaluate performance. Analyze how regularization controls model complexity and interpret coefficients to identify key price factors. Dataset can be obtained from Kaggle or UCI like public repository.	2 hours
9. A healthcare organization wants to detect patients at risk of a rare heart disease based on medical records. Since only a small percentage of patients are diagnosed, the dataset is highly imbalanced. Task: Apply suitable class imbalance techniques to accurately identify high-risk patients while minimizing false negatives. Dataset can be obtained from Kaggle or UCI like public repository.	2 hours
10. An international airline wants to accurately predict future sales and demand of its tickets in order to increase the booking price and gain profit. Task: Apply time series analysis techniques to model and predict sales trends over time. Dataset can be obtained from Kaggle or UCI like public repository.	2 hours

11. Utility companies need to forecast energy consumption to provide reliable services and plan dynamic pricing strategies. Task: Apply a Hierarchical Clustering algorithm to group households or businesses based on their electricity consumption patterns (e.g., hourly/daily usage). Dataset can be obtained from Kaggle or UCI like public repository.	2 hours
12. A retail store wants to gain insights into its customers by grouping them based on various characteristics such as geography, demography, purchasing behavior, and lifestyle. Task: Apply the K-Means clustering algorithm for customer segmentation. Dataset can be obtained from Kaggle or UCI like public repository.	2 hours
13. The Modified National Institute of Standards and Technology (MNIST) dataset contains images of handwritten digits. Task: Reduce the dimensionality of the dataset using PCA and t-SNE and analyze their effectiveness for digit recognition. Dataset can be obtained from Kaggle or UCI like public repository.	2 hours
14. A wine manufacturing company wants to predict wine quality based on its physicochemical properties such as acidity, sugar content, pH level, sulphates, etc. Task: Apply ensemble learning techniques to accurately predict wine quality and identify key factors influencing it. Dataset can be obtained from Kaggle or UCI like public repository.	2 hours
15. A Courier Company handles daily delivery requests from a central depot to various locations. Currently, routes are assigned manually. Task: Apply machine learning optimization techniques to determine the shortest and most efficient delivery routes to minimize time and fuel consumption. Dataset can be obtained from Kaggle or UCI like public repository.	2 hours
Total Laboratory Hours:	30 hours

Mode of Evaluation: Continuous Assessment Test, Quiz, Final Assessment Test, Lab Continuous Assessment, Lab Final Assessment, Oral Examination, Presentation, Course Project	
Recommended by Board of Studies :	16-10-2025
Approved by Academic Council : No. 80	20-11-2025

Course Code	Course Title	L	T	P	C
BACSE303	DEEP LEARNING	3	0	2	4
Pre-requisite	NIL	Syllabus Version			
		1			
Course Objectives					
To impart knowledge on the fundamental concepts of neural networks and optimization techniques. To introduce deep learning architectures for vision, sequential and temporal data. To build the skills to create and assess advanced generative and transformer based models					
Course Outcomes					
Apply the fundamental concepts of neural networks and optimization algorithms to understand model training, convergence and performance improvement. Implement Convolutional Neural Network (CNN) architectures, utilize transfer learning techniques with pre-trained deep learning models for real-time applications. Design and develop advanced vision architectures and GAN variants to perform object detection and image generation. Create Recurrent Neural Network (RNN) architectures and Seq2Seq models to build and predict sequential or temporal data. Evaluate and compare the performance of autoencoders and transformer architectures on real-world datasets.					
Module:1	Introduction	10 hours			
Neural Networks Basics - Functions in Neural Networks - Activation Functions - Linear, Threshold, Sigmoid, Tanh, Softmax, ReLU, LeakyReLU - Loss Function - Function Approximation - Parameters - Hyperparameters - Gradient Descent(GD) - Vanishing and Exploding Gradient Problems - Variants of GD - Batch GD, Stochastic GD, Mini-batch GD - Exponential Weighted Averages - Gradient Descent with Momentum - Forward and Back Propagation - Learning Rates - Adadelta, Adagrad, RMSProp and Adam Optimization - Hyperparameter Tuning - Early Stopping - Batch Normalization - Regularization - Under-Fitting vs Over-Fitting.					
Module:2	Convolutional Neural Network	8 hours			

Fundamentals of CNN - CNN Operations - CNN Layers - Interleaving Between Layers - Deep Convolutional Models - AlexNet, VGGNet, Network in Network (NiN), GoogLeNet, ResNet, DenseNet, EfficientNet - Training - Image Augmentation - Transfer Learning with Pre-trained Models - Applications.		
Module:3	Vision-Based and Generative Models	7 hours
Region-based CNN(RCNN) - Fast RCNN - You Only Look Once (YOLO) - Single Shot Detector - Transpose Convolution - Encoder - Decoder - Attacking Neural Networks with Adversarial Examples - Generative Adversarial Networks (GAN) - Vanilla GAN, DC-GAN, C-GAN, SR-GAN - Deep Belief Networks, Vision Transformer (ViT).		
Module:4	Recurrent Neural Networks	9 hours
Introduction - Text Augmentation - Components of RNN - Working Principle of RNN - Bidirectional RNNs, Sequence-to-Sequence (Seq2Seq) Architectures, Deep Recurrent Networks - Training Recurrent Networks - Long-term Dependencies - Echo State Networks - Long Short-Term Memory (LSTM) - Gated RNNs - RNN Optimization.		
Module:5	Autoencoders and Transformers	9 hours
Queries, Keys, and Values - Attention Pooling by Similarity - Attention Scoring Functions - Attention Mechanisms and Multi-Head Attention - Self-Attention and Positional Encoding - Transformers - Bidirectional Encoder Representations from Transformers (BERT) - Decoder-only Model - Generative Pre-trained Transformers (GPT) - Text-to-Text Transfer Transformer (T5) - Variational Autoencoders (VAE).		
Module:6	Contemporary Topics	2 hours
Total Lecture Hours:		45 hours
Text Book(s)		
Ian Goodfellow, Yoshua Bengio, and Aaron Courville, " Deep Learning ", MIT Press , 1 st Edition, 2016 Aston Zhang, Zachary C. Lipton, Mu Li, and Alexander J. Smola, " Dive into Deep Learning ", Cambridge University Press, 1 st Edition, 2023 Christopher M. Bishop and Hugh Bishop, " Deep Learning: Foundations and Concepts ", Springer Nature, 1 st Edition, 2023		
Reference Books		
Nikhil Buduma, Nisha Buduma, and Joseph Papa, " Fundamentals of Deep Learning: Designing Next - Generation Machine Intelligence Algorithms ", Oâ€™Reilly Media, 2 nd Edition, 2022		

Oswal Antonio Montesinos L3pez, Abelardo Montesinos L3pez, and Jos3 Crossa., "**Fundamentals of Artificial Neural Networks and Deep Learning, In Multivariate Statistical Machine Learning Methods for Genomic Prediction**", Springer International Publishing, 1st Edition, 2022

