GM UNIVERSITY

COURSE DOCUMENT

2024 SCHEME

I-VIII SEMESTER

B.Tech in
CS-Cloud Computing

GM UNIVERSITY
Innovating Minds

School of Computer Science & Technology
Faculty of Engineering & Technology

Semester-1			
S. No.	**Course Code**	**Course Title**	**Credits**
1.	UE24CS1101	Foundational Mathematics for Computer Science	3
2.	UE24CS1102	Analog & Digital Fundamentals	3
3.	UE24CS1103	Advanced Materials Integration in Computing Technology	3
4.	UE24CS1104	Problem Solving through C Programming	3
5.	UE24CS1105	Web Designing & Programming	3
6.	UE24CS1106	Project Based Learning / mini project on Web Designing	2
7.	SDTCD	Technical Competency	0
8.	CASP	Life Skills	0
9.	CIBI	Innovation and Entrepreneurial Skills	0
10.	SA	Environmental Awareness and Community Services	0
11.	SA	Athletics, Sports, Yoga, Gymnasium	0
12.	SA	Cultural & Literary Activities	0
13.	SASP	Co-Curricular Activities (Seminar/Conference/Exhibition/Technical Competition)	0
14.	CASP	Placement Training	0
Total			**17**

Semester-2			
S. No.	**Course Code**	**Course Title**	**Credits**
1.	UE24CS1201	Applied Mathematics for Computer Science	3
2.	UE24CS1202	Applied Physics for CSE	3
3.	UE24CS1203	Data Structures & Algorithms	3
4.	UE24CS1204	Python Programming	3
5.	UE24CS1205	Fundamentals of Computer Networks	3
6.	UE24CS1206	Fundamentals of DBMS	3
7.	UE24CS1207	Project Based Learning / mini project on Computer Networks	2
8.	SDTCD	Technical Competency	02
9.	CASP	Life Skills	01
10.	CIBI	Innovation and Entrepreneurial Skills	00
11.	SA	Environmental Awareness and Community Services	01
12.	SA	Athletics, Sports, Yoga, Gymnasium	00
13.	SA	Cultural & Literary Activities	00
14.	SASP	Co-Curricular Activities (Seminar/Conference/Exhibition/Technical Competition)	00
15.	CASP	Placement Training	00
Total			**24**

Semester-3			
S. No.	**Course Code**	**Course Title**	**Credits**
1.	UE24CS2301	Algorithm Design and Complexity Analysis	4
2.	UE24CS2302	Internet of Things	3
3.	UE24CS2303	Object Oriented Programming	3
4.	UE24CS2304	Computer Organization and Architecture	3
5.	UE24CS2305	Operating System Concepts	3
6.	UE24CS2306	Project Based Learning / mini project	2
7.	SDTCD	Technical Competency	02
8.	CASP	Life Skills	01
9.	CIBI	Innovation and Entrepreneurial Skills	00
10.	SA	Environmental Awareness and Community Services	01
11.	SA	Athletics, Sports, Yoga, Gymnasium	01
12.	SA	Cultural & Literary Activities	00
13.	SASP	Co-Curricular Activities (Seminar/Conference/Exhibition/Technical Competition)	00
14.	CASP	Placement Training	01
Total			**24**

Semester-4			
S. No.	**Course Code**	**Course Title**	**Credits**
1.	UE24CS2401	Machine Learning	3
2.	UE24CS2402	Software Development Methodologies	3
3.	UE24CS2403	Discrete Structures for Computing	2
4.	UE24CS2404	Advanced DBMS + NoSql	3
5.	UE24CS2405	Automata Theory and Compiler Design	3
6.	UE24CS2406	Project Based Learning / mini project on building a Machine Learning Model	2
7.	SDTCD	Technical Competency	02
8.	CASP	Life Skills	01
9.	CIBI	Innovation and Entrepreneurial Skills	01
10.	SA	Environmental Awareness and Community Services	01
11.	SA	Athletics, Sports, Yoga, Gymnasium	01
12.	SA	Cultural & Literary Activities	01
13.	SASP	Co-Curricular Activities (Seminar/Conference/Exhibition/Technical Competition)	00
14.	CASP	Placement Training	01
Total			**24**

Semester-5			
S. No.	**Course Code**	**Course Title**	**Credits**
1.	UE24CS3501	Advanced Machine Learning	3
2.	UE24CC3502	Cloud Computing and its Applications	3
3.	UE24CC3503	Generative AI	3
4.	UE24CC3504	Data Privacy	3
5.	UE24CC35XX	Professional Elective -1	3
6.	UE24CC3506	Project Based Learning	3
7.	SDTCD	Technical Competency	2
8.	CASP	Life Skills	0
9.	CIBI	Innovation and Entrepreneurial Skills	0
10.	SA	Environmental Awareness and Community Services	0
11.	SA	Athletics, Sports, Yoga, Gymnasium	1
12.	SA	Cultural & Literary Activities	0
13.	SASP	Co-Curricular Activities (Seminar/Conference/Exhibition/Technical Competition)	0
14.	CASP	Placement Training	1
Total			**22**

Semester-6			
S. No.	**Course Code**	**Course Title**	**Credits**
1.	UE24CC3601	Cloud Management and Security	3
2.	UE24CC3602	Full Stack development with mini project	3
3.	UE24CC3603	Big Data and Cloud Data Analytics	3
4.	UE24CC36XX	Professional Elective - 2	3
5.	UE24CC3604	Project Based Learning	3
6.	SDTCD	Technical Competency	2
7.	CASP	Life Skills	0
8.	CIBI	Innovation and Entrepreneurial Skills	1
9.	SA	Environmental Awareness and Community Services	0
10.	SA	Athletics, Sports, Yoga, Gymnasium	0
11.	SA	Cultural & Literary Activities	1
12.	SASP	Co-Curricular Activities (Seminar/Conference/Exhibition/Technical Competition)	0
13.	CASP	Placement Training	0
Total			**19**

Semester-7			
S. No.	**Course Code**	**Course Title**	**Credits**
1.	UE24CS4701	Open Elective -1	3
2.	UE24CS4702	Intellectual Property Rights	3
3.	UE24CS4703	Industry Internship	4
4.	UE24CS4704	Project - 1	4
5.	SDTCD	Technical Competency	00
6.	CASP	Life Skills	00
7.	CIBI	Innovation and Entrepreneurial Skills	00
8.	SA	Environmental Awareness and Community Services	00
9.	SA	Athletics, Sports, Yoga, Gymnasium	00
10.	SA	Cultural & Literary Activities	01
11.	SASP	Co-Curricular Activities (Seminar/Conference/Exhibition/Technical Competition)	01
12.	CASP	Placement Training	00
Total			**16**

Semester-8			
S. No.	**Course Code**	**Course Title**	**Credits**
1.	UE24CS4801	Engineering Project Management	3
2.	UE24CS4802	Open Elective -2	3
3.	UE24CS4803	Project - 2	6
4.	SDTCD	Technical Competency	00
5.	CASP	Life Skills	00
6.	CIBI	Innovation and Entrepreneurial Skills	01
7.	SA	Environmental Awareness and Community Services	00
8.	SA	Athletics, Sports, Yoga, Gymnasium	00
9.	SA	Cultural & Literary Activities	00
10.	SASP	Co-Curricular Activities (Seminar/Conference/Exhibition/TechnicalCompetition)	01
11.	CASP	Placement Training	00
Total			**14**

Semester-1			
S. No.	**Course Code**	**Course Title**	**Credits**
1.	UE24CS1101	Foundational Mathematics for Computer Science	3
2.	UE24CS1102	Analog & Digital Fundamentals	3
3.	UE24CS1103	Advanced Materials Integration in Computing Technology	3
4.	UE24CS1104	Problem Solving through C Programming	3
5.	UE24CS1105	Web Designing & Programming	3
6.	UE24CS1106	Project Based Learning / mini project on Web Designing	2
7.	SDTCD	Technical Competency	0
8.	CASP	Life Skills	0
9.	CIBI	Innovation and Entrepreneurial Skills	0
10.	SA	Environmental Awareness and Community Services	0
11.	SA	Athletics, Sports, Yoga, Gymnasium	0
12.	SA	Cultural & Literary Activities	0
13.	SASP	Co-Curricular Activities (Seminar/Conference/Exhibition/Technical Competition)	0
14.	CASP	Placement Training	0
Total			**17**

Course Code	UE24CS1101
Course Title	**Foundational Mathematics for Computer Science**

Course Details:

- **Linear Algebra:** Basics of Matrices, Elementary row transformation, Rank of a matrix-echelon form.
- **Solution of system of linear equations:** Consistency, Gauss-elimination method, Gauss- Jordan method and approximate solution by Gauss-Seidel method.
- **Eigenvalues and eigenvectors:** Definition,¬ Rayleigh's power method.
- **Differential Calculus:** Taylor's and Maclaurin's series expansion for one variable (Statement only) – problems on Maclaurin's series.
- **Indeterminate forms:** L'Hospital's rule.
- **Partial differentiation:** Differentiation of composite functions, Jacobian and problems.
- **Modular Arithmetic:** Importance of modular arithmetic in the field of Computer science & engineering, Introduction to Congruence's, Linear Congruence's.
- **Finding GCD:** Finding GCD using Euclid's Algorithm, Remainder theorem (statement only), Solving Polynomials.
- **Linear Diophantine Equation,** System of Linear Congruence.**Euler's Theorem (statement only),** Wilson's Theorem (statement only) and Fermat's little theorem (statement only).
- **Numerical Methods:** Solution of algebraic and transcendental equations - Regula- Falsi and Newton-Raphson methods (only formulae).
- **Finite differences:** Interpolation using Newton's forward and backward difference formulae, Newton's divided difference formula and Lagrange's interpolation formula (All formulae without proof).
- **Numerical integration:** Simpson's (1/3)rd and (3/8)th rules(without proof).
- **Numerical Solution of Ordinary Differential Equations (ODE's):** Taylor's series method, Modified Euler's method, Runge-Kutta method of fourth order and Milne's predictor-corrector formula (No derivations of formulae).

