III Year

Details of Course:

Course Title	Course Structure			Pre-Requisite
MC301:	L	T	P	NIL
Theory of Computation	3	1	0	

Course Objective: The objective of the course is to equip students with a deep understanding of the mathematical foundations of computation, including automata theory and formal language theory, essential for advanced studies and practical applications in computer science.

Course Outcome (CO):

CO1	Demonstrate a deep understanding of fundamental models of computation, and describe their significance in theoretical computer science.
CO2	Classify programming languages using Chomsky's hierarchy and evaluate their characteristics and limitations.
CO3	Demonstrate the concepts, representations, and limitations of regular languages.
CO4	Define, construct, and simplify Context free grammars, analyse their properties, and apply theoretical principles to evaluate their characteristics and behaviours.
CO5	Demonstrate a deep understanding of pushdown automata and Turing machines, and apply these models to solve computational problems.

S. No.	Contents	Contact hours
UNIT 1	Automata: Definition of an Automaton, Description of a Finite Automaton, Transition system & its properties, Acceptability of a string by a finite Automaton, Nondeterministic Finite Automaton (NDFA), Equivalence of DFA and NDFA, Minimization of finite automaton, Moore & Mealy machines.	8
UNIT 2	Formal Languages: Definition of a Grammar, Derivations, Language generated by a grammar, Chomsky classification of languages & their relation, operations on languages.	6
UNIT 3	Regular Sets: Regular expressions, Arden's theorem, Transition system containing λ moves, Kleene's theorem, Algebraic method using Arden's theorem, construction of finite automata equivalent to a regular expression, Equivalence of two finite automata, Pumping lemma for regular sets, closure Properties of regular sets.	8
UNIT 4	Context Free Languages: Definition of CFL, Derivation trees, Ambiguity in CFG, Simplification of CFG, Normal forms (CNF & GNF), Pumping lemma for CFL, Decision algorithms for CFL.	6
UNIT 5	Pushdown Automata: Definition & Description of PDA, Instantaneous description, Move relation, Acceptance by PDA.	6
UNIT 6	Turing Machines: Basic model, Definition & representation, Instantaneous description, Representation by transition table & transition diagram Language accepted by Turing Machine, Design of Turing Machine, Decidability and Complexity.	8
	Total	42

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Suggested Books:

S. No.	Name of Books/Authors/Publishers	Year of Publication
1.	K.L.P. Mishra and N. Chandrasekaran; Theory of Computer Science Automata, Languages and Computation, PHI, 3rd Edition	2006
2.	Martin J.C.; Introduction to Languages and Theory of Computations, Tata McGraw Hill, 4th edition	2007
3.	J.E. Hopcroft, R. Motwani, and J.D. Ullman; Introduction to Automata Theory, Languages, and Computation, Pearson Education India, 3rd Edition	2008
4.	Peter Linz; An Introduction to Formal Languages and Automata, Jones and Bartlett Publishers, Inc., 6th Edition	2016
5.	Michael Sipser; Introduction to the Theory of Computation, Cengage India Private Limited, 3rd Edition	2014

Details of Course:

Course Title	Course Structure			Pre-Requisite
MC302: Mathematical Modelling and Simulation	**L**	**T**	**P**	Knowledge of differential equations and numerical methods
	3	**0**	**2**	

Course Objective: The objective of the course is to understand and develop the mathematical model to answer real life problem.

Course Outcome (CO):

CO1	Develop an understanding of concepts of modelling and simulation, by extracting the necessary and relevant information regarding the problem.
CO2	Apply various techniques to analyse stability and long term behaviour
CO3	Development of mathematical models of some real world problems and their solution
CO4	Develop an understanding of various population models.
CO5	Develop an understanding about nonlinear dynamics, bifurcation and chaos.