Indicative Experiments

1. Demonstration and implementation of Shallow architecture, using Python, PyTorch/TensorFlow Task: Implement Multiclass classification on an image having digit 0 - 9 based on its features. Data Set (Example: MNIST) can be obtained from Kaggle/UCI like public repository.	2 hours
2. Hyperparameter tuning and regularization Task: Build a neural network that classifies whether an image represents a handwritten digit (0 - 9) based on pixel values. Apply Hyperparameter tuning and regularization to improve the performance. Data Set (Example: MNIST) can be obtained from Kaggle/UCI like public repository.	4 hours
3. Convolution Neural Network Task: Implement a custom CNN model for image classification. Data Set (Example: CIFAR - 10) can be obtained from Kaggle/UCI like public repository.	2 hours
4. Transfer Learning of CNN architectures. Task: Implement a transfer learning model for image classification. Data Set (Example: CIFAR - 10) can be obtained from Kaggle/UCI like public repository.	4 hours
5. Experimentation with YOLO Task: Implement a latest YOLO model to classify the objects. Data Set (Example: COCO) can be obtained from Kaggle/UCI like public repository.	2 hours
6.	4 hours

Implementation of variants of GAN Task: Build a suitable GAN model for text/image augmentations. Data Set (Example: IMDB and MNIST) can be obtained from Kaggle/UCI like public repository.	
7. Implementation of RNN/Gated RNN Task: Develop the RNNs to classify movie reviews as positive or negative based on their text content. Data Set (Example: IMDB and MNIST) can be obtained from Kaggle/UCI like public repository.	4 hours
8. Implementation of LSTM and Bi-directional LSTM for sequence learning Task: Develop long-short term memory model to classify movie reviews as positive or negative based on their text content. Data Set (Example: IMDB) can be obtained from Kaggle/UCI like public repository.	2 hours
9. Implementation of Transformers Task: Build a Transformer model for text classification. Data Set (Example: IMDB) can be obtained from Kaggle/UCI like public repository.	2 hours
10. Image denoising using Auto Encoders and VAE. Task: Develop an Auto Encoder model to remove noise from the images. Data Set (Example: Fashion - MNIST) can be obtained from Kaggle/UCI like public repository.	4 hours
Total Laboratory Hours:	30 hours
Mode of Evaluation: Continuous Assessment Test, Quiz, Final Assessment Test, Lab Continuous Assessment, Lab Final Assessment, Oral Examination, Presentation, Course Project	
Recommended by Board of Studies :	16-10-2025
Approved by Academic Council : No. 80	20-11-2025

Course Code	Course Title	L	T	P	C
BACSE304	REINFORCEMENT LEARNING	3	0	2	4
Pre-requisite	NIL	Syllabus Version			
		1			
Course Objectives					
To introduce the theoretical foundations and core principles of reinforcement learning. To illustrate the algorithmic methods for policy optimization and control. To develop the skills towards implementing reinforcement learning based solutions for real-world applications.					
Course Outcomes					
Understand reinforcement learning concepts, including MDPs, value functions, and exploration-exploitation strategies. Apply dynamic programming and temporal-difference learning to evaluate and optimize policies in reinforcement learning. Implement Dyna, policy gradient methods, and heuristic and Monte Carlo tree search algorithms to solve reinforcement learning problems. Develop on-policy control algorithms with approximation, such as actor-critic methods with function approximation. Apply agentic AI and reinforcement learning techniques to real-world problems					
Module:1	Introduction	7 hours			
Introduction to Reinforcement Learning (RL) - Agent, Environment, Rewards, Policies, Markov Decision Processes - States, Actions, Transition Probabilities, Value Functions and Bellman Equations, Multi-armed Bandits - Exploration vs. Exploitation - μ -Greedy - Softmax Exploration.					
Module:2	Dynamic Programming and Temporal-Difference Learning	9 hours			
Dynamic Programming - Policy Evaluation, Policy and Value Iteration, Monte-Carlo Methods - Prediction and Control, Off-policy Prediction via Importance Sampling, Discounting-Aware Importance Sampling (DAIS), Per-Decision Importance Sampling - Temporal-Difference Learning - Prediction, Methods, Optimality, State-Action-Reward-State-Action(SARSA), Q-Learning - N-Step Bootstrapping - Backup and Unifying Algorithms.					

Module:3	Planning and Learning	10 hours
Dyna - Integrated Planning, Acting, and Learning - Prioritized Sweeping - Trajectory Sampling - Real-Time Dynamic Programming - Heuristic and Monte Carlo Tree Search - Policy Gradient Methods: Theorem - REINFORCE - Monte Carlo Policy Gradient and Baseline - Actor-Critic Methods.		
Module:4	Approximate Solution Methods	9 hours
On-policy Prediction with Approximation - On-policy Control with Approximation - Off-policy Methods with Approximation - Eligibility Traces.		
Module:5	Agentic AI and Application of Reinforcement Learning	8 hours
Agentic AI Principles - Autonomy - Decision-Making - Hierarchical Reinforcement Learning and Transfer Learning - Multi-Agent Reinforcement Learning - RL Applications in Healthcare: AI-assisted Diagnosis, Drug Discovery - Finance- Algorithmic Trading, Portfolio Optimization - Industrial Automation and Smart Grids - Natural Language Processing- Conversational AI, Large Language Models (LLMs).		
Module:6	Contemporary Topics	2 hours
Total Lecture Hours:		45 hours
Text Book(s)		
Richard S. Sutton and Andrew G. Barto., " Reinforcement Learning: An Introduction ", MIT Press, 2 nd Edition, 2020 Stefano V. Albrecht, Filippos Christianos, and Lukas Schödl, " Multi - Agent Reinforcement Learning: Foundations and Modern Approaches ", MIT Press, 1 st Edition, 2024		
Reference Books		
Dimitri P. Bertsekas , " A Course in Reinforcement Learning ", Athena Scientific, 2 nd Edition, 2024		
Indicative Experiments		
1. Build and simulate Markov Decision Processes(MDPs) in a customizable GridWorld environment. Dataset: No external dataset is needed. GridWorld is to be generated programmatically.		2 hours

Processing: Define states, actions, transitions, rewards. Customize grid size, walls, goal states. Simulate agent movement. Sample Input: 5x5 Grid, Goal at (4,4), Wall at (2,2). Expected Output: Optimal policy mapping each grid cell to an action. Application: Game AI. Tools: Python, Gym library.	
2. Compare exploration strategies in Bandit algorithms for personalized product recommendation systems. Data Set (Example: MovieLens) can be referred from Kaggle/UCI like public repositories. Processing: Define bandit arms, Implement exploration strategies, Track cumulative rewards. Sample Input: 10 products with random reward probabilities. Expected Output: Graph comparing total rewards across strategies. Application: E-commerce recommendations. Tools: Python, scikit - learn.	2 hours
3. Implement and compare policy iteration and value iteration methods for solving MDPs. Dataset: No external dataset is needed. GridWorld is to be generated programmatically. Processing: Implement Policy Iteration, Implement Value Iteration, Measure number of iterations and time. Sample Input: MDP with 16 states, 4 actions. Expected Output: Final policy and value function. Application: Game design, robotics. Tools: Python, Gym library.	2 hours
4. Learn on-policy and off-policy Monte Carlo methods to solve the Blackjack card game problem. Dataset: OpenAI gymnasium's Blackjack - v1(Inbuilt dataset from Gym library) Processing: Implement on-policy MC (first-visit or every-visit), Implement off-policy MC with importance sampling. Sample Input: Initial hands; Expected Output: State-value estimations.	2 hours