Course Code	UE24CS1102
Course Title	**Analog and Digital Fundamentals**

Course Content

- **Semiconductor Diodes and Applications:** P-N junction diode, Equivalent circuit of diode, Rectification-Half wave rectifier, Full wave rectifier (Ripple factor, Efficiency-only Definition) Zener Diode, Zener diode as a voltage regulator, Bipolar Junction Transistor (BJT) structure, The BJT as an amplifier, The BJT as a switch: Switching operation, A simple Application of a Transistor Switch, Feedback Amplifiers and Oscillators: Introduction, Types of feedback, Gain stability with feedback, Oscillators, Phase Shift oscillator, Wien Bridge oscillator.
- **The Operational Amplifiers:** Introduction to Op-Amp, Op-Amp Input Modes: Differential mode, Common mode, Op-Amp Parameters: CMRR, Maximum output Voltage Swing, Input Offset Voltage, Input Bias Current, Input and Output Impedance, Input offset current, Slew Rate, Basic Op-Amp Circuits: Inverting amplifier, Virtual ground, Non-Inverting amplifier, Linear applications of Op-amp: Summer, Subtractor, Voltage follower, Integrator, Differentiator and Comparator Numerical.
- **Digital Concepts and Number System:** Introduction to Number Systems, Number system Conversions: Binary to Hexadecimal, Hexadecimal Conversion, Hexadecimal and Octal to binary conversion, binary to decimal conversion Principal of combinational logic: Introduction, Definition of combinational logic, Canonical forms, generation of switching equation from truth tables, Karnaugh map (Three and Four variables k-maps), quine-McCluskey minimization technique: using don’t care terms.
- **Analysis and design of combinational logic:** Introduction, General approach to combinational logic design Binary Adders and Sub-tractors, comparators, Decoders, Encoders: 8:3 line priority encoder, multiplexers.
- **Flip-Flops and its Applications:** Basic Bistable elements, Latches, The master-slave flip-flops(pulse-triggered flip-flops): SR flip-flops, JK flip-flops, Edge triggered flip-flops, Characteristic equations, Registers, binary ripple counters (3 bits only) and Design of synchronous binary counters (3 bits only)

Course Code	UE24CS1103
Course Title	**Advanced Materials Integration in Computing Technology**

Course Content

- **Energy Materials for Engineering**:

  Polymers: Introduction to polymers, conducting mechanism of polyacetylene, structure and applications of conducting polyaniline and its commercial applications.
  Composites: Introduction, properties and industrial applications of carbon-based reinforced composites and metal matrix polymer composites.
  Perovskite Materials: Introduction, properties and applications in optoelectronic devices.
- **Nanotechnology and Memory Devices:**

  Nanomaterials: Introduction, preparation of nanomaterials by different approaches, size dependent properties of nanomaterials (Surface area, Catalytic, Conducting, Thermal and Electrical). Introduction, properties and applications of Nano-fibres, Nano-photonics and Nano-sensors.

  Memory Devices: Introduction, Basic concepts of electronic memory, Organic/polymer electronic memory devices, classification of electronic memory devices, types of organic memory devices (organic molecules, polymeric materials, organic inorganic hybrid materials).
- **Energy Conversion and Storage Devices Battery Technology:** Introduction, characteristics, classification of batteries, Construction, working and applications of Lithium ion and Sodium ion batteries in electrical vehicles. Quantum Dot Sensitized Solar Cells (QDSSC's) - Principle, Properties and Applications. Construction, working and applications of Solar cell.

  Electrode System: Introduction, types of electrodes, Ion selective electrode – definition, construction, working and applications of glass electrode. Reference electrode- Introduction, calomel electrode– construction, working and applications of calomel electrode. Concentration cell definition, construction and numerical problems.
- **Sensors and Display Systems**

  Sensors: Introduction, working, principle and applications of electrochemical sensors, electrochemical sensors for the pharmaceuticals. Electrochemical gas sensors for Sox and NOx. Disposable sensors in the detection of biomolecules and pesticides.

  Display Systems: Liquid crystals (LC's)-Introduction, classification, properties and application in Liquid Crystal Displays (LCD's). Properties and application of Organic Light Emitting Diodes (OLED's) and Quantum Light emitting diodes (QLED's).
- **Analytical Techniques and E-waste Managements**

  Analytical Techniques: Introduction, principle and instrumentation of colorimetric sensors; its application in the estimation of copper, principle and instrumentation of potentiometric sensors; principle and instrumentation of its application in the estimation of Iron, conduct metric sensors; its application in estimation of weak acid v/s strong base.

  E-Waste: Introduction, sources of e-waste, Composition and Need of E-waste management. Toxic materials used in manufacturing electronic and electrical products; health hazards due to exposure to e-waste. Recycling of E-waste by hydro metallurgical and pyro-metallurgical methods. Role of stakeholders in environmental management of e-waste: producers, consumers, recyclers, and statutory bodies.

Course Code	UE24CS1104
Course Title	**Problem Solving through C Programming**

1.1 Course Content

- **Introduction to Computer languages and C Programming:** Introduction to basic structure of a computer, evolution of computer languages. Introduction to C, Structure of C program, Steps required to create and execute a C program, design tools – algorithm, flowchart and pseudo code, C tokens, variables, constants, Input/output statements in C.
- **Operators and expressions:** Types of operators in C, evaluation of expressions and type conversion.
- **Branching and looping statements:** Introduction to decision control, conditional branching statements, looping statements, nested loops and unconditional branching.
- **Functions:** Introduction to functions, function definition, function declaration, function call, return statement, passing parameters to functions, scope of variables, storage classes, recursive functions.
- **Arrays:** Declaration and initialization of single dimension and multi-dimensional arrays, accessing the elements of an array, passing arrays to functions, applications of arrays – searching and sorting.
- **Strings:** Introduction to strings, string taxonomy, operations on strings, miscellaneous string and character functions, arrays of strings.
- **Pointers:** Introduction to pointers, declaring pointer variables, types of pointers, passing arguments to functions using pointers, dynamic memory management using pointers.
- **Structure, Union, and Enumerated Data Type:** Structure declaration, typedef, array of structures, nested structures, pointer to structures, structures as parameter to functions, Introduction to union and enumerated data type.
- **Files:** Introduction to files in C, types of files, basic file operations, fseek and rewind.

Course Code	UE25CS1105
Course Title	Web Designing & Programming

Course Content

- **Traditional HTML and XHTML:** Introduction to websites, Purpose and Examples of different types of websites, Key Components of a Website: Frontend (client-side), Backend (server-side), understand how websites work, understand how the internet works. First Look at HTML and XHTML, Hello HTML and XHTML World, HTML and XHTML: Version History, HTML and XHTML DTDs: The Specifications Up Close, (X) HTML Document Structure, Browsers and (X)HTML, The Rules of (X)HTML, Major Themes of (X)HTML, The Future of Markup—Two Paths?
- **HTML5:** Hello HTML5, Loose Syntax Returns, XHTML5, HTML5: Embracing the Reality of Web Markup, Presentational Markup Removed and Redefined, HTML5 Document Structure Changes, Adding Semantics, HTML5's Open Media Effort, Client-Side Graphics with <canvas>, HTML5 Form Changes, Emerging Elements and Attributes to Support Web Applications
- **Cascading Style Sheets (CSS):** Introduction, CSS Overview , CSS Rules, Example with Type Selectors and the Universal Selector, CSS Syntax and Style, Class Selectors, ID Selectors, span and div Elements, Cascading, style Attribute, style Container, External CSS Files, CSS Properties, colour Properties, RGB Values for colour, Opacity Values for colour, HSL and HSLA Values for colour, Font Properties, line-height Property, Text Properties, Border Properties, Element Box, padding Property, margin Property , Case Study: Description of a Small City's Core Area.
- **Tables and CSS, Links and Images** : Table Elements, Formatting a Data Table: Borders, Alignment, and Padding, CSS Structural Pseudo Class Selectors, thread and tbody Elements, Cell Spanning, Web Accessibility, CSS display Property with Table Values, a Element, Relative URLs, Navigation Within a Web Page, CSS for Links, Bitmap Image Formats: GIF, JPEG, PNG, img Element, Responsive Images, Positioning Images, Shortcut Icon, iframe Element .
- **Introduction to JavaScript: Functions, DOM, Forms, and Event Handlers:** History of JavaScript, Hello World Web Page, Buttons, Functions, Variables, Identifiers, Assignment Statements and Objects, Document Object Model, Forms and How They're Processed: Client-Side Versus Server-Side, form Element, Controls, Text Control, Accessing a Form's Control Values, reset and focus Methods

Course Code	UE24CS1106
Course Title	**Project Based Learning/Mini Project**

3. Course Guidelines

- Students can work individually or in teams (maximum 4 members). Below 4 students may special case during Resit/Re-Registration
- Project work must be documented in a structured Project Report (Template provided).
- Regular faculty interactions are mandatory for guidance and feedback.
- Final Evaluation is based on the CE Rubrics—there is no Semester End Examination (SEE).
- Project Selection by the project teams

A. Faculty-Floated Projects

- Faculty members publish projects in the faculty-Floated Student Project Repository.
- Students can select projects based on their interests and expertise.
- Faculty member who authored the project act as guide, providing mentorship and evaluation.

B. Student-Initiated Projects

- Students can propose their own projects based on real-world problems, research interests, or interdisciplinary applications.
- Such students team must submit a project proposal for suitable faculty approval and seek the guideship.
- A faculty guide must be assigned to supervise the project in case students team fails find one.

4. Assessment weight Distribution
Continuous Evaluation (CE) – Assessment Criteria

This course follows a 100% Continuous Evaluation (CE) model, with the following weight distribution:

Evaluation Component	Weightage (%)	Remarks
Problem Definition & Proposal	10%	Clarity, Feasibility, Innovation
Project Planning & Progress	20%	Timeline, Milestones, Resource Utilization
Implementation & Execution	30%	Technical Implementation, Quality of Solution
Report & Documentation	20%	Structure, Clarity, Completeness
Presentation & Demonstration	20%	Communication, Delivery, Effectiveness

Additional Evaluation Requirements:

A. Weekly Review Meetings:

- The project guide must conduct a dedicated 1-hour review meeting every week to monitor progress, provide feedback, and ensure timely completion of milestones.

B. Formal Evaluation Schedule:

- The project and its progress must be evaluated three times per semester, aligning with major academic milestones.
- Evaluations will take place alongside theoretical course tests, as scheduled in the Calendar of Events for the semester.

C. Customizable Rubrics:

- Guides may define rubric-specific evaluation criteria tailored to the nature and complexity of the project.

  Since this course does not have a Semester End Examination (SEE), the final grade will be based entirely on Continuous Evaluation (CE), ensuring a comprehensive assessment of student performance throughout the semester.