S. No.	Contents	Contact Hours
UNIT 1	Concept of Mathematical modelling, some modelling approaches: empirical, simulation, deterministic, statistical, Classification of mathematical models: black and white box, SQM space, Qualitative and quantitative approaches, Conceptual and physical model, Stationary and in-stationary models, distributed and lumped models, Compartment models.	**8**
UNIT 2	Steady State solution, Long term behaviour, Phase plane analysis, Linearization, Stability Analysis, Routh Hurwitz Criteria, Lyapunov functions.	**8**
UNIT 3	Models of single populations, Interacting Species models and extended population models, Prey – predator model, Growth models, Decay models, Lotka-Volterra model, Allee effect.	**8**
UNIT 4	Epidemic Models: Susceptible Infected (SI), Susceptible Infected Susceptible (SIS), Susceptible Infected Recovered (SIR), Lanchester combat model, Case Studies.	**8**
UNIT 5	Introduction to Bifurcation, Saddle node bifurcation, Trans-critical bifurcation, Pitchfork bifurcation, Hopf bifurcation: Forward and backward, Introduction to Chaos theory and non-linear dynamics, Case Studies.	**10**
	TOTAL	**42**

17/2/22

Suggested Books:

S.No.	Name of Books/Authors/Publishers	Year of Publication
1	Belinda Barnes , Mathematical Modelling with case studies, CRC Press,2nd Ed.	2011
2	Fred Brauer and Carlos C. Chavez, Mathematical Models in population biology and Epidemiology, Springer, 2ndEd.	2012
3	Steven H. Strogatz , Nonlinear Dynamics and Chaos, CRC, 3rd Ed.	2024
4	William E. Boyce and Richard C. Diprima, Elementary Differential Equations and Boundary Value Problems, Wiley, 9th Ed.	2009

	PRACTICALS LIST
1	Write a program to draw direction fields for the system of differential equations with constant coefficients.
2	Write a program to find the steady-state solution, draw its phase plane plot for the system of ODEs and plot the solution of the system.
3	Write a program to find critical points, Jacobian matrix, eigen values and eigen vectors of system of differential equations with constant coefficients.
4	Develop a MATLAB function to check the stability of a linear system using the Routh-Hurwitz criterion.
5	Write a program to check the stability of a linear system using the Lyapunov function.
6	Simulate the Lotka-Volterra prey-predator model and analyze the population dynamics over time.
7	Implement the SIR model for an epidemic and analyze how varying parameters (infection rate, recovery rate) affect the spread of disease.
8	Simulate and analyze the saddle-node bifurcation in a simple dynamical system.
9	Simulate a transcritical bifurcation in a simple system.
10	Simulate the chaotic behavior of the Lorenz system.

Details of Course:

Course Title	Course Structure			Pre-Requisite
MC303: Stochastic Processes	L	T	P	Probability and Statistics
	3	1	0	

Course Objective: The objective of the course is to develop the mathematical theory of random variables and random processes for Telecom Engineers. The goal is to teach theoretical concepts and techniques for solving problems that arise in practice. Beginning with the random variables, this course leads to the concept of stochastic process and linear filtering of random processes.

Course Outcome (CO):

CO1	Identify the type of the random process associated with the physical phenomena and model the process
CO2	Apply random processes concepts to solve engineering and other related problems.
CO3	Model the physical situation for multidisciplinary problems/fields to suitable random processes and analyze that for better project management and finance.
CO4	Justify computing skills using MATLAB/SPSS to design and analyze different stochastic processes.
CO5	Critique the assumptions underlying stochastic models and their implications on the validity of results.

S. NO	Contents	Contact Hours
UNIT 1	Introduction, Classification and examples of stochastic processes such as Bernoulli process, Poisson process, Gaussian process, Renewal process, Stationary process, Brownian motion	9
UNIT 2	Introduction and examples of Random Walk, simple random with unrestricted, two absorbing barriers, one absorbing barrier, two reflecting barriers and one reflecting barrier.	8
UNIT 3	Properties of Poisson processes, Arrival rate and inter-arrival times, Superposition and thinning of Poisson processes, Applications in modelling arrival phenomena.	8
UNIT 4	Discrete time Markov chain, n-step transition probability, States classification, Limiting probabilities, Distribution of times between states, Irreducible finite chains with aperiodic states, Reducible chains (Finite Markov chains with absorbing states).	8
UNIT 5	Continuous time Markov chain, Chapman- Kolmogorov equation, Birth-Death process, Special cases of Birth-Death process, Markov chains with absorbing states, Application to queueing models, M/M/1; M/M/c and Erlang loss models. Steady state solutions.	9
	TOTAL	42