Application: Casino gaming strategies. Tools: Python, Gym library.	
5. Develop and analyze tabular Q-learning for navigating the FrozenLake environment under uncertain conditions. Dataset: FrozenLake (Inbuilt dataset from Gym library) Processing: Implement tabular Q-learning, train under slippery (stochastic) and non-slippery settings. Sample Input: FrozenLake 8x8 grid. Expected Output: Learned Q-table. Application: Pathfinding under uncertainty. Tools: Python, Gym.	2 hours
6. Use SARSA($\hat{I}$) with eligibility traces to enhance learning efficiency for robotic navigation tasks. Dataset: GridWorld (Inbuilt dataset from Gym library) Processing: Implement SARSA($\hat{I}$) update rules and Vary $\hat{I}$ to observe effects. Sample Input: Maze configuration. Expected Output: Faster convergence to optimal policy. Applications: Real-time navigation systems. Tools: Python, Gym.	2 hours
7. Integrate planning and learning with Dyna-Q to adapt to dynamic maze navigation challenges. Dataset: Dynamic maze (Inbuilt dataset from Gym library). Processing: Implement model learning and planning and update policies after environment changes. Sample Input: Maze with shifting walls. Expected Output: Policy resilience after dynamic changes. Applications: Disaster response robots. Tools: Python, Gym.	2 hours
8. Implement Actor-Critic architectures to solve the CartPole balancing challenge with reduced variance. Dataset: CartPole-v1 (Inbuilt dataset from Gym library) Processing: Build Actor network (policy) and Build Critic n/w (value estimation).	2 hours

Sample Input: Cart position, velocity, pole angle. Expected Output: Balanced pole time duration. Applications: Robotics control, automation. Tools: Python, Gym, PyTorch.	
9. Apply deep Q-learning techniques to teach a spacecraft to land on the LunarLander safely. Dataset: LunarLander-v2 (Inbuilt dataset from Gym library). Processing: Implement DQN with experience replay and target network. Sample Input: Spacecraft's coordinates, velocity, angles. Expected Output: Successful landings. Applications: Autonomous spacecraft landing, drones. Tools: Python, Gym, PyTorch.	2 hours
10. Explore robust policy gradient methods with Proximal Policy Optimization (PPO) for solving continuous action-space problems. Dataset: Pendulum-v1 (Inbuilt dataset from Gym library) Processing: Implement PPO clipping mechanism. Sample Input: Pendulum state vector. Expected Output: Continuous torque actions. Applications: Robotics/industrial automation. Tools: Python, Stable - Baselines3, PyTorch.	2 hours
11. Use hierarchical reinforcement learning to decompose and solve complex, multi-step tasks. Dataset: Maze (Inbuilt dataset from Gym library) Processing: Define high-level and low-level policies. Sample Input: Multi-room navigation. Expected Output: Execution of subgoals. Application: Warehouse automation. Tools: Python, Gym, PyTorch.	2 hours
12. Develop multi-agent RL systems for cooperative and competitive scenarios like games and automation. Dataset: PettingZoo or Multi-Agent Environments (Inbuilt dataset from gym library). Processing: Implement cooperative and adversarial learning. Sample Input: Agents controlling characters in a game.	2 hours

Expected Output: Win rates, team rewards. Applications: Multiplayer games. Tools: Python, PettingZoo, PyMARL, Stable-Baselines3.	
13. Implement reinforcement learning solutions tailored to healthcare, finance, or cybersecurity applications. Dataset:(Example: Healthcare MIMIC-III Clinical database/ Finance/ Cybersecurity) can be referred from Kaggle/UCI like public repositories. Processing: Define environment: patients, stock prices, attacks, Train RL agent. Sample Input: Health states/ stock trends. Expected Output: Treatment policies/ trading strategies. Application: Automated decision systems. Tools: Python, TensorFlow, PyTorch.	2 hours
14. Analyze and compare Temporal Difference methods, TD(0) and TD($\hat{\gamma}$), for faster convergence in value estimation. Dataset: No external dataset is needed. GridWorld is to be generated programmatically. Processing: Train value estimators using both methods then Compare learning speed. Sample Input: Initial random value table. Expected Output: Convergence graphs. Application: Faster learning in large MDPs. Tools: Python, numpy, matplotlib.	2 hours
15. Analyze the performance of the following below models using anyone of the datasets mentioned in the previous experiments. a) Value based RL b) Policy based RL c) Model based RL d) Cooperative and competitive RL	2 hours
Total Laboratory Hours:	30 hours
Mode of Evaluation: Continuous Assessment Test, Quiz, Final Assessment Test, Lab Continuous Assessment, Lab Final Assessment, Oral Examination, Presentation, Course Project	

Recommended by Board of Studies :	16-10-2025
Approved by Academic Council : No. 80	20-11-2025

Course Code	Course Title	L	T	P	C
BACSE401	GENERATIVE AI	3	0	2	4
Pre-requisite	BACSE303	Syllabus Version			
		1			
Course Objectives					
To impart knowledge on foundational and advanced natural language processing and generative AI concepts.					
To introduce the strategies to develop, fine-tune, and evaluate transformer-based and GPT family models.					
To equip with the ability to design and implement advanced generative AI applications using prompting and multimodal techniques.					
Course Outcomes					
Analyze and apply natural language processing techniques to build and evaluate language models and generative AI systems.					
Apply advanced models such as transformers, GPT and BERT to solve NLP tasks.					
Demonstrate proficiency in GPT architectures and variants for text generation, dialogue systems, and explore leading proprietary and open - source LLMs.					
Investigate prompting techniques in GPT models and improve LLM capabilities.					
Implement GenAI for Vision Language Models (VLM).					
Module:1	Introduction to Large Language Models and GenAI	8 hours			
Overview - Language Models - Generative Models - Agentic AI and its Architecture - Multimodal Generative AI - Evolution of LLMs - Natural Language Processing Techniques for LLMs - Applications of LLM and Generative AI.					
Module:2	Transformer Architecture and variants	10 hours			
Transformer Architecture - Multiplicative and Additive Attention - Transformer Models - Transformer Variants - Attention Mechanism Variants - Cross-Modal Transformers - Transfer Learning with Transformers - BERT and T5 Model - Fine-tuning - LoRA - Metrics - BLEU, ROUGE, METEOR - Quantization Techniques - Knowledge Distillation.					
Module:3	Generative Pre-trained Transformer	9 hours			