Semester-2			
Sl. No.	**Course Code**	**Course Title**	**Credits**
1.	UE24CS1201	Applied Mathematics for Computer Science	3
2.	UE24CS1202	Applied Physics for CSE	3
3.	UE24CS1203	Data Structures & Applications	3
4.	UE24CS1204	Python Programming	3
5.	UE24CS1205	Fundamentals of Computer Networks	2
6.	UE24CS1206	Fundamentals of DBMS	2
7.	UE24CS1207	Project Based Learning / mini project on Computer Networks	2
8.	HG23TCDS01	Embracing Data Structures And Algorithms For Project Development	2
9.	HG23TPLS01	Life Skills	1
10.	HG23SAEA01	Environmental Awareness and Community Services	1
Total			**22**

Course Code	UE24CS1201
Course Title	**Applied Mathematics for Computer Science**

Course Content

- Descriptive Statistics: Concept of primary and secondary data, Methods of collection and editing of primary data, Classification and tabulation of data.
- Measures of central tendency : Arithmetic mean, median, mode, geometric mean and harmonic mean with simple applications. Absolute and relative measures of dispersion range, quartile deviation, mean deviation, standard deviation and variance with simple applications, Importance of moments, kurtosis based on moments with real life examples and Skewness: meaning.
- Vector Calculus : Scalar and vector fields. Gradient, directional derivative, curl and divergence - physical interpretation, solenoidal and irrotational vector fields. Problems. Vector spaces: Definition and examples, subspace, linear span, Linearly independent and dependent sets, Basis and dimension.
- Linear transformations: Definition and examples, Algebra of transformations, Matrix of a linear transformation. Curve fitting by the method of least squares: fitting the curves of the form $y = ax$ + , $y = ax^b$, $y = ax^2 + bx + c$. Correlation : Karl Pearson's coefficient of correlation and rank correlation(without repetition) –problems. Regression analysis: lines of regression –problems, Multiple regression, angle between the lines of regression.
- Review of basic probability theory: Random variables (discrete and continuous), probability mass and density functions, Mathematical expectation, mean and variance.
- Probability Distribution: Binomial , Poisson , normal distribution and exponential distribution-problems(derivation for mean and standard deviation for Binomial and Poisson distributions only)-Illustrative examples.
- Joint Probability distribution: Joint Probability distribution for two discrete random variables, expectation and covariance, Correlation.

Course Code	UE24CS1202
Course Title	**Applied Physics for CSE**

1.1 Course Content

- Quantum Mechanics: de Broglie Hypothesis and Matter Waves, de Broglie wavelength and expression by analogy, Phase Velocity and Group Velocity, Heisenberg's Uncertainty Principle and its application (Non- existence of electron inside the nucleus - Relativistic), Principle of Complementarity, Wave Function, Time independent Schrödinger wave equation, Physical Significance of a wave function and Born Interpretation, Expectation value, Eigen functions and Eigen Values, Particle inside one dimensional infinite potential well, Quantization of Energy States, Waveforms and Probabilities. Numerical.

- Quantum Computing: Quantum Computing: Principles of Quantum Information &Quantum Computing: Introduction to Quantum Computing, Moore's law & its end, Differences between Classical & Quantum computing. Concept of qubit and its properties. Representation of qubit by Bloch sphere. Single and Two qubits. Extension to N qubits.

- Dirac representation and matrix operations: Matrix representation of 0 and 1 States, Identity Operator I, Applying I to$|0\rangle$and $|1\rangle$ states, Pauli Matrices and its operations on $|0\rangle$and $|1\rangle$states, Explanation of i) Conjugate of a matrix and ii) Transpose of a matrix. Unitary matrix U, Examples: Row and Column Matrices and their multiplication (Inner Product), Probability, Quantum Superposition, normalization rule. Orthogonality, Orthonormality. Numerical Problems, Quantum Gates: Single Qubit Gates: Quantum Not Gate, Pauli – X, Y and Z Gates, Hadamard Gate, Phase Gate (or S Gate), T Gate, Multiple Qubit Gates: Controlled gate, CNOT Gate, (Discussion for 4 different input states). Representation of Swap gate, Controlled -Z gate, Toffoli gate.

- Applications of Physics in Computing: Physics of Animation: Taxonomy of physics-based animation methods, Frames, Frames per Second, Size and Scale, Weight and Strength, Motion and Timing in Animations, Constant Force and Acceleration, The Odd rule, Odd- rule Scenarios, Motion Graphs, Examples of Character Animation: Jumping, Parts of Jump, Jump Magnification, Stop Time, Walking: Strides and Steps, Walk Timing. Numerical Problems.

- Statistical Physics for Computing: Descriptive statistics and inferential statistics, Poissondistribution and modeling the probability of proton decay, Normal Distributions (Bell Curves), Monte Carlo Method: Determination of Value of π. Numerical Problems.

- Communication and Networking: Laser and Optical Fibers

  Lasers: Characteristic properties of a LASER beam, Interaction of Radiation with Matter, Einstein's A and B Coefficients and Expression for Energy Density, Laser Action, Population Inversion, Metastable State, Requisites of a laser system, Semiconductor Diode Laser, Applications: Bar code scanner, Laser Printer, Laser Cooling (Qualitative), Numerical Problems.Optical Fiber: Principle and Structure, Propagation of Light, Acceptance angle and Numerical Aperture (NA), Derivation of Expression for NA, Modes of Propagation, RI Profile, Classification of Optical Fibers, Attenuation and Fiber Losses, Applications: Fiber Optic networking, Fiber Optic Communication. Numerical Problems.

- **Semiconductors and Superconductors for Computing Applications: Semiconductors:** Fermi level in Intrinsic and extrinsic Semiconductor, Expression for the concentration of electrons in conduction band & holes concentration in valance band, Relation between Fermi energy and energy gap in intrinsic semiconductors, Hall effect, Expression for Hall coefficient and its application.**Superconductors:** Introduction to Super Conductors, Temperature dependence of resistivity, Meissner's Effect, Critical Field, Temperature dependence of Critical field, Types of Super Conductors, BCS theory (Qualitative), Quantum Tunnelling, High-Temperature superconductivity, Josephson Junctions (Qualitative), DC and RF SQUIDs (Qualitative), Applications in Quantum Computing: Charge, Phase and Flux qubits, Numerical Problems.

Course Code	UE24CS1203
Course Title	**Data Structures & Algorithms**

Course Content

- **Introduction To Data Structures:** Data Structures, Classifications , Data structure Operations ,**Review of** pointers and dynamic Memory Allocation, Arrays, Dynamic Allocated Arrays, Structures and Unions, Polynomials, Sparse Matrices, representation of Multidimensional Arrays, Strings.
- **Stacks , Queues, Linked Lists-1:** Stacks, Stacks Using Dynamic Arrays, Evaluation and conversion of Expressions, Queues, Circular Queues, Using Dynamic Arrays, Singly Linked, Lists and Chains, Representing Chains in C, Linked Stacks and Queues.
- **Linked Lists-2, Trees** : Additional List Operations, Doubly Linked List. TREES: Introduction, Binary Trees, Binary Tree Traversals, Binary Search trees, Selection Trees, Forests, Representation of Disjoint sets, Counting Binary Trees.
- **Graphs & Hashing:** The Graph Abstract Data Types, Elementary Graph Operations, HASHING: Introduction, Static Hashing, Dynamic Hashing.
- **Priority Queues & Efficient Binary Search Trees:** Single and double ended Priority Queues, Leftist Trees INTRODUCTION TO EFFICIENT BINARY SEARCH TREES: Optimal Binary Search Trees.

Course Code	UE24CS1204
Course Title	**Python Programming**

Course Content

- Python Basics, Objects- Python Objects, Standard Types, Other Built-in Types, Internal Types, Standard Type Operators, Standard Type Built-in Functions, Categorizing the Standard Types, Unsupported Types Numbers - Introduction to Numbers, Integers, Floating Point Real Numbers, Complex Numbers, Operators, Built-in Functions, Related Modules Sequences - Strings, Lists, and Tuples, Mapping and Set Types.
- FILES: File Objects, File Built-in Function [open()], File Built-in Methods, File Built-in Attributes, Standard Files, Command-line Arguments, File System, File Execution, Persistent Storage Modules, Related Modules Exceptions: Exceptions in Python, Detecting and Handling Exceptions, Context Management, *Exceptions as Strings, Raising Exceptions, Assertions, Standard Exceptions, *Creating Exceptions, Why Exceptions (Now)?, Why Exceptions at All?, Exceptions and the sys Module, Related Modules: Modules and Files, Namespaces, Importing Modules, Importing Module Attributes, Module Built-in Functions, Packages, Other Features of Modules.
- Regular Expressions: Introduction, Special Symbols and Characters, Res and Python Multithreaded Programming: Introduction, Threads and Processes, Python, Threads, and the Global Interpreter Lock, Thread Module, Threading Module, Related Modules GUI Programming: Introduction, Tkinter and Python Programming, Brief Tour of Other GUIs, Related Modules and Other GUIs WEB Programming: Introduction, Wed Surfing with Python, Creating Simple Web Clients, Advanced Web Clients, CGI-Helping Servers Process Client Data, Building CGI Application Advanced CGI, Web (HTTP) Servers
- Database Programming: Introduction, python Database Application Programmer’s interface (DB-API), Object Relational Managers (ORMs), Related Modules.

Course Code	UE24CS1205
Course Title	**Fundamentals of Computer Networks**

Course Content

- Introduction to networks: Network hardware, Network software, Reference models, Physical Layer: Guided transmission media, Wireless transmission
- The Data link layer: Design issues of DLL, Error detection and correction, Elementary data link protocols, Sliding window protocols. The medium access control sublayer: The channel allocation problem, Multiple access protocols.
- The Network Layer: Network Layer Design Issues, Routing Algorithms, Internetworking, The Network Layer on the internet.
- The Transport Layer: The Transport Service, Elements of transport protocols, Congestion control, the internet transport protocols.
- Application Layer: Principles of Network Applications, The Web and HTTP, Electronic Mail in the Internet, DNS—The Internet's Directory Service.

Course Code	UE24CS1206
Course Title	**Fundamentals of DBMS**

Course Content

- **Introduction to Databases:** Characteristics of the Database Approach, Actors on the Scene, Workers behind the Scene, Advantages of Using the DBMS Approach, Brief History of Database Applications
- **Database System Concepts and Architecture**: Data Models, Schemas, and Instances, Three-Schema Architecture and Data Independence, Database Languages and Interfaces.
- **Data Modeling Using the Entity–Relationship (ER) Model**: Entity Types, Entity Sets, Attributes, and Keys, Relationship Types, Relationship Sets, Roles, and Structural Constraints, Weak Entity Types, Refining the ER Design for Database, ER Diagrams Naming Conventions, and Design Issues, Example of Other Notation: UML Class Diagrams.
- **Case Studies for ER Diagram**: University Database System, Library Information System, Employee Management System - identify entities, relationships, and attributes accurately and use proper notation to represent cardinality and participation constraints, Construct appropriate Schemas.
- **Relational Algebra and Relational Calculus**: Unary Relational Operations: SELECT and PROJECT, Relational Algebra Operations from Set Theory, Binary Relational Operations: JOIN and DIVISION, Additional Relational Operations, Examples of Queries in Relational Algebra, Tuple Relational Calculus, Domain Relational Calculus.