Suggested Books:

S.No.	Name of Books/Authors/Publishers	Year of Publication
1	Kishor S. Trivedi, Probability and Statistics with Reliability, Queueing and Computer Science Applications, Wiley.	2001
2	Sheldon Ross, Stochastic Processes, Wiley.	1995
3	Frank Beichelt, Stochastic Processes in Science, Engineering and Finance, Chapman & Hall.	2006
4	Cox and Miller, Theory of Stochastic Processes, Chapman & Hall.	1977

Details of Course:

Course Title	Course Structure			Pre-Requisite
MC304: Financial Engineering	L	T	P	A course in Statistics with sound knowledge of random variable, expectation and variance, m.g.f. and probability distribution.
	3	1	0	

Course Objective: The objective of the course is to Knowledge of financial market, risk attached, and derivative on underlying asset. Knowledge and Optimization of portfolio.

Course Outcome (CO):

CO1	Describe the financial market and various terminologies used. List the assumptions for mathematical modelling of financial markets. Categorize the types of instruments traded in the financial markets.
CO2	Compute the risk and return attached with risky and risk free instruments. Pricing of Bonds, Forward, and Future and apply to real problem.
CO3	Do the option pricing using various models. Effectively compute the volatility and its impact on derivative pricing.
CO4	Define the stochastic processes, and calculus for forming and solving stochastic differential equations. Apply the Stochastic calculus in option pricing, and other real world and engineering problem.
CO5	Explain the portfolio and to compute the risk and return attached with it. Construct a multi asset portfolio with minimum risk and maximum return. Use the skill for financial management.

S. NO	Contents	Contact Hours
UNIT 1	Some basic definitions and terminology: Basic Notions and Assumptions, No-Arbitrage Principle, One-Step Binomial Model, Risk and Return, Forward Contracts, Call and Put Options, Managing Risk with Options.	10
UNIT 2	Basic Theory of Option Pricing: Single and Multi-Period Binomial Pricing Models, Cox Ross-Rubinstein (CRR) Model, Black-Scholes Formula for Option Pricing as a Limit of CRR Model.	10
UNIT 3	Introduction to Brownian and Geometric Brownian Motion, Theory of Martingales. Stochastic Calculus, Stochastic Differential Equations, Ito's Formula to Solve SDE's. Feymann Kac Theorem. Applications of Stochastic Calculus in Option Pricing. Black-Scholes Partial Differential Equation and Black-Scholes Formula.	12
UNIT 4	Mean-Variance Portfolio Theory: Markowitz Model of Portfolio Optimization and Capital Asset Pricing Model (CAPM). Limitations of Markowitz Model and New Measures of Risk.	10
	TOTAL	42

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Suggested Books:

S.No.	Name of Books/Authors/Publishers	Year of Publication
1	M. Capińsky and T. Zastawniak, Mathematics for Finance: An Introduction to Financial Engineering, Springer.	2004
2	Investment Science, D. G. Luenberger, Oxford University Press.	1999
3	Elementary Stochastic Calculus with Finance in view, Thomas Mikosch, World Scientific.	2006
4	Stochastic Calculus for Finance, Vol. I & Vol. II, S. E. Shreve, Springer.	2004
5	Financial Mathematics: An Introduction, S. Chandra, S. Dharmaraja, Narosa.	2014

Details of Course:

Course code: Course Title	Course Structure			Pre-Requisite
MC 305: Computer Networks	L	T	P	NIL
	3	1	0	

Course Objective: To provide knowledge about the principles, concepts and applications of computer networks, its application and communication protocols.