GPT Architecture - GPT Variants - Tokenization and Pre-training - GPT Applications in Text Generation and Dialogue Systems - Google's Gemini - Anthropic Claude - Open Source Models - LLaMA, Mistral.		
Module:4	Prompt Engineering and LLM capabilities	7 hours
Prompting Techniques - Zero-Shot Learning - Few-Shot Learning - Instruction Fine-tuning - Vector Store - Retrieval Augmented Generation (RAG) - Reinforcement Learning from Human Feedback (RLHF) - Llama Index.		
Module:5	GenAI and Applications	9 hours
Categories of GenAI Models - Diffusion Models - Stable Diffusion, Classifier-free Guidance - Denoising Diffusion Probabilistic Models - Multimodal GenAI Techniques - Vision Language Models - Contrastive Image Pre-training (CLIP), Language-Conditioned Models (LCM), Latent Alignment Models (LAM), Mixture of Experts (MoE) Models - OpenAI DALL-E - OpenAI ChatGPT - Google Vertex AI - OpenAI Whisper - Google DeepMind Gemini.		
Module:6	Contemporary Topics	2 hours
Total Lecture Hours:		45 hours
Text Book(s)		
Tanmoy Chakraborty, "Introduction to Large Language Models: Generative AI for Text", Wiley, 1 st Edition, 2024 Omar Sanseviero, Pedro Cuenca, Apolinario Passos, and Jonathan Whitaker, " Hands - On Generative AI with Transformers and Diffusion Models", Oâ€™Reilly Media, 1 st Edition, 2024		
Reference Books		
Valentiana Alto, "Modern Generative AI with ChatGPT and OpenAI Models: Leverage the Capabilities of OpenAIâ€™s LLM for Productivity and Innovation with GPT - 3 and GPT - 4", Packt Publishing, 1 st Edition, 2023 Thimira Amaratunga, " Understanding Large Language Models: Learning Their Underlying Concepts and Technologies", Apress, 1 st Edition, 2023		
Indicative Experiments		
1. Implement LSTM model to generate stories:		2 hours

a) Apply preprocessing using foundational NLP techniques like tokenization, stemming, and n-gram modelling before training the LSTM model. b) Train a 2-layer LSTM model to generate stories based on the processed data and evaluate the coherence and quality of the generated stories using appropriate NLP based metrics. Sample Dataset: TinyStories dataset.	
2. Implement Variational Autoencoder (VAE) for image generation: a) Train a VAE to generate handwritten digits. b) Build a CNN based encoder-decoder pipeline with reconstruction loss (MSE) and KL divergence loss and visualize latent space interpolations using Matplotlib. Sample Dataset: MNIST dataset.	2 hours
3. Implement GAN for Image Discrimination and Synthesis: a) Develop a DCGAN to synthesize anime faces. b) Implement Wasserstein loss, train for 100 epochs in TensorFlow, and evaluate real vs. generated images using OpenCV (or) use a pre-trained DCGAN (Example: from TensorFlow Hub). Sample Dataset: Anime Face Dataset.	4 hours
4. Implement Transformer based LLM: a) Build and train a mini Transformer (2-layer encoder) from scratch using PyTorch. (i) Use a small text dataset such as TinyStories or a small subset of IMDB reviews for pretraining. (ii) Train a tokenizer (e.g., ByteLevelBPETokenizer or WordPiece) rather than using BertTokenizer. (iii) Fine-tune the model for sentiment analysis on a medium sized dataset (e.g., 1,000 reviews). b) Load a pretrained DistilBERT model from HuggingFace and fine-tune it for 1 epoch on a small dataset (e.g., 100 reviews) for comparison. Sample Dataset: IMDB Movie Review Dataset.	2 hours
5. Implement GPT architecture for text generation and dialogue system: a) Pre-train a GPT model for masked language modeling. Fine-tune it on 1000 dialogue instances and evaluate with ROUGE-L, BLEU, and perplexity using HuggingFace's Trainer.	2 hours

b) Use a pre-trained GPT-2 model and fine-tune it for a single epoch. Give your observations on inference. Sample Dataset: OpenSubtitles Dataset.	
6. Practice few-shot learning (using 10 labeled examples) and zero-shot prompting using OpenAI's GPT-3 API. Compare the performance of both approaches using an appropriate evaluation metric. Sample Dataset: SST - 2 sentiment analysis Dataset.	2 hours
7. Implement Prompt Engineering techniques and Instruction Fine-Tuning for text summarization tasks. Apply prompt engineering using examples such as: "Summarize this article in three sentences." Perform instruction fine-tuning on a LLaMA model to generate concise news summaries. Sample Dataset: CNN/DailyMail Dataset.	4 hours
8. Evaluation of qualitative metrics: Evaluate toxicity, bias, coherence and relevance for LLM generated text. Analyze outputs using established frameworks for ethical alignment and bias detection, ensuring compliance with fairness and safety standards. Sample Dataset: BBQ bias benchmark Dataset.	2 hours
9. Implement RAG to improve LLM capabilities: Develop a RAG pipeline to answer medical questions. Use FAISS for document retrieval and BART for answer generation, and evaluate the performance using metrics such as ROUGE - L, BLEU, and accuracy. Sample Dataset: PubMedQA Dataset.	2 hours
10. Generate synthetic medical X-ray images using Stable Diffusion models. Experiment with Classifier-Free Guidance (CFG = 1.0) through HuggingFace's Diffusers library, and evaluate the generated images using SSIM (Structural Similarity Index) and FID (Fr�chet Inception Distance) to assess image quality and clinical relevance. Sample Dataset: NIH Chest X-ray Dataset.	2 hours
11. Generate synthetic chest X-ray images of "normal" and "pneumonia" using Stable Diffusion with CFG:	2 hours

Train a stable diffusion v1.4 model with label-based conditioning for 50 epochs with a batch size of 16 using MSE loss, and compare results across CFG scales of 3.0 (weak guidance) and 7.5 (strong guidance). Use HuggingFace Diffusers and PyTorch for inference to generate images for prompts such as “pneumonia” , and evaluate label alignment. Provide your observations on the variations in image quality and label consistency with different CFG scales. Sample Dataset: NIH Chest X-ray Dataset(Resize to 256x256).	
12. Synthesize images from text using Style Transfer techniques: Apply neural style transfer to convert images into Van Gogh style art using the AdaIN model. Implement the pipeline in TensorFlow, visualize the results with OpenCV, and evaluate performance using metrics like ArtFID and human perceptual scores. Sample Dataset: COCO Dataset.	2 hours
13. Implement a multimodal GenAI model: Train a Contrastive Language Image Pre-training (CLIP) model to align images and captions via contrastive loss. Use appropriate image and text encoder techniques to derive dense vector embeddings. Evaluate cross-modal retrieval performance using suitable metrics. Sample Dataset: Flickr30k Dataset.	2 hours
Total Laboratory Hours:	30 hours
Mode of Evaluation: Continuous Assessment Test, Quiz, Final Assessment Test, Lab Continuous Assessment, Lab Final Assessment, Oral Examination, Presentation, Course Project	
Recommended by Board of Studies :	16-10-2025
Approved by Academic Council : No. 80	20-11-2025