Course Code	UE24CS1206
Course Title	**Project Based Learning ~~on building a Machine Learning Model~~**

Course Guidelines

- Students can work individually or in teams (maximum 4 members). Below 4 students may special case during Resit/Re-Registration
- Project work must be documented in a structured Project Report (Template provided).
- Regular faculty interactions are mandatory for guidance and feedback.
- Final Evaluation is based on the CE Rubrics—there is no Semester End Examination (SEE).
- Project Selection by the project teams

A. Faculty-Floated Projects

- Faculty members publish projects in the faculty-Floated Student Project Repository.
- Students can select projects based on their interests and expertise.
- Faculty member who authored the project act as guide, providing mentorship and evaluation.

B. Student-Initiated Projects

- Students can propose their own projects based on real-world problems, research interests, or interdisciplinary applications.
- Such students team must submit a project proposal for suitable faculty approval and seek the guide ship.
- A faculty guide must be assigned to supervise the project in case students team fails find one.

4. Assessment weight Distribution

Continuous Evaluation (CE) – Assessment Criteria

This course follows a 100% Continuous Evaluation (CE) model, with the following weight distribution:

Evaluation Component	Weightage (%)	Remarks
Problem Definition & Proposal	10%	Clarity, Feasibility, Innovation
Project Planning & Progress	20%	Timeline, Milestones, Resource Utilization
Implementation & Execution	30%	Technical Implementation, Quality of Solution
Report & Documentation	20%	Structure, Clarity, Completeness
Presentation & Demonstration	20%	Communication, Delivery, Effectiveness

Additional Evaluation Requirements:

D. Weekly Review Meetings:

- The project guide must conduct a dedicated 1-hour review meeting every week to monitor progress, provide feedback, and ensure timely completion of milestones.

E. Formal Evaluation Schedule:

- The project and its progress must be evaluated three times per semester, aligning with major academic milestones.
- Evaluations will take place alongside theoretical course tests, as scheduled in the Calendar of Events for the semester.

F. Customizable Rubrics:

- Guides may define rubric-specific evaluation criteria tailored to the nature and complexity of the project.

  Since this course does not have a Semester End Examination (SEE), the final grade will be based entirely on Continuous Evaluation (CE), ensuring a comprehensive assessment of student performance throughout the semester.

Semester-3			
S. No.	**Course Code**	**Course Title**	**Credits**
1.	UE24CS2301	Algorithm Design and Complexity Analysis	4
2.	UE24CS2302	Internet of Things	3
3.	UE24CS2303	Object Oriented Programming	3
4.	UE24CS2304	Computer Organization and Architecture	3
5.	UE24CS2305	Operating System Concepts	3
6.	UE24CS2306	Project Based Learning / mini project	2
7.	SDTCD	Technical Competency	02
8.	CASP	Life Skills	01
9.	CIBI	Innovation and Entrepreneurial Skills	00
10.	SA	Environmental Awareness and Community Services	01
11.	SA	Athletics, Sports, Yoga, Gymnasium	01
12.	SA	Cultural & Literary Activities	00
13.	SASP	Co-Curricular Activities (Seminar/Conference/Exhibition/Technical Competition)	00
14.	CASP	Placement Training	01
Total			**24**

Course Code	UE24CS2301
Course Title	**Algorithm Design and Complexity Analysis**

Course Content

- **Introduction:** What is an Algorithm? It's Properties. Algorithm Specification-using natural language, using Pseudo code convention, Fundamentals of Algorithmic Problem solving, Analysis Framework- Time efficiency and space efficiency, Worst-case, Best-case and Average case efficiency. Performance Analysis: Estimating Space complexity and Time complexity of algorithms. Asymptotic Notations: Big-Oh notation (O), Omega notation (Ω), Theta notation (Θ) with examples, Basic efficiency classes, Mathematical analysis of Non- Recursive and Recursive Algorithms with Examples.
- **Divide and Conquer:** General method, Recurrence equation for divide and conquer, solving it using Master's theorem. , Divide and Conquer algorithms and complexity Analysis of Finding the maximum & minimum, Binary search, Merge sort, Quick sort. Decrease and Conquer Approach: Introduction, Insertion sort, Graph searching algorithms, Topological Sorting. It's efficiency analysis..
- **Greedy Method:** General method, Coin Change Problem, Knapsack Problem, solving Job sequencing with deadlines Problems. Minimum cost spanning trees: Prim's Algorithm, Kruskal's Algorithm with performance analysis. Single source shortest paths: Dijkstra's Algorithm. Optimal Tree problem: Huffman Trees and Codes. Transform and Conquer Approach: Introduction, Heaps and Heap Sort.
- **Dynamic Programming:** General method with Examples, Multistage Graphs. Transitive Closure: Warshall's Algorithm. All Pairs Shortest Paths: Floyd's Algorithm, Knapsack problem, Bellman-Ford Algorithm, Travelling Sales Person problem. Space-Time Tradeoffs: Introduction, Sorting by Counting, Input Enhancement in String Matching- Harspool's algorithm. .
- **Backtracking:** General method, solution using back tracking to N-Queens problem, Sum of subsets problem, Graph coloring, Hamiltonian cycles Problems. Branch and Bound: Assignment Problem, Travelling Sales Person problem, 0/1 Knapsack problem NP-Complete and NP-Hard problems: Basic concepts, non- deterministic algorithms, P, NP, NP- Complete, and NP-Hard classes.

Course Code	UE24CS2302
Course Title	**Internet of Things**

Course Content

- Emergence of IoT: Introduction, Evolution of IoT, Enabling IoT and the Complex Interdependence of Technologies, IoT Networking Components, Addressing Strategies in IoT
- IoT Sensing and Actuation: Introduction, Sensors, Sensor Characteristics, Sensorial Deviations, Sensing Types, Sensing Considerations, Actuators, Actuator Types, Actuator Characteristics
- IoT Processing Topologies and Types: Data Format, Importance of Processing in IoT, Processing Topologies, IoT Device Design and Selection Considerations, Processing Offloading.
- IoT Connectivity Technologies: Introduction, IEEE 802.15.4, Zigbee, Thread, ISA100.11A,
- WirelessHART, RFID, NFC, DASH7 ,Z-Wave ,Weightless ,Sigfox ,LoRa ,NB-IoT ,Wi-Fi ,Bluetooth.
- IoT Communication Technologies: Introduction, Infrastructure Protocols: Internet protocol
- version 6 (IPv6), LOADng, RPL ,6LoWPAN. Data Protocols: MQTT, CoAP ,AMQP,XMPP ,SOAP, REST, WebSocket.
- IOT Case Studies and Future Trends
- Agricultural IoT – Introduction and Case Studies
- Vehicular IoT – Introduction
- Healthcare IoT – Introduction, Case Studies
- Paradigms, Challenges, and the Future: Introduction, Evolution of New IoT, Paradigms Challenges associated with IoT, Emerging Pillars of IoT

Course Code	UE24CS2303
Course Title	**Object Oriented Programming**

Course Content

- An Overview of Java: Object-Oriented Programming, A First Simple Program, A Second Short Program, Two Control Statements, Using Blocks of Code, Lexical Issues, The Java Class Libraries, Data Types, Variables, and Arrays: Java Is a Strongly Typed Language, The Primitive Types, Integers, Floating-Point Types, Characters, Booleans, A Closer Look at Literals, Variables, Type Conversion and Casting, Automatic Type Promotion in Expressions, Arrays, A Few Words About Strings
- Operators: Arithmetic Operators, The Bitwise Operators, Relational Operators, Boolean Logical Operators, The Assignment Operator, The ? Operator, Operator Precedence, Using Parentheses, Control Statements: Java's Selection Statements, Iteration Statements, Jump Statements.
- Introducing Classes: Class Fundamentals, Declaring Objects, Assigning Object Reference Variables, Introducing Methods, Constructors, The this Keyword, Garbage Collection, The finalize( ) Method, A Stack Class, A Closer Look at Methods and Classes: Overloading Methods, Using Objects as Parameters, A Closer Look at Argument Passing, Returning Objects, Recursion, Introducing Access Control, Understanding static, Introducing final, Arrays Revisited,
- Inheritance: Inheritance, using super, creating a Multilevel Hierarchy, When Constructors Are Called, Method Overriding, Dynamic Method Dispatch, Using Abstract Classes, Using final with Inheritance, The Object Class. Packages and Interfaces: Packages, Access Protection, Importing Packages, Interfaces,
- Exception Handling: Exception-Handling Fundamentals, Exception Types, Uncaught Exceptions, Using try and catch, Multiple catch Clauses, Nested try Statements, throw, throws, finally, Java's Built-in Exceptions, Creating Your Own Exception Subclasses.

Course Code	UE24CS2304
Course Title	**Computer Organization and Digital Circuits/Architecture**

Course Content

- **Basic Structure of Computers:** Functional Units, Basic Operational Concepts, Bus structure, Performance – Processor Clock, Basic Performance Equation, Clock Rate, Performance Measurement.
- **Machine Instructions and Programs:** Memory Location and Addresses, Memory Operations, Instruction and Instruction sequencing, Addressing Modes.
- **Input/output Organization:** Accessing I/O Devices, Interrupts – Interrupt Hardware, Enabling and Disabling Interrupts, Handling Multiple Devices, Direct Memory Access: Bus Arbitration.
- **Memory System:** Basic Concepts, Speed, Size, and Cost, Cache Memories – Mapping Functions.
- **Basic Processing Unit:** Some Fundamental Concepts: Register Transfers, Performing ALU operations, fetching a word from Memory, Storing a word in memory. Execution of a Complete Instruction, Single bus & Multiple Bus Organization. **Pipelining:** Basic concepts of pipelining.
- **Karnaugh maps:** minimum forms of switching functions, two and three variable Karnaugh maps, four variable karnaugh maps, determination of minimum expressions using essential prime implicants, Quine-McClusky Method: determination of prime implicants, the prime implicant chart, simplification of incompletely specified functions, simplification using map-entered variables.
- **Combinational Logic:** Introduction, Combinational Circuits, Design Procedure, Gate delays and Timing diagrams, Hazards in combinational Logic. Binary Adder- Subtractor, Decoders, Encoders, Multiplexers.
- **Sequential Logic:** Introduction, Sequential Circuits, Storage Elements: Flip-Flops: Set Reset Latch, Gated Latches, Edge-Triggered D Flip Flop 3, SR Flip Flop, J K Flip Flop, T Flip Flop, Flip Flop with additional inputs, Asynchronous Sequential Circuits.