Course Outcome (CO):

CO1	Define basic computer network terminology and describe the Data Communications System and its components.
CO2	Illustrate the layers of the OSI model and TCP/IP reference model and also describe the functions of each layer.
CO3	Analyze the way protocols are currently used on the Internet and the requirements for designing network protocols.
CO4	Explain different types of physical layer transmissions and transmission media, and determine techniques for handling transmission errors.
CO5	Explain the routing protocols and discuss the process of assigning IP addresses within a given network, also demonstrate the connection-oriented and connection-less protocols.

S.No.	Contents	Contact Hours
UNIT 1	**Introduction:** Fundamentals and applications of Networks, data communications, network architecture, network classification, Reference models - OSI and TCP/IP, interfaces and services, network topology design, Physical Layer Transmission Media, Switching methods, ISDN.	8
UNIT 2	**Data Link Layer:** Framing, Error Handling, Elementary Data Link Protocols, Sliding Window protocols. **Medium Access sublayer:** Channel Allocations, LAN protocols, multiple access protocols, IEEE 802.X standards, FDDI.	9
UNIT 3	**Network Layer:** Point-to-point networks, logical addressing, routing, routing algorithms, Congestion control algorithms, Internetworking, IP addressing and subnet masking, IPv6.	9
UNIT 4	**Transport Layer:** Transport Layer Design issues, Transport layer protocols, connection management, congestion control. **Session Layer:** Design issues, remote procedure call.	8
UNIT 5	**Presentation Layer:** Data compression techniques, Encryption and Decryption. **Application Layer:** Application layer protocols, File Transfer, Access and Management, DNS, Electronic mail, Virtual Terminals, Internet and Public Networks.	8
	TOTAL	**42**

Suggested Books:

S.No.	Name of Books/Authors/Publishers	Year of Publication
1	Tanenbaum, A. S., Feamster, N., & Wetherall, D., *Computer networks*, Pearson Education, 6th Edition, ISBN: 978-0-13-752321-4.	2021
2	Forouzan, B. A., *Data communications and networking*, McGraw-Hill, 5th Edition, ISBN: 978-0-07-337622-6.	2012
3	Stallings, W., *Data and computer communications*, Pearson Education, 10th Edition, ISBN: 978-0-13-350648-8.	2013

Details of Course:

Course Title	Course Structure			Pre-Requisite
MC306:	L	T	P	Programming
Object Oriented Programming	3	0	2	Fundamentals

Course Objective: To introduce object-oriented paradigm using C++ and Java, including composition, inheritance, polymorphism, templates, exception handling and file operations.

Course Outcome (CO):

CO1	Define the object-oriented features of C++ and Java.
CO2	Identify classes, objects, members of a class and relationships among them needed for a specific problem.
CO3	Explain how to apply the major object-oriented concepts such as encapsulation, inheritance, polymorphism, exception handling, etc to implement object-oriented programs in C++ and Java.
CO4	Develop, analyze and test programming solutions of real life problems in C++ and Java.
CO5	Design and develop Java application programs using GUI, Swings, network programming etc.

S.No.	Contents	Contact Hours
UNIT 1	**Introduction to Object-Oriented paradigm using C++**: Evolution of programming paradigm, structured versus object-oriented development, elements of object-oriented programming, Objects, classes, methods, software reuse. **Classes and objects:** Introduction, Class revisited, constant objects, constructor, constructor overloading, static data members with constructors and destructors, composition, objects as arguments, returning objects, friend functions and friend classes, constant parameters and member functions, static data and member functions, this pointer.	9
UNIT 2	**Operator Overloading**: Basic concept of overloading, overloading of unary and binary operators, conversion between objects and basic types, conversion between objects of different classes, overloading with friend functions and member functions. **Inheritance and Polymorphism:** Public vs Private vs Protected inheritance, inheritance with composition, abstract classes, virtual base classes, virtual functions, pointer to derived class objects, and base class objects, pure virtual functions, virtual destructors.	8
UNIT 3	**Generic programming with templates:** Introduction, function templates, overloaded function templates, class templates, inheritance of class template, class template with overloaded operators. **Exception Handling:** Exception types, nested try-catch, throw, throws and finally statements, Multi Thread Programming: thread creation, synchronization and priorities.	7