Course Code	Course Title	L	T	P	C
BAESP201	Spanish Level II	2	0	2	3
Pre-requisite	BAESP101/BESP101L	Syllabus Version			
		1			
Course Objectives					
To understand the conversation on familiar matters regularly encountered in work, school, leisure, and traveling to Spanish-speaking countries. To produce simple connected text in the target language on topics that are familiar or of personal interest. To describe experiences and events, plans, hopes, and ambitions, and briefly give reasons and explanations for opinions and plans in the target language.					
Course Outcomes					
To understand topics related to day-to-day life encountered in work, school, and leisure. To develop listening and speaking ability with an understanding of the target country's culture in real situations, such as at home, city, market, workplace, restaurant, hospital, and holidays To converse on various day-to-day topics by expressing their feelings, opinions, and ideas. To write formal letters, emails, and CVs and correspond professionally.					
Module:1	Lo que ya sabemos	3 hours			
Recursos Comunicativos- Saludos y Presentaciones, Descripciones de lugares y de personas, Hablar de hábitos y de dificultades, hablar de sentimientos, hablar de vida cotidiana, preguntar y responder sobre motivaciones, ¿Dónde quieres trabajar? Recursos Gramaticales- Presente de indicativo de verbos regulares e irregulares, verbos reflexivos, ser/estar, Interrogativos ¿qué?, ¿cuál?, ¿quién?, ¿cómo?, ¿cuánto?, ¿dónde?, ¿cuándo?, ¿Por qué? Recursos Léxicos- sentimientos, profesiones, actividades para aprender idiomas, Recurso Cultural- Lugares de interés turístico en el mundo hispano					
Module:2	Expresar los planes futuros	4 hours			

Recursos Comunicativos- hablar de planes de futuro, plan de viaje, plan de actividades, hablar de horarios. Recursos Gramaticales- Ir +a+ Infinitivo, Futuro, Por y Para, Recursos Léxicos- Actividades y lugar de ocio, viajes. Recursos Culturales- La educación en el mundo hispano		
Module:3	Escribir un correo electrónico formal e informal.	4 hours
Recursos Comunicativos- Hablar de actividades, hablar de intenciones, hablar de proyectos, relatar experiencias profesionales pasadas Recursos Gramaticales- El pretérito perfecto, Ya/ todavía no, Querer/Pensar + Infinitivo, Estar + Gerundio Recursos Léxicos- palabras profesionales, actividades Recursos culturales- La sociedad y la economía española, Relación económica entre India y España.		
Module:4	Currículo Vitae. Presentarse en una entrevista formal	4 hours
Recursos Comunicativos- 1. Hablar de experiencias interesantes, 2. Valorar personas y cosas, 3. expresar el deseo de hacer algo, Recursos Gramaticales- Los pronombres personales definido e indefinido, Superlativo y comparativo, Recursos Léxicos – Más que/ menos que, Palabras formales, técnicas. Recursos culturales- La sociedad y economía de G20 países hispanicos (Argentina y México) y su relación con la India		
Module:5	Hogar, sitios y personas: expresar gustos/disgustos	4 hours
Recursos Comunicativos- Hablar de experiencias de la vida, expresar los deseos,		

Pedir cosas, favores, pedir permiso, dar excusas y justificar Recursos Gramaticales- frases exclamativas, verbos- Gustar, Encantar, interesar, preferir, Querer. Recursos Léxicos- caer bien/mal, lugar de interés, espectáculos, Recursos culturales- La sociedad y la economía de América Central		
Module:6	El pasado: Cuando yo era Niño/a Ayer disfruté mucho con la familia	5 hours
Recursos Comunicativos- Hablar de hábitos, y costumbres y circunstancias en el pasado, Situar acciones en el pasado y en el presente, Argumentar y debatir, Relatar en pasado, Secuenciar acciones Recursos Gramaticales- El pretérito imperfecto, Marcadores temporales para el imperfecto, El pretérito indefinido, la diferencia ente pretérito imperfecto e indefinido, Marcadores temporales para indefinido. Recurso Léxicos- Viajes del pasado, etapas de la vida, Acontecimientos de la vida, emociones. Recursos culturales- La sociedad y la economía de Venezuela, Colombia, Ecuador y Perú, Chile		
Module:7	Solicitar o dar órdenes: Imperativos	4 hours
Recursos comunicativos- dar consejos, dar órdenes, conversaciones en restaurante, tienda, describir dolores, molestias y síntomas. Conversaciones con el médico. Recursos gramaticales- Imperativo afirmativo, Imperativo negativo, verbo- doler, Recursos léxicos- vocabulario de restaurante, comida, bebida, Partes del cuerpo, enfermedades. Recursos culturales-La lengua y la cultura hispana en la India		

Module:8	Contemporary Issues	2 hours
Guest Lectures		
Total Lecture Hours:		30 hours
Text Book(s)		
Álvarez Martínez, Ma Ángeles, " Nuevo Sueña 1 (A1-A2), Libro del alumno + Cuaderno de ejercicios ", ANAYA, S.A. Madrid, 2 nd Edition, 2023		
Reference Books		
Ma Angeles Palomino, " Chicos chicas, nivel 1, Libro del alumno + cuaderno de ejercicios ", Eldesa Grupo de Didascalia, S.A. Madrid, 1 st Edition, 2010 Shalu Chopra, " Viva latino 1 curso de español ", Goyal Publishers and Distributors Pvt. Ltd, New Delhi, India, 1 st Edition, 2016 Jaime Corpas, Eva Garcia, Agustin Garmendia, " Aula internacional, nueva edición ", Goyal Publishers and Distributors Pvt. Ltd, New Delhi, India, 2 nd Edition, 2016 Ernesto Puertas, Nitzia Tudela., " Dale al Dele A1 ", En Clave-ELE, 1 st Edition, 2018 Ernesto Puertas., " Dale al Dele A2 ", Goyal Publishers and Distributors Pvt. Ltd, New Delhi, India, 1 st Edition, 2013		
Indicative Experiments		
1. Reading		3 hours
2. Comprehension		2 hours
3. Listening		3 hours
4. Roleplay		3 hours
5. Writing		3 hours
Total Laboratory Hours:		30 hours
Mode of Evaluation :Continuous Assessment Test, Digital Assignment, Quiz, Final Assessment Test, Lab Continuous Assessment, Lab Final Assessment		
Recommended by Board of Studies :		13-02-2025
Approved by Academic Council : No. 78		12-06-2025

Course Code	Course Title	L	T	P	C
BAFRE201	French Level II	2	0	2	3
Pre-requisite	BAFRE101/BFRE101L	Syllabus Version			
		1			
Course Objectives					
1. To recall and recognize frequently used vocabulary, expressions, and grammatical structures in French. 2. To comprehend spoken and written French in familiar contexts, such as conversations, directions and short texts. 3. To identify and differentiate between various tenses, sentence structures and formal/informal language use.					
Course Outcomes					
1. To understand the nuances of French discourse 2. To acquire and demonstrate complicated tasks such as elaborating, complaining and apologizing. 3. To describe the ideas, opinions and concepts in French. 4. To analyze and explain it in a multi-cultural context.					
Module:1	Revision linguistique	3 hours			
Grammaire : La révision des bases de la grammaire. Lexique : Les salutations, La présentation de soi et de l'autrui, l'application de la conjugaison des verbes, l'heure et les temps, la construction des phrases Savoirs interculturels : Faire des contacts, Les échanges d'informations culturelles					
Module:2	L espace public	3 hours			
Grammaire: Les pronoms indéfinis, Les pronoms démonstratifs, Les pronoms compléments objets directs/ indirects, La formation du future simple, Le passé composé. Lexique : Les voyages, les transports, La nourriture, etc., Les lieux de la ville. Savoirs interculturels : Réserver les billets pour le voyage, réserver les chambres dans un hôtel, Demander des informations sur les lieux d'une ville, indiquer la direction à un étranger.					
Module:3	C est la fete	5 hours			
Grammaire: Conditionnel, Subjonctif, Impératif, La négation de l'impératif, Les fêtes indiennes et françaises, Les goûts.					