Course Code	UE24CS2305
Course Title	**Operating System Concepts**

Course Content

- **Introduction to operating systems, System structures**: What operating systems do; Computer System organization; Computer System architecture; Operating System structure; Operating System operations; Process management; Memory management; Storage management; Protection and Security; Distributed system; Special-purpose systems; Computing environments.
- **Operating System Services**: User - Operating System interface; System calls; Types of system calls; System programs; Operating system design and implementation; Operating System structure; Virtual machines; Operating System debugging, Operating System generation; System boot.
- **Process Management**: Process concept; Process scheduling; Operations on processes; Inter process communication
- **Multi-threaded Programming**: Overview; Multithreading models; Thread Libraries; threading issues.
- **Process Scheduling**: Basic concepts; Scheduling Criteria; Scheduling Algorithms – FCFS, SJF, Round Robin and Priority Scheduling; Thread scheduling; Multiple-processor scheduling
- **Process Synchronization**: Synchronization: The critical section problem; Peterson's solution; Synchronization hardware; Semaphores; Classical problems of synchronization;
- **Deadlocks**: System model; Deadlock characterization; Methods for handling deadlocks; Deadlock prevention; Deadlock avoidance; Deadlock detection and recovery from deadlock.
- **Memory Management**: Memory management strategies: Background; Swapping; Contiguous memory allocation; Paging; Structure of page table; Segmentation.
- **Virtual Memory Management**: Background; Demand paging; Copy-on-write; Page replacement; Allocation of frames; Thrashing.
- **File System, Implementation of File System**: File system: File concept; Access methods; Directory and Disk structure; File system mounting; File sharing;
- **Implementing File system**: File system structure; File system implementation; Directory implementation; Allocation methods; free space management.
- **Secondary Storage Structure, Protection**: Mass storage structures; Disk structure; Disk attachment; Disk scheduling; Disk management; Protection: Goals of protection, Principles of protection, Domain of protection, Access matrix.

Course Code	UE24CS2306
Course Title	Project Based Learning

Course Guidelines

- Students can work individually or in teams (maximum 4 members). Below 4 students may special case during Resit/Re-Registration
- Project work must be documented in a structured Project Report (Template provided).
- Regular faculty interactions are mandatory for guidance and feedback.
- Final Evaluation is based on the CE Rubrics—there is no Semester End Examination (SEE).
- Project Selection by the project teams

A. Faculty-Floated Projects

- Faculty members publish projects in the faculty-Floated Student Project Repository.
- Students can select projects based on their interests and expertise.
- Faculty member who authored the project act as guide, providing mentorship and evaluation.

B. Student-Initiated Projects

- Students can propose their own projects based on real-world problems, research interests, or interdisciplinary applications.
- Such students team must submit a project proposal for suitable faculty approval and seek the guideship.
- A faculty guide must be assigned to supervise the project in case students team fails find one.

Assessment weight Distribution
Continuous Evaluation (CE) – Assessment Criteria

This course follows a 100% Continuous Evaluation (CE) model, with the following weight distribution:

Evaluation Component	Weightage (%)	Remarks
Problem Definition & Proposal	10%	Clarity, Feasibility, Innovation
Project Planning & Progress	20%	Timeline, Milestones, Resource Utilization
Implementation & Execution	30%	Technical Implementation, Quality of Solution
Report & Documentation	20%	Structure, Clarity, Completeness
Presentation & Demonstration	20%	Communication, Delivery, Effectiveness

Additional Evaluation Requirements:

G. Weekly Review Meetings:

- The project guide must conduct a dedicated 1-hour review meeting every week to monitor progress, provide feedback, and ensure timely completion of milestones.

H. Formal Evaluation Schedule:

- The project and its progress must be evaluated three times per semester, aligning with major academic milestones.
- Evaluations will take place alongside theoretical course tests, as scheduled in the Calendar of Events for the semester.

I. Customizable Rubrics:

- Guides may define rubric-specific evaluation criteria tailored to the nature and complexity of the project.

  Since this course does not have a Semester End Examination (SEE), the final grade will be based entirely on Continuous Evaluation (CE), ensuring a comprehensive assessment of student performance throughout the semester.

1. **Expected Deliverables & Attainment Calculations:**

- Project Proposal & Approval Form
- Two Progress Report and presentation to guide (one during the Test-1 and another during Test-2)
- Final Project Report having Project Code / Implementation / Prototype and Final Presentation & Demonstration – (Soon after the Test-3)

Semester-4			
Sl. No.	**Course Code**	**Course Title**	**Credits**
1.	UE24CS2401	Machine Learning	3
2.	UE24CS2402	Data Mining & Data Warehousing	3
3.	UE24CS2403	Discrete Structures for Computing	2
4.	UE24CS2404	Advanced DBMS + NoSql	3
5.	UE24CS2405	Automata Theory and Compiler Design	3
6.	UE24CS2406	Project Based Learning / mini project	2
7.	SDTCD	Technical Competency	02
8.	CASP	Life Skills	01
9.	CIBI	Innovation and Entrepreneurial Skills	01
10.	SA	Environmental Awareness and Community Services	01
11.	SA	Athletics, Sports, Yoga, Gymnasium	01
12.	SA	Cultural & Literary Activities	01
13.	SASP	Co-Curricular Activities (Seminar/Conference/Exhibition/Technical Competition)	00
14.	CASP	Placement Training	01
Total			**24**

Course Code	UE24CS2401
Course Title	Machine Learning

Course Content:

- Introduction to Machine learning: Introduction to ML, Types of ML- overview of Regression and Classification, Supervised and Unsupervised learning, designing a Learning System, main challenges in ML.
- Concept Learning: Introduction, Find-S algorithm, Candidate Elimination Algorithm.
- Decision Trees: Decision Tree Learning: Introduction, Decision tree representation, appropriate problems, the basic Decision Tree learning algorithm (ID3). ANN: Introduction, Perceptron (Representational power of perceptron), The Backpropagation algorithm
- Bayesian Learning: Introduction, Bayes theorem, Bayes theorem and concept learning, Naive Bayes classifier, Bayesian Belief Networks (BBN).
- Instance-Base Learning: Introduction, k-Nearest Neighbors Learning. Training Models: Linear regression, logistic regression, bias, variance. Reinforcement Learning: Introduction, The learning Task, Q learning (The Q function, An algorithm for learning Q)
- Preparing Machine Learning model for training a Binary classifier and performance measure.

Course Code	UE24CCS2402
Course Title	**Data Mining & Data Warehousing**

Course Content

- **Data Warehousing:** Basic Concepts - Definition of a Data Warehouse, Differences between Operational Database Systems and Data Warehouses, Importance of a Separate Data Warehouse, A multitier Architecture,
- **Data warehouse models:** Enterprise warehouse, Data mart and virtual warehouse, Extraction, Transformation and loading.
- **Data Mining:** Introduction to Data mining, Challenges, Data Mining Tasks, and Types of Data, Data Quality, Data Pre-processing, Measures of Similarity and Dissimilarity.
- **Data Cube:** A multidimensional data model, Stars, Snowflakes and Fact constellations: Schemas for multidimensional Data models, Dimensions: The role of concept Hierarchies, Measures, Typical OLAP Operations.
- **Efficient Data Cube computation**: An overview, Indexing OLAP Data: Bitmap index and join index, Efficient processing of OLAP Queries, OLAP server Architecture, ROLAP versus MOLAP Versus HOLAP.
- **Classification:** Decision Trees Induction, Rule Based Classifiers, Nearest Neighbor Classifiers.
- **Clustering Analysis:** Overview, K-Means, Agglomerative Hierarchical Clustering, DBSCAN, Cluster Evaluation, Density-Based Clustering, Graph- Based Clustering.

Course Code	UE24CS2403
Course Title	Discrete Structures for Computing

Course Content

- **Fundamentals of Logic**

  Basic Connectives and Truth Tables, Logic Equivalence – The Laws of Logic, Logical Implication – Rules of Inference. Definitions and the Proofs of Theorems.

- **Properties of the Integers**

  The Well Ordering Principle – Mathematical Induction,

- **Fundamental Principles of Counting**

  The Rules of Sum and Product, Permutations, Combinations, the Binomial Theorem, Combinations with Repetition.

- **Relations and Functions**

  Cartesian Products and Relations, Functions – Plain and One-to One, Onto Functions. The Pigeon-hole Principle, Function Composition and Inverse Functions.

- **Properties of Relations**

  Computer Recognition – Zero-One Matrices and Directed Graphs, Partial Orders – Hasse Diagrams, Equivalence Relations and Partitions.

- **The Principle of Inclusion and Exclusion**

  The Principle of Inclusion and Exclusion, Generalizations of the Principle, Derangements , Rook Polynomials.

- **Recurrence Relations**

  First Order Linear Recurrence Relation, The Second Order Linear Homogeneous Recurrence Relation with Constant Coefficients.

  Graph Theory

  Basic Concepts: Different types of graphs, sub graphs, walks and connectedness. Degree sequences, directed graphs, distances and self-complementary graphs. Blocks: Cut-points, bridges and blocks, block graphs and cut-point graphs, Prefix CODE.

Course Code	UE24CS2404
Course Title	Advanced Database Management System and PL/SQL

Course Content

- **Basic SQL**: SQL Data Definition and Data Types, Specifying Constraints in SQL, concepts, syntaxes and examples of Data Definition Language (DDL) create a database, drop a database, create table, drop table, alter table, DQL (Data query language) – SELECT, Data Manipulation Language (DML)- INSERT, UDATE, DELETE, Data Control Language (DCL)- GRANT, REVOKE and Transaction Control Language (TCL)- COMMIT, ROLLBACK and SAVEPOINT.

- **Structured Query Language (continued)**: Create relationships between database tables, Null values, aggregate functions - min, max, count, average, sum, nested sub-queries, group by, having, exists, order by. Join operations - inner, left join, right join, natural join and Cartesian product, Views (Virtual Tables) in SQL

- **Basics of Functional Dependencies and Normalization for Relational Databases:** Informal Design Guidelines for Relation Schemas, Functional Dependencies, Normal Forms Based on Primary Keys, General Definitions of Second and Third Normal Forms, Boyce-Codd Normal Form, Transaction Processing-ACID Properties.

- **PL/SQL : I**ntroduction-Loops and Conditional Statements in PL/SQL, Triggers-Insert,Update,Delete, Procedures-With IN,OUT,INOUT Parameter, Functions- With IN,OUT,INOUT Parameter.