Lexique: Les fêtes : événements sportifs, spectacles, activités, grands festivals, Les cadeaux, Les préférences, Les intérêts Savoirs interculturels : Parler de ses goûts, raconter les vacances, construire des phrases complexes, Raconter les souvenirs de l'enfance, Parler des traditions de son pays d'origine.		
Module:4	A la mode	5 hours
Grammaire: les adjectifs qualificatifs, comparatifs, superlatifs Lexique: dresser le portrait physique et émotionnel d'une personne, faire des appréciations, faire des achats, demander et indiquer des prix et des tailles, parler de la santé, donner des explications, Les mots interrogatifs. Savoirs interculturels: la mode en France, le système de santé en France		
Module:5	Les sorties	4 hours
Grammaire: proposer/accepter/refuser une sortie, parler de ses activités, commander au restaurant, parler de son logement. Lexique: les adverbes de fréquence, le futur proche, l'article partitif, les formules de politesse. Savoirs interculturels: la gastronomie francophone, la fête de la Chandeleur		
Module:6	Carnet de voyage	4 hours
Grammaire: le passé récent (venir de), discours direct/indirect Lexique: réserver un logement, écrire une carte postale de ses vacances, exprimer une opinion Savoirs interculturels: la France d'Outre-Mer		
Module:7	Le monde professionnel	4 hours
Grammaire: les verbes modaux (devoir/savoir/pouvoir/vouloir) Lexique: rédiger un courriel, faire son CV, postuler à une petite annonce, exprimer son savoir-faire. Savoirs interculturels: le monde du travail en France et les échanges professionnels		
Module:8	Echanges interculturels	2 hours
Rencontre avec des experts, échanges interculturels et colloques.		
Total Lecture Hours:		30 hours
Text Book(s)		

Clémence FAFA, " Edito A2 Méthode de Français ", Didier Paris, 1 st Edition, 2022	
Reference Books	
Clémence FAFA, " Edito A2, Le cahier d'exercices ", Didier Paris, 1 st Edition, 2022	
Indicative Experiments	
1. Ressources Audio: Coffee Break French, Linguistica 360, News in Slow French.	3 hours
2. Sites Internet: Duolingo, TV5 Monde Langue Française, FrenchPod101, BBC French, LingQ, Le Point du FLE.	3 hours
3. Chaînes YouTube: Apprendre le français avec Alexa: Leçons interactives et engageantes pour les apprenants intermédiaires, Français Authentique: Vidéos pour pratiquer l'écoute avec du français authentique, EdX Français : Cours vidéo gratuits des universités, avec exercices interactifs et contenus d'écoute.	3 hours
4. Outils interactifs- Forvo: Prononciation des mots et phrases par des locuteurs natifs pour s'exercer à l'oral.	3 hours
5. Quizlet en français: Créez des cartes mémoire interactives avec des enregistrements audio pour apprendre le vocabulaire.	3 hours
Total Laboratory Hours:	30 hours
Text Book(s)	
L. GUIACHINO & C. BARACCO, " Nouvelle Génération A2, Méthode de français ", Didier Paris, 1 st Edition, 2020	
Reference Books	
L. GUIACHINO & C. BARACCO, " Nouvelle Génération A2, Le cahier d'activités ", Didier Paris, 1 st Edition, 2020	
Mode of Evaluation :Continuous Assessment Test, Digital Assignment, Quiz, Final Assessment Test, Lab Continuous Assessment, Lab Final Assessment, Oral Examination, Group Discussion, Presentaion	
Recommended by Board of Studies :	14-02-2025
Approved by Academic Council : No. 78	12-06-2025

Course Code	Course Title	L	T	P	C
BAGER201	German Level II	2	0	2	3
Pre-requisite	BAGER101/BGER101L	Syllabus Version			
		1			
Course Objectives					
Improve reading, writing and communication skills in the target language by including intermediate level texts. Improve listening and comprehension capability in everyday real-life situations. Develop better understanding of the usages of the target language and culture.					
Course Outcomes					
Develop listening and speaking ability in real situations, such as, at home, university, market, work, hospital, holidays. Converse on various day to day topics by expressing their feelings, opinions and ideas. Write formal letters, emails, CV and correspond officially in professional life. Be able to translate some basic technical texts from the target language into English and vice-versa.					
Module:1	Landeskunde	4 hours			
Kultur, Sitten und Bräuche der deutschsprachigen Länder, allgemeine Informationen über das Leben der Studenten und Kosten des Lebens in Deutschland					
Wortschatz: Kultur, Sitten, Bräuche, Leben in deutschsprachigen Ländern					
Grammatik: Wiederholung der Grammatik der Grundstufe					
Module:2	Kontakte	4 hours			
Termine absprechen, Anleitungen verstehen und beantworten, Informationen in Texten finden, Gespräche verstehen und an den Gesprächen teilnehmen					
Wortschatz: Büro, Telefon, Brief					
Grammatik: Dativ (Artikel und Präposition), Possessivartikel (Akkusativ)					
Module:3	Meine Wohnung	4 hours			
Wohnungsanzeigen verstehen, eine Wohnung beschreiben, über eine Wohnungseinrichtung sprechen, einen Text über eine Wohnung schreiben					

Wortschatz: Wohnung, Zimmer, Wohnformen, Möbel und Geräte, Farben		
Grammatik: Adjektiv mit 'sein' (+ sehr/zu), Wechselpräpositionen		
Module:4	Studium und Beruf	4 hours
einen Tagesablauf beschreiben, Stellenanzeigen verstehen, ein Telefongespräch vorbereiten, Blogs über Jobs verstehen, über Arbeit sprechen		
Wortschatz: Beruf, Arbeitsort, Studium, Job		
Grammatik: Perfekt, Partizip II: regelmäßige und unregelmäßige Verben, Sätze verbinden: und, oder, aber		
Module:5	Kleidung und Mode	4 hours
über Kleidung sprechen, Kleidung kaufen, Farben und Größen angeben, sich im Kaufhaus orientieren		
Wortschatz: Kleidung, Stockwerke und Waren im Kaufhaus, Geschäfte und Läden		
Grammatik: Welcher, Welches, Welche/ Dieser, Dieses, Diese, Personalpronomen im Dativ, Verben mit Dativ		
Module:6	Körper und Gesundheit	4 hours
Persönliche Angaben machen, Körperteile nennen, eine Sportübung verstehen und erklären, Gespräche beim Arzt führen, Anweisungen verstehen und geben, Gesundheitstipps verstehen und geben		
Wortschatz: Körperteile, Körperpflege, Krankheiten, Medikamente		
Grammatik: Imperativ, Aufforderungssätze, sollen, müssen, dürfen		
Module:7	Urlaub	4 hours
Vorschläge für eine Stadttour verstehen, einen Weg beschreiben, eine Postkarte schreiben, das Wetter beschreiben, Reiseberichte verstehen, Probleme im Hotel beschreiben, über Reiseziele sprechen		