Laboratory:

Consider the Company Database, Create following tables

Employee: (EmployeeID (Primary Key), FirstName, LastName, DepartmentID (Foreign Key), Salary)

Department (DepartmentID (Primary Key), DepartmentName)

Project(ProjectID (Primary Key), ProjectName)

1. Write a query to retrieve all the columns from the Employees table.
2. Write a query to find all employees who earn more than 50,000?
3. Insert a new employee into the Employees table with the following details: FirstName: 'Jane', LastName: 'Smith', DepartmentID: 3, Salary: 80000, and HireDate: '2025-01-10'. Update the salary of the employee with EmployeeID: 1 to 90,000. Delete all employees in department 4 from the Employees table.
4. Write a query to join the Employees and Departments tables to display each employee's full name and their department name.
5. Count the total number of employees in each department. Find the average, minimum and maximum salary of employees.
6. Retrieve all employees who earn more than the average salary of the company.
7. Create a query to list all departments with more than 5 employees.
8. Write a query using a subquery to find employees who are not assigned to any projects.
9. Query to retrieve department IDs and the total number of employees in each department with more than 5 employees
10. Retrieve the names and salaries of employees in department 2, sorted by salary in descending order.

Course Code	UE24CS2405
Course Title	AUTOMATA THEORY AND COMPUTATIONS

Course Content

- Introduction to Finite Automata, Structural Representations, Automata and Complexity. The Central Concepts of Automata Theory. Deterministic Finite Automata, Nondeterministic Finite Automata, An Application: Text Search, Finite Automata with Epsilon-Transitions
- Regular Expressions, Finite Automata and Regular Expressions, Proving Languages not to be Regular. Closure Properties of Regular Languages, Equivalence and Minimization of Automata, Applications of Regular Expressions
- Context-Free Grammars, Parse Trees, Ambiguity in Grammars and Languages, Ambiguity inGrammars and Languages, Definition of the Pushdown Automaton, The Languages ofa PDA,Equivalence of PDA's and CFG's, Deterministic Pushdown Automata.
- Normal Forms for Context-Free Grammars, The Pumping Lemma for Context-Free Languages, Closure Properties of Context-Free Languages.
- Introduction to Turing Machines: Problems That Computers Cannot Solve, The Turing Machine, Programming Techniques for Turing Machines, Extensions to the Basic Turing Machine, Undecidability: A Language That Is Not Recursively Enumerable.

Course Code	UE24CS2406
Course Title	**Project Based Learning**

3. Course Guidelines

- Students can work individually or in teams (maximum 4 members). Below 4 students may special case during Resit/Re-Registration
- Project work must be documented in a structured Project Report (Template provided).
- Regular faculty interactions are mandatory for guidance and feedback.
- Final Evaluation is based on the CE Rubrics—there is no Semester End Examination (SEE).
- Project Selection by the project teams

A. Faculty-Floated Projects

- Faculty members publish projects in the faculty-Floated Student Project Repository.
- Students can select projects based on their interests and expertise.
- Faculty member who authored the project act as guide, providing mentorship and evaluation.

B. Student-Initiated Projects

- Students can propose their own projects based on real-world problems, research interests, or interdisciplinary applications.
- Such students team must submit a project proposal for suitable faculty approval and seek the guideship.
- A faculty guide must be assigned to supervise the project in case students team fails find one.

4. Assessment weight Distribution

Continuous Evaluation (CE) – Assessment Criteria

This course follows a 100% Continuous Evaluation (CE) model, with the following weight distribution:

Evaluation Component	Weightage (%)	Remarks
Problem Definition & Proposal	10%	Clarity, Feasibility, Innovation
Project Planning & Progress	20%	Timeline, Milestones, Resource Utilization
Implementation & Execution	30%	Technical Implementation, Quality of Solution
Report & Documentation	20%	Structure, Clarity, Completeness
Presentation & Demonstration	20%	Communication, Delivery, Effectiveness

Additional Evaluation Requirements:

J. Weekly Review Meetings:

- The project guide must conduct a dedicated 1-hour review meeting every week to monitor progress, provide feedback, and ensure timely completion of milestones.

K. Formal Evaluation Schedule:

- The project and its progress must be evaluated three times per semester, aligning with major academic milestones.
- Evaluations will take place alongside theoretical course tests, as scheduled in the Calendar of Events for the semester.

L. Customizable Rubrics:

- Guides may define rubric-specific evaluation criteria tailored to the nature and complexity of the project.

  Since this course does not have a Semester End Examination (SEE), the final grade will be based entirely on Continuous Evaluation (CE), ensuring a comprehensive assessment of student performance throughout the semester.

Expected Deliverables & Attainment Calculations:

- Project Proposal & Approval Form
- Two Progress Report and presentation to guide (one during the Test-1 and another during Test-2)
- Final Project Report having Project Code / Implementation / Prototype and Final Presentation & Demonstration – (Soon after the Test-3)

Semester-5			
Sl. No.	**Course Code**	**Course Title**	**Credits**
1.	UE24CC3501	Advanced Machine Learning	3
2.	UE24CC3502	Cloud Computing and its Applications	3
3.	UE24CC3503	Generative AI	3
4.	UE24CC3504	Data Privacy	3
5.	UE24CC3505	Project Based Learning / mini project	3
6.	UE24CC35XX	Professional Elective - 1	3
7.	SDTCD	Technical Competency	02
8.	CASP	Life Skills	00
9.	CIBI	Innovation and Entrepreneurial Skills	00
10.	SA	Environmental Awareness and Community Services	00
11.	SA	Athletics, Sports, Yoga, Gymnasium	01
12.	SA	Cultural & Literary Activities	00
13.	SASP	Co-Curricular Activities (Seminar/Conference/Exhibition/Technical Competition)	00
14.	CASP	Placement Training	01
Total			**22**

Course Code	UE24CC3501
Course Title	**Advanced Machine Learning**

Course Content

- **Advanced Machine Learning:** Overview, Gradient Descent algorithm, Scikit-learn library for ML, Advanced Regression models, Advanced ML algorithms, KNN, ensemble methods.
- **Forecasting :** Overview, components, moving average, decomposing time series, autoregressive Models
- **Clustering:** Introduction, Types of clustering, Partitioning methods of clustering (k-means, k-medoids), hierarchical methods
- **Recommender System:** Datasets, Association rules, Collaborative filtering, User-based similarity, item-based similarity, using surprise library, Matrix factorization
- **Text Analytics:** Overview, Sentiment Classification, Naïve Bayes model for sentiment classification, using TF-IDF vectorizer, Challenges of text analytics
- **Neural networks:** Introduction, Neural Network Representation – Problems – Perceptron – Multilayer Networks and Back Propagation Algorithms
- **Evaluating Hypothesis:** Motivation, Estimating hypothesis accuracy, Basics of sampling theorem, General approach for deriving confidence intervals, Difference in error of two hypothesis, Comparing learning algorithms.
- **Instance Based Learning:** ntroduction, k-nearest neighbour learning (review), locally weighted regression, radial basis function, cased-based reasoning

Course Code	UE24CC3502
Course Title	**Cloud Computing and its Applications**

Course Content

- **Introduction:** Cloud Computing at a Glance, The Vision of Cloud Computing, Defining a Cloud, A Closer Look, Cloud Computing Reference Model, Characteristics and Benefits, Challenges Ahead, Building Cloud Computing Environments.
- **Virtualization:** Introduction, Characteristics of Virtualized, Environments Taxonomy of Virtualization Techniques, Execution Virtualization, Other Types of Virtualization, Virtualization and Cloud Computing, Pros and Cons of Virtualization.
- **Cloud Computing Architecture:** Introduction, Cloud Reference Model, Architecture, Infrastructure / Hardware as a Service, Platform as a Service, Software as a Service, Types of Clouds, Public Clouds, Private Clouds, Hybrid Clouds, Community Clouds.
- **Cloud Application Platform:** Framework Overview, Anatomy of the Aneka Container, From the Ground Up: Platform Abstraction Layer, Fabric Services, foundation Services, Application Services, Building Aneka Clouds, Infrastructure Organization, Logical Organization, Private Cloud Deployment Mode, Public Cloud Deployment Mode, Hybrid Cloud Deployment Mode.
- **Concurrent Computing:** Thread Programming, Introducing Parallelism for Single Machine Computation, Programming Applications with Threads, What is a Thread?, Thread APIs, Techniques for Parallel Computation with Threads, Multithreading with Aneka, Introducing the Thread Programming Model, Aneka Thread vs. Common Threads.
- **High-Throughput Computing:** Task Programming, Task Computing, Characterizing a Task, Computing Categories, Frameworks for Task Computing, Task-based Application Models, Embarrassingly Parallel Applications, Parameter Sweep Applications, MPI Applications, Workflow Applications with Task Dependencies, Aneka Task-Based Programming, Task Programming Model, Developing Applications with the Task Model, Developing Parameter Sweep Application, Managing Workflows.
- **Data Intensive Computing:** Map-Reduce Programming, What is Data-Intensive Computing?, Characterizing Data-Intensive Computations, Challenges Ahead, Historical Perspective, Technologies for Data-Intensive Computing, Storage Systems, Programming Platforms, Aneka MapReduce Programming, Introducing the MapReduce Programming Model.
- **Cloud Platforms in Industry:** Amazon Web Services, Compute Services, Storage Services, Communication Services, Additional Services, Google App Engine, Architecture and Core Concepts, Application Life-Cycle, Cost Model, Observations, Microsoft Azure, Azure Core Concepts, SQL Azure, Windows Azure Platform Appliance.

Course Code	UE24CC3503
Course Title	**Generative AI**

Course Content

2.1 Course Content

- **Introduction to Generative AI:** What is Generative AI? Discriminative vs Generative models. Applications in image, text, audio, and design Mathematical foundations: probability distributions, latent variables
- **Autoencoders and Variational Autoencoders (VAEs):** .Autoencoder architecture and bottleneck.VAE formulation and loss function.Sampling from latent space. Hands-on: Build a simple VAE in Python
- **Generative Adversarial Networks (GANs):** GAN architecture: Generator vs Discriminator. Training dynamics and challenges (mode collapse, convergence). Variants: DCGAN, WGAN, Conditional GAN. Hands-on: GAN for image generation (e.g., MNIST or Fashion-MNIST)
- **Transformers and Large Language Models:** Sequence modeling with Transformers. Introduction to GPT models and their architecture. Text generation with pretrained models. Case study: ChatGPT, DALLE, etc.
- **Applications, Trends, and Ethics**: Generative AI in healthcare, art, design, music, and education. Deepfakes, misinformation, and copyright. Bias, fairness, and regulation. Future trends: Multimodal models, diffusion models

Course Code	UE24CC3504
Course Title	**Data Privacy**

- **Data privacy and Importance:** Need for Sharing Data- Methods of Protecting Data - Importance of Balancing Data Privacy and Utility – Disclosure - Tabular Data - Micro data - Approaches to Statistical disclosure control –Ethics – principles-guidelines and regulations.
- **Microdata:** Disclosure -Disclosure risk -Estimating re-identification risk -Non-Perturbative Micro data masking - Perturbative Micro data masking -Information loss in Micro data.
- **Static Data Anonymization on Multidimensional Data:** Privacy – Preserving Methods - Classification of Data in a Multidimensional Dataset - Group based Anonymization: k-Anonymity, l-Diversity, t-Closeness.
- **Anonymization on Complex Data Structures:** Privacy-Preserving Graph Data, Privacy-Preserving Time Series Data, Time Series Data Protection Methods, Privacy Preservation of Longitudinal Data, Privacy Preservation of Transaction Data.
- **Threats to Anonymized Data:** Threats to Anonymized Data, Threats to Data Structures, Threats by Anonymization Techniques: Randomization, k-Anonymization, l-Diversity, t-Closeness.
- **Dynamic Data Protection:** Dynamic Data Protection: Tokenization, Understanding Tokenization, Use Cases for Dynamic Data Protection, Benefits of Tokenization Compared to Other Methods, Components for Tokenization.

Course Code	UE24CC3505
Course Title	**Project Based Learning/ Mini Project**

Course Guidelines

- Students can work individually or in teams (maximum 4 members). Below 4 students may special case during Resit/Re-Registration
- Project work must be documented in a structured Project Report (Template provided).
- Regular faculty interactions are mandatory for guidance and feedback.
- Final Evaluation is based on the CE Rubrics—there is no Semester End Examination (SEE).
- Project Selection by the project teams

  A. Faculty-Floated Projects

  - Faculty members publish projects in the faculty-Floated Student Project Repository.
  - Students can select projects based on their interests and expertise.
  - Faculty member who authored the project act as guide, providing mentorship and evaluation.

  B. Student-Initiated Projects

  - Students can propose their own projects based on real-world problems, research interests, or interdisciplinary applications.
  - Such students team must submit a project proposal for suitable faculty approval and seek the guideship.
  - A faculty guide must be assigned to supervise the project in case students team fails find one.

Assessment weight Distribution

Continuous Evaluation (CE) – Assessment Criteria

This course follows a 100% Continuous Evaluation (CE) model, with the following weight distribution:

Evaluation Component	Weightage (%)	Remarks
Problem Definition & Proposal	10%	Clarity, Feasibility, Innovation
Project Planning & Progress	20%	Timeline, Milestones, Resource Utilization
Implementation & Execution	30%	Technical Implementation, Quality of Solution
Report & Documentation	20%	Structure, Clarity, Completeness
Presentation & Demonstration	20%	Communication, Delivery, Effectiveness

Additional Evaluation Requirements:

M. Weekly Review Meetings:

- The project guide must conduct a dedicated 1-hour review meeting every week to monitor progress, provide feedback, and ensure timely completion of milestones.

N. Formal Evaluation Schedule:

- The project and its progress must be evaluated three times per semester, aligning with major academic milestones.
- Evaluations will take place alongside theoretical course tests, as scheduled in the Calendar of Events for the semester.

O. Customizable Rubrics:

- Guides may define rubric-specific evaluation criteria tailored to the nature and complexity of the project.

  Since this course does not have a Semester End Examination (SEE), the final grade will be based entirely on Continuous Evaluation (CE), ensuring a comprehensive assessment of student performance throughout the semester.

Course Code	UE24CC35XX
Course Title	**Professional Elective 1**

Course Content

Sl	Course Code	Course Title	Credits
1	UE25CS3540	Devops Essential	3
2	UE25CS3541	Principles of Artificial Intelligence	3
3	UE25CC3542	Object Oriented Modelling & Design	3
4	UE25CS3543	Ethical Hacking	3
5	UE25CS3544	Information Network Security	3
6	UE25CS3545	Advanced Cryptography	3

Semester-6			
S. No.	**Course Code**	**Course Title**	**Credits**
1.	UE24CC3601	Cloud Management and Security	3
2.	UE24CC3602	Full Stack development with mini project	3
3.	UE24CC3603	Big Data and Cloud Data Analytics	3
4.	UE24CC36XX	Professional Elective - 2	3
5.	UE24CC3604	Project Based Learning	3
6.	SDTCD	Technical Competency	2
7.	CASP	Life Skills	0
8.	CIBI	Innovation and Entrepreneurial Skills	1
9.	SA	Environmental Awareness and Community Services	0
10.	SA	Athletics, Sports, Yoga, Gymnasium	0
11.	SA	Cultural & Literary Activities	1
12.	SASP	Co-Curricular Activities (Seminar/Conference/Exhibition/Technical Competition)	0
13.	CASP	Placement Training	0
Total			**19**

Course Code	UE24CC3601
Course Title	Cloud Management and Security

Course Content

Cloud Introduction: Definitions, evolution, service models, deployment models, and cloud challenges.

Cloud Structure & Management Foundations: Infrastructure components, cloud layering, vertical/horizontal slices, and cloud relations.

Cloud Management Services: Virtual control center, requirement delegation, policy/context/dependency parameters.

Cloud Operational Properties: Adaptability, resilience, scalability, availability, reliability, security, and privacy.

Automated Management Services: Virtual/application layer self-managed services and multi-tier deployment.

Cloud Security Fundamentals: Foundations of Trust**,** TPM, TCG components, device trust properties, trust establishment functions.

Cloud Security Challenges: Scaling, load balancing, redundancy, clustering, and cloud dynamism impacts.

Security Trust Chains: Roots of trust, resource chain of trust, compositional chain of trust, and trust across layered cloud architectures.

Course Code	UE24CC3602
Course Title	Full Stack development with mini project

Course Content :

1. **Introduction to Full Stack Development:** Introduction to Git and GitHub, Installation of Eclipse and JDK, Overview of Web Applications, Full Stack Architecture and Components, Client–Server Model, HTTP/HTTPS Protocols, MVC Architecture, Mapping URLs to Controllers, Request–Response Life Cycle in Java Web Applications.

Front-End Development: HTML5: Forms, Tables, Media, Semantic Elements, CSS3: Selectors, Box Model, Flexbox, Grid, Responsive Web Design, Bootstrap Framework, Introduction to JavaScript, DOM Manipulation and Events, Introduction to React,React Overview and Features, Component-Based Architecture, JSX and Virtual DOM, Props and State (concepts).

Back-End Development with Java: JavaScript ES6 Features, Form Validation, AJAX and Fetch API, JSON Data Handling, Introduction to Front-end Frameworks (Angular/React – concepts), Java Servlets, JDBC (Java Database Connectivity), Session Management (Cookies & HttpSession), RESTful Web Services (Basics), React with REST API Integration, Calling REST APIs from React.

Back-End Development with Java: Java Web Technologies Overview, Servlets: Lifecycle, Request & Response Handling, JSP: Directives, Scriptlets, Expression Language, Session Management, Introduction to Spring Framework, Spring MVC Architecture, Creating Model-Driven Forms, URL Mapping Best Practices, URL Pattern Configuration.

Database and ORM Integration: Relational Database Concepts, SQL Basics (CRUD Operations), Adding toString() Methods, Inserting, Updating, Selecting and Deleting Records, Schema Evolution and Database Migration, JDBC Architecture and API, Connection Pooling, Introduction to Hibernate, ORM Mapping and Annotations.

Course Code	UE24CC3603
Course Title	Big Data and Cloud Data Analytics

Course Content

- **Introduction to Big Data**

Evolution of data and need for Big Data, Big Data characteristics (5Vs), Types of Big Data: Structured, Semi-structured, Unstructured Big Data analytics lifecycle, Applications of Big Data in industry.

- **Big Data Architecture and Technologies**

Big Data reference architecture, Distributed computing concepts, Hadoop ecosystem overview, HDFS architecture and data storage, Map Reduce programming model

- **Big Data Processing Frameworks**

Hadoop YARN architecture, Apache Spark: Architecture and components, Spark RDDs and Data Frames, Spark SQL and Spark Streaming (Overview), Comparison of Hadoop Map Reduce and Spark. Various big data tools

- **Cloud Computing for Data Analytics**

Cloud computing fundamentals, Definition of Cloud Data Analytics, Need for analytics in cloud environments, Differences between traditional analytics and cloud-based analytics, Advantages: scalability, elasticity, cost efficiency, high availability, Challenges: data transfer latency, vendor lock-in, security , Big Data on cloud platforms, Introduction to AWS, Azure, and Google Cloud analytics services

- **Cloud Data Analytics and Applications**

Data analytics in cloud environments, Cloud-based data storage and processing, Analytics-as-a-Service (AaaS), Cloud-based ETL tools, Stream analytics in cloud ,Machine learning and AI services for analytics, Visualization and reporting tools in cloud, Analytics-as-a-Service (AaaS), Security and privacy issues in cloud analytics. Case studies: Business, Healthcare, Smart Cities

- **Applications & Case studies of Cloud Data Analytics**

Business intelligence and decision support, Healthcare analytics, Financial and risk analytics, Smart city and IoT analytics, Social media and web analytics, Sales forecasting using cloud analytics, Real-time log analytics in cloud, Sales forecasting using cloud analytics, Real-time log analytics in cloud. Healthcare data analytics using cloud platforms.

Course Code	UE24CC3604
Course Title	Project Based Learning

Course Guidelines

- Students can work individually or in teams (maximum 4 members). Below 4 students may special case during Resit/Re-Registration
- Project work must be documented in a structured Project Report (Template provided).
- Regular faculty interactions are mandatory for guidance and feedback.
- Final Evaluation is based on the CE Rubrics—there is no Semester End Examination (SEE).
- Project Selection by the project teams

A. Faculty-Floated Projects

- Faculty members publish projects in the faculty-Floated Student Project Repository.
- Students can select projects based on their interests and expertise.
- Faculty member who authored the project act as guide, providing mentorship and evaluation.

B. Student-Initiated Projects

- Students can propose their own projects based on real-world problems, research interests, or interdisciplinary applications.
- Such students team must submit a project proposal for suitable faculty approval and seek the guideship.
- A faculty guide must be assigned to supervise the project in case students team fails find one.

4. Assessment weight Distribution

Continuous Evaluation (CE) – Assessment Criteria

This course follows a 100% Continuous Evaluation (CE) model, with the following weight distribution:

Evaluation Component	Weightage (%)	Remarks
Problem Definition & Proposal	10%	Clarity, Feasibility, Innovation
Project Planning & Progress	20%	Timeline, Milestones, Resource Utilization
Implementation & Execution	30%	Technical Implementation, Quality of Solution
Report & Documentation	20%	Structure, Clarity, Completeness
Presentation & Demonstration	20%	Communication, Delivery, Effectiveness

Additional Evaluation Requirements:

P. Weekly Review Meetings:

- The project guide must conduct a dedicated 1-hour review meeting every week to monitor progress, provide feedback, and ensure timely completion of milestones.

Q. Formal Evaluation Schedule:

- The project and its progress must be evaluated three times per semester, aligning with major academic milestones.
- Evaluations will take place alongside theoretical course tests, as scheduled in the Calendar of Events for the semester.