Wortschatz: Urlaubsorten und Reiseziele, Sehenswürdigkeiten, Wetter		
Grammatik: Pronomen: man, Fragewörter: wer, wen, wem, was, Zeitadverbien: zuerst, dann, später, zum Schluss		
Module:8	Contemporary Issues	2 hours
Invited Talk: Contemporary issues (Cultural History of German Speaking Countries; Experiences in working in German cultural environment in industries)		
Total Lecture Hours:		30 hours
Text Book(s)		
Stefanie Dengler, Paul Rusch, Helen Schmitz, Tanja Sieber, " Netzwerk neu A1.2 ", Goyal Publisher, 2024 Stefanie Dengler, Paul Rusch, Helen Schmitz, Tanja Sieber, " Netzwerk A1 ", Goyal Publisher, 2021		
Reference Books		
Indicative Experiments		
1. Hörverstehen – Telefongespräche, Gespräch führen – Termin vereinbaren		2 hours
2. Video:Wohnungssuche, Wohnungbeschreiben, Gespräche führen – Meine Wohnung		2 hours
3. Video – Tagesablauf, Im Büro, Interview Gespräche führen – Arbeit, Studium, Tagesablauf		2 hours
4. Video: Gespräch im Kaufhaus, Orientierung im Kaufhaus, Dialog üben- im Geschäft, im Laden, im Kaufhaus		2 hours
5. Video: Beim Arzt, die Körperteile nennen, Krankheit Gespräche führen – Beim Arzt, über die Krankheit sprechen		2 hours
6. Video – Orientierung in der Stadt, Wegbeschreibung		5 hours

Sich äußern: Weg beschreiben	
Film: Nico's Weg, A1, A2	
Total Laboratory Hours:	30 hours
Mode of Evaluation : Continuous Assessment Test, Digital Assignment, Quiz, Final Assessment Test, Lab Continuous Assessment, Lab Final Assessment	
Recommended by Board of Studies :	14-02-2025
Approved by Academic Council : No. 78	12-06-2025

Course Code	Course Title	L	T	P	C
BAHIN101	Prathamik Hindi	3	0	0	3
Pre-requisite	NIL	Syllabus Version			
		1			
Course Objectives					
To Communicate in Hindi in their day to day life. To become Industry ready Build a foundation for continued language learning.					
Course Outcomes					
Developing communicative skills. Learn how to use right tense for right situations. Understand the basic principles of grammar. Designed to make the student comfortable in real life situations where Hindi becomes a necessity.					
Module:1	Hindi Bhasha aur Varnamala	9 hours			
Hindi aur Devnagari parichay - Swar - Swar ke bhed - Vyanjan - Vyanjan ke bhed - Maatra- samyukt akshar - Halant - Anuswaar aur uske niyam - Ra ke vibhinn bhed					
Module:2	Vyavahaarik Shabdawali Evam Sankhya	5 hours			
Abhivaandan - vaar - Mahine - Samay - Disha - Khadya aur Pey padharth - phal - sabzi - phul - Pakshi aur jaanwar - Kapde - Sharir ke ang -Vyavasay - gruhasthi ke saaman - Rang- mausam - Rishtom ke naam Ganana sankhya shabd- kramsuchak sankhya					
Module:3	Vyakaran	6 hours			
Sarvanaam - sambandh vachak shabd - Ling ke niyam (Puling / Streeling) - ling parivartan ke niyam - vachan parivartan ke niyam					
Module:4	Hindi Vakya Kram Kriya evam Kaal	6 hours			
Vakya Rachana - Kriya - Hona Kriya ka prayog - Vartaman - Bhut - Bhavishya					
Module:5	Shabd Bhed	9 hours			
Vibhakti Chinn - ne, Ka/Kee/Ke, se, mein, Par, Ko ka prayog, samyukt Vibhakti Chinn, Sambandh bodhak avyay, Prashnavachak Shabd					
Module:6	Samvaad Lekhan	4 hours			
Saamanya Vakya : Abhivaadan - Dosthom ke Beech - Hostel mein - Hotel mein - Parivaar ke saath					

Module:7	Anuvaad	4 hours
Anuvaad (Hindi se Angrezi) - Angrezi se Hindi		
Module:8	Guest Lecture	2 hours
Guest Lecture		
Total Lecture Hours:		45 hours
Text Book(s)		
Sawan, " Teach yourself Hindi ", Manoj Publications , 1 st Edition, 2020		
Reference Books		
Rajiv Ranjan, " Basic Hindi I ", Libre Texts, 1 st Edition, 2021 Getway Guides, " Hindi for Beginners: The Handbook for learning to speak Hindi ", Create Space , 2 nd Edition, 2015		
Mode of Evaluation :Continuous Assessment Test, Digital Assignment, Quiz, Final Assessment Test		
Recommended by Board of Studies :		13-02-2025
Approved by Academic Council : No. 78		12-06-2025

Course Code	Course Title	L	T	P	C
BAHIN102	Prayojanmulak Hindi	2	0	2	3
Pre-requisite	NIL	Syllabus Version			
		1			
Course Objectives					
Imperative to be proficient in both native and foreign languages. Equipping students with vital communication skills to succeed in the highly competitive international arena. The proposed course offers in-depth, practical exposure to the usage of Hindi in the professional sphere,					
Course Outcomes					
Understand the language, usage and style, Comprehend different forms and techniques of Functional Hindi Acquainted with the newly emerged functional forms of Hindi- commercial, Administration, Banking, Insurance etc. Acquire proficiency in communication and official language Hindi.					
Module:1	Hindi Bhasha Prayog ke Dhristi se Vividh Roop	5 hours			
Rashtra Bhasha - Rajbhasha - Sampark Bhasha - Rachnatmak Bhasha evam sanchar Bhasha - Bhoomandalikaran aur suchana kranti ka hindi par prabhav.					
Module:2	Prayojanmulak Hindi samanya parichay	5 hours			
Prayojanmulak Hindi Samanya parichay - Visheshataayem - Aavashyakta evam upayogita - prayojanmulak hindi aur Sahitiyak Hindi mein samya - vaishmya - samsyayem aur samaadhan- seemayem aur sambhavanayem					
Module:3	Prayojanmulak Hindi karya kshetra ka parichay	5 hours			
Rajbhasha ke roop mein Hindi - vidhi kshetra mein Hindi - vyavasayik Hindi - Bank, Bhima, Vanijya aur vyapar - takni ke Hindi - vigyan suchana evam prodhogi ke mein Hindi - Film samiksha ke Hindi - Fashion Jagat ke Hindi.					
Module:4	Anuvaad Siddhant aur prayog	5 hours			
Anuvaad arth evam paribhasha - swaroop- mahattva- Anuvaad ke kshetra - Anuvaad ke prakar- Anuvaad ke samsyayem - Anuvaad ke gun.					
Module:5	Computer aur Hindi	2 hours			
Computer mein Hindi ka anuprayog - Hindi aur internet ka vikas - Hindi ke pramukh software- fonts- Machine anuvaad- sambhavanayem aur seemayem - new media aur hindi Bhasha.					