R. Customizable Rubrics:

- Guides may define rubric-specific evaluation criteria tailored to the nature and complexity of the project.

  Since this course does not have a Semester End Examination (SEE), the final grade will be based entirely on Continuous Evaluation (CE), ensuring a comprehensive assessment of student performance throughout the semester.

1. Expected Deliverables & Attainment Calculations:

- Project Proposal & Approval Form
- Two Progress Report and presentation to guide (one during the Test-1 and another during Test-2)
- Final Project Report having Project Code / Implementation / Prototype and Final Presentation & Demonstration – (Soon after the Test-3)

Course Code	UE24CC36XX
Course Title	**Professional Elective 2**

Professional Elective – 2 List for 6th Semester

Sl. No	Course Code	Course Title	Credits
1	UE24CC3640	Visualisation, Cloud Management, Cloud security	3
2	UE24CC3641	Amazon Web Services	3
3	UE24CC3642	APIs & Web Services (REST, SOAP, GraphQL)	3
4	UE24CC3643	Cloud-based Machine Learning (AWS Sagemaker / Azure ML / Vertex AI)	3
5	UE24CC3644	Blockchain & Cloud Integration	3
6	UE24CC3645	Edge & Fog Computing	3

Course Code	UE24CC3645
Course Title	Edge and Fog Computing

- **Introduction To Computing Paradigms:** Introduction, Relevant Technologies, Fog and Edge Computing Completing the Cloud, Hierarchy of Fog and Edge Computing, Business Models, Opportunities and Challenges
- **Addressing The Challenges In Federating Edge Resources:** Introduction, Networking Challenge, Management Challenge, Integrated C2F2T Literature by Modeling Technique, Integrated C2F2T Literature by Use-Case Scenarios, Integrated C2F2T Literature by Metrics.
- **Management And Orchestration Of Network Slices In 5g, Edge, Fog, Clouds And Optimization:** Introduction, Background, Network Slicing, Network Slicing in Software, Defined Clouds, Network Slicing Management in Edge and Fog. **Introduction to Optimization:** The Case for Optimization in Fog Computing, Formal Modeling Framework for Fog Computing, Metrics, Optimization Opportunities along the Fog Architecture, Optimization Opportunities along the Service Life Cycle, Taxonomy of Optimization Problems in Fog Computing.
- **Middleware For Fog And Edge Computing :** Need for Fog and Edge Computing Middleware, Design Goals, State-of-the-Art Middleware Infrastructures, System Model, Proposed Architecture, Case Study Example, Edge Cloud Architectures, Clusters for Lightweight Edge Clouds, Architecture Management, Storage and Orchestration, IoT Integration.
- **Technologies And Applications:** Fog Data Management, Predictive Analysis with FogTorchΠ, Machine Learning in Fog Computing, Data Analytics in the Fog, Data Analytics in the Fog, Health Monitoring, Object tracking, Smart Transportation, IoT Applications, Simulation of iFogSim Toolkit.

Semester-7			
Sl. No.	**Course Code**	**Course Title**	**Credits**
1.	UE24CS4701	Intellectual Property Rights	3
2.	UE24CS4702	Industry Internship	3
3.	UE24CS4703	Project - 1	4
4.	UE24CS47XX	Open Elective -1	4
5.	SDTCD	Technical Competency	00
6.	CASP	Life Skills	00
7.	CIBI	Innovation and Entrepreneurial Skills	00
8.	SA	Environmental Awareness and Community Services	00
9.	SA	Athletics, Sports, Yoga, Gymnasium	00
10.	SA	Cultural & Literary Activities	01
11.	SASP	Co-Curricular Activities (Seminar/Conference/Exhibition/Technical Competition)	01
12.	CASP	Placement Training	00
Total			**16**

Course Code	UE24CS4701
Course Title	**Intellectual Property Rights**

Course Content

- Overview of Intellectual Property: Definition of intellectual property, Types of intellectual property, patents, trademarks, copyrights, trade secrets, Importance of intellectual property in fostering innovation and creativity. Intellectual Property Laws and Treaties: Introduction to key international treaties (e.g., TRIPS Agreement), Understanding national and regional intellectual property laws, Comparison of intellectual property laws across jurisdictions.
- Patents: Basics of patent protection, Patentable subject matter, Patent application process, Rights and limitations conferred by a patent, Trademarks: Nature and purpose of trademarks, trademark registration process, Trademark rights and enforcement, Trademark infringement and defences.
- Copyrights: Understanding copyright protection, Copyrightable works, Copyright registration process, Fair use and exceptions to copyright protection. Trade Secrets: Definition and characteristics of trade secrets, Protection and management of trade secrets, Trade secret vs. patent protection.
- Licensing and Technology Transfer: Licensing as a strategy for leveraging intellectual property, Technology transfer and its role in innovation, Negotiating and drafting licensing agreements. IPR Enforcement and Litigation: Remedies for intellectual property infringement, Legal proceedings and litigation in intellectual property cases, Alternative dispute resolution mechanisms.
- Ethical and Social Considerations: Ethical issues in intellectual property, Balancing public interest and private rights, Social and cultural implications of intellectual property. International Perspectives on IPR: Comparative analysis of intellectual property systems globally, Global challenges and cooperation in intellectual property.

Course Code	UE24CS4702
Course Title	**Industry Internship**

Course Content

The primarily learning experiences gained through hands-on work may facilitate learning and provide guidance to interns. Thus complement practical experiences with guidance and support, helping interns maximize their learning and development.

Assessing interns during their internship is crucial for evaluating their performance and ensuring they meet the desired learning outcomes. Combining multiple assessment approaches provides a comprehensive view of interns' performance and growth. The assessment methods for an internship program:

Problem Understanding:

- To assess the quality and completion of assigned projects.
- Enable insight to accuracy, creativity, timelines, and overall contribution.

Performance Reviews:

- Regular performance reviews is scheduled by supervisors to discuss progress, challenges, and goals.
- Use feedback, address concerns, and guide interns in their learning.

Presentation and Communication Skills:

- Assess interns through presentations.
- Evaluate Clarity, organization, engagement, and effectiveness of communication.
- The projects key findings are presented to a panel who check articulated ideas and queries.

Professionalism and Ethical Conduct:

- The Assessment adherence to professional and ethical standards.
- The Punctuality, reliability, ethical decision-making, and respect for confidentiality.
- To evaluate interns' professionalism, factors meeting deadlines, company policies, maintaining confidentiality.

Final Presentation or Report:

Remember that the goal of teaching during an internship is Adjust these teaching strategies based on the specific needs and objectives of the internship program.

- The interns must present a comprehensive overview of their internship experience.
- Integration of learning, overall impact, and ability to synthesize experiences.
- Organize a final presentation which reflect on their learning, and contributions

Course Code	UE24CS4703
Course Title	**Project - 1**

Teaching and Assessment

3.1. Assessment weight Distribution:

Sl. No	Distribution Details	Bifurcation	Marks	Remarks
	Project Deliverables	50		
	Level-1: Presentation for Acceptance and Outcome		**50**	
	Process and Progress	30		
	Collaboration and Teamwork	15		
	Individual Reflection and Self-Assessment	05		
	Level-2: Final Presentation with Report		**50**	
		Total	**100**	

Semester-8			
Sl. No.	**Course Code**	**Course Title**	**Credits**
1.	UE24CS4801	Parallel Computing	3
2.	UE24CS4802	Project - 2	6
3.	UE24CS48XX	Open Elective -2	2
4.	SDTCD	Technical Competency	00
5.	CASP	Life Skills	00
6.	CIBI	Innovation and Entrepreneurial Skills	01
7.	SA	Environmental Awareness and Community Services	00
8.	SA	Athletics, Sports, Yoga, Gymnasium	00
9.	SA	Cultural & Literary Activities	00
10.	SASP	Co-Curricular Activities (Seminar/Conference/Exhibition/Technical Competition)	01
11.	CASP	Placement Training	00
Total			**13**

Course Code	UE24CS801
Course Title	**Parallel Computing**

2.3 Course Content

- Theory of Parallelism: Parallel Computer Models, The State of Computing, Multiprocessors and Multicomputer, Multi-vector and SIMD Computers, Program and Network Properties, Conditions of Parallelism, Program Partitioning and Scheduling, Program Flow Mechanisms, System Interconnect Architectures, Principles of Scalable Performance, Performance Metrics and Measures, Parallel Processing Applications, Speedup Performance Laws, Scalability Analysis and Approaches.
- Hardware Technologies: Processors and Memory Hierarchy: Advanced Processor Technology, Superscalar and Vector Processors, Memory Hierarchy Technology
- Pipelining and Superscalar Techniques: Linear Pipeline Processors, Nonlinear Pipeline Processors, Instruction Pipeline Design, Arithmetic Pipeline Design
- Parallel and Scalable Architectures: Multiprocessors and Multi computers -Multiprocessor System Interconnects, Cache Coherence and Synchronization Mechanisms, Three Generations of Multi computers, Message-Passing Mechanisms. Software for parallel programming: Parallel Program Development and Environments: Parallel Programming Environments, Synchronization and Multiprocessing Modes. Instruction and System Level Parallelism, Instruction Level Parallelism: Computer Architecture, Basic Design Issues, Problem Definition, Model of a Typical Processor, Compiler-detected Instruction Level Parallelism, Operand Forwarding, Reorder Buffer, Register Renaming, Tomasulo's Algorithm, Branch Prediction, Limitations in Exploiting Instruction Level Parallelism, Thread Level Parallelism.

Reference Books:

1) Kai Hwang and Naresh Jotwani, "Advanced Computer Architecture (SIE): Parallelism, Scalability, Programmability", 3rd Edition, McGraw Hill Education, 2015
2) John L. Hennessy and David A. Patterson "Computer Architecture: A quantitative approach" 5th Edition, Morgan Kaufmann, Elseveir 2013.
3) Richard Y.Kain, "Advanced Computer Architecture: A System's Design Approach", Pearson Publications, 2015
4) John D. Carpinelli, "Computer Systems Organization and Architecture", Pearson Publications, 2001

Course Code	UE24CS4805
Course Title	**Project -2**

Assessment weight distribution/ Rubrics:

Sl.N0	***Distribution Details***	***Bifurcation***	***Marks***	***Remarks***
	Need Analysis, Arriving at the Problem Statement	15		
	Literature Review/ background work	5		
	Level-1: Presentation for Acceptance of the Project		**20**	
	Problem Solving, Design, Implementation	15		
	Testing and Validation	5		
	Results and Discussion	10		
	Recommendation for future enhancement	5		
	Level-2: Presentation of Outcome		**35**	
	Report writing and Submission	30		
	Exhibit/ Demonstrate and Viva Voce	15		
	Level-3 Final Evaluation		**45**	
		Total	**100**	

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