Module:6	Vigyapan aur Hindi	2 hours
Paribhasha - Uddeshya - Vigyapan ke prakar - Vartaman yug mein vigyapan ka mahattva - Vigyapan kee Bhasha - Vigyapan aur Hindi		
Module:7	Paaribhashik Shabdawali	4 hours
Arth evam swaroop - Paribhasha - saamanya Shabd tatha Paaribhashik shabdom mein antar- nirmaan prakriya - shabdawali ayog- aavishyakata evam mahattva - vikas - upyogita - apekshit gun - samasyayem - Adhunik yug mein paaribhashik shabdawali ka mahatva aur bhoomika		
Module:8	Guest Lecture	2 hours
Guest lecture		
Total Lecture Hours:		30 hours
Text Book(s)		
Anirudh Pathak , " Prayojanmulak Hindi ", Arjun Publication, 1 st Edition, 2020		
Reference Books		
Dr. S. A. Manjunath , " Prayojanmulak Hindi ", Notion Press, 1 st Edition, 2022 Dr. Deepak Vishwaasrao Paateel , " Prayojanmulak Hindi ", Atharva Publications, 1 st Edition, 2024 Dr. Asha Mohan & Dr. Jagdeesh Sharma, " Prayojanmulak Hindi ", Sahitya Sarovar, 10 th Edition, 2017		
Indicative Experiments		
1. Vigyapan Nirman, Abhyas - vargikrit evam sajavati vigyapan, sansthanik Vigyapan		4 hours
2. Anuvaad Samajik, Vaigyanik, Takneeke		3 hours
3. Anuvaad - Vyigyanik		2 hours
4. Anuvaad - Takneekee		3 hours
5. Vibhinn Kshetraom kee paaribhashik shabdawali - vigyapan, Prashashanik, Karyalayom ke naam, padnaam, Prashasanik Vakyamsh		3 hours
6. anuvaad		2 hours
7. Prashashanik Shbdawali		2 hours
8. Paribhashik Shabdawali - Karyalayom ke naam		2 hours
9. Shabdawali - Padnaam.		2 hours
10. Prashasanik Vyakyamsh,		2 hours

11. Anuvaad	3 hours
12. Anuvaad	2 hours
Total Laboratory Hours:	30 hours
Reference Books	
Vinod Godare, " Prayojanmulak Hindi ", Vani Publication, 1 st Edition, 2016	
Mode of Evaluation :Continuous Assessment Test, Digital Assignment, Quiz, Final Assessment Test, Lab Continuous Assessment, Lab Final Assessment, Seminar	
Recommended by Board of Studies :	13-02-2025
Approved by Academic Council : No. 78	12-06-2025

Course Code	Course Title	L	T	P	C
BAJAP201	Japanese Level II	2	0	2	3
Pre-requisite	BAJAP101/BJAP101L	Syllabus Version			
		1			
Course Objectives					
Improve reading, writing and communication skills in the target language. Improve listening and comprehension capability in everyday real life situations. Develop better understanding of the usages of the target language and culture.					
Course Outcomes					
Understand topics related to day-to-day life, encountered in work, school and leisure. Develop listening and speaking ability in real life situations such as, at home, university and workplace. Converse on various day-to-day topics by expressing their feelings, opinions and ideas. Express their hobbies, daily routine, plan and schedule.					
Module:1	Introduction, Japanese scripts: Hiragana, Katakana and Kanji	4 hours			
Introduction to Japanese language. Reading and writing Hiragana, Katakana and Kanji. Basic vocabulary and counting in Japanese. Basic rule of Japanese phonetics; contracted sounds, vowel, double consonants and devoicing.					
Module:2	Japanese Greetings	4 hours			
Daily greetings; basic phrases to greet in Japanese. Konnichiwa, Ohayoogozaimasu, etc. Body language such as bowing, pointing to your face, etc.					
Module:3	Self Introduction and Family	4 hours			
How to introduce oneself in Japanese; self-introduction (Jikoshookai). How to express name, age, hobby, occupation, educational institute . Framing simple questions. Introducing family members.					
Module:4	Food and Drinks	4 hours			
Describing, favorite food items, dishes and drinks in Japanese. Talk about breakfast, lunch and dinner. Placing order in restaurant. Use of adjectives.					
Module:5	Describing house, visiting someone's house in Japan	4 hours			
Describing the house and the things present in house by using adjectives. Etiquette and manners associated with visiting someone's house in Japan as a guest. Basic Verbs (います、あります, etc.). How to say today, tomorrow and yesterday.					
Module:6	Daily routine	4 hours			

Talk about your daily routine. Vocabulary related to time, dates, weekdays, month, year and birthday in Japanese. Framing questions related to time.		
Module:7	Describing and knowing about things, places, persons and directions	4 hours
Use of demonstrative pronouns; kore, sore, are , kono , sono , ano, dono, etc. Asking questions and giving answers in Japanese.		
Module:8	Guest Lecture	2 hours
Guest Lecture		
Total Lecture Hours:		30 hours
Text Book(s)		
The Japan Foundation, " Marugoto Japanese Language and Culture Starter A1 Coursebook For Communicative Language Activities ", Goyal Publishers , 1 st Edition, 2017		
Reference Books		
Banno, Eri et al, " Genki: An Integrated Course in Elementary Japanese I ", Japan: The Japan Times, 3 rd Edition, 2020 The Japan Foundation, " Marugoto Japanese Language and Culture Starter A1 Coursebook For Communicative Language Competences ", Goyal Publishers , 1 st Edition, 2017 The Japan Foundation, " Marugoto Japanese Language and Culture Starter A1 Coursebook For Communicative Language Competences ", Goyal Publishers , 1 st Edition, 2017		
Indicative Experiments		
1. Reading, Writing, Listening, Comprehension, Role play		15 hours
Total Laboratory Hours:		30 hours
Text Book(s)		
The Japan Foundation, " Marugoto Japanese Language and Culture Starter A1 Coursebook For Communicative Language Activities ", Goyal Publishers , 1 st Edition, 2017		
Reference Books		
Banno, Eri et al , " Genki: An Integrated Course in Elementary Japanese I ", The Japan Times, 3 rd Edition, 2020		
Mode of Evaluation :Continuous Assessment Test, Digital Assignment, Quiz, Final Assessment Test, Lab Continuous Assessment, Lab Final Assessment		
Recommended by Board of Studies :		14-02-2025

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