UNIT 4	**Introduction to Java:** Main method, objects and classes, objects on garbage collectible heap, reference variables, arrays and arraylist in Java, encapsulation, method arguments and return types, using the library and packages, inheritance, polymorphism, overriding methods, abstract classes and abstract methods, polymorphic references, deadly diamond of death problem, interfaces, constructor chaining, exception handling.	**10**
UNIT 5	**Advanced Topics:** GUI in Java, Swings, Input Output streams, Object Serialization, File operations. Networking concepts: connecting, sending and receiving, network sockets.	**8**
	TOTAL	**42**

Suggested Books:

S.No.	Name of Books/Authors/Publishers	Year of Publication
1	Deitel, P., & Deitel, H. *C++ How to Program: Introducing the New C++14 Standard*. Pearson, 10th Edition, ISBN: 978-0134448237.	2016
2	Stroustrup, B. *The C++ Programming Language*. Pearson, 4th Edition, ISBN: 978-0321563842.	2013
3	Sierra, K., Bates, B., & Gee, T. *Head First Java: A Brain-Friendly Guide*. O'Reilly, 3rd Edition, ISBN: 978-1491910771.	2022
4	Balagurusamy, E. *Programming with Java*. McGraw Hill, 7th Edition, ISBN: 978-9355322575.	2023

PRACTICALS LIST	
1	Create a class named "Time" in C++ with three data members namely hour, minute and seconds. Create two member functions of the class namely "setTime" that sets the hour, minute and seconds for any object; and "print" function that prints the hour, minute, and seconds value for the object. Test the class by creating its two objects in main.
2	Write a program in C++ demonstrating the use of constructor (with no arguments), constructor (with parameterized arguments) and destructor. Create objects of that class in main and test those objects with these constructors and destructor function.
3	Write a C++ program illustrating the operator overloading of binary operators (addition and subtraction), and unary operators (prefix and postfix increment).
4	Implement inheritance in C++ program. Create a base class named Person (with data members first_name, and last_name). Derive a class named Employee from base class Person. The Employee class should include a data member named employee_id. Further a class named Manager should be derived from the class Employee and the Manager class should include two data members named employee_designation and employee_salary. Create at least three objects of class Manager, specify the values of all their attributes, and determine which manager has the highest salary.
5	Write a program in C++ demonstrating class templates.
6	Write a program in C++ demonstrating rethrowing an exception.
7	Create an inheritance hierarchy (any inheritance example of your choice) in JAVA. Create one super class and three sub classes should inherit from that super class. Also highlight the

	concept of function overriding and function overloading in your program. Create objects of sub classes and test you program.
8	Write a JAVA program explaining the working of constructors along with the super keyword.
9	Write a Java program consisting of abstract classes and abstract method(s). The first concrete sub class in the inheritance hierarchy must implement the abstract method(s). Create the objects of the concrete class and test your program.
10	Write a Java program explaining the working of static methods in a class.
11	Write a Java program implementing Swing Applet.

Details of Course:

Course Title	Course Structure			Pre-Requisite
MC307 Artificial Intelligence	L	T	P	NIL
	3	0	2	

Course Objective: To introduce basic knowledge representation, problem-solving, and learning methods of Artificial Intelligence and understand the role of knowledge representation, problem-solving and learning in intelligent system engineering.

Course Outcome (CO):

CO1	Identify and describe Artificial Intelligence techniques such as search heuristics, knowledge representation and automated planning.
CO2	Compare Artificial Intelligence with paradigms such as Machine Learning, Deep Learning, Natural Language Processing, Expert Systems, etc.
CO3	Apply Artificial Intelligence techniques to a wide range of problems, including complex problem solving via search, knowledge-based systems, machine learning, probabilistic models, agent decision making, etc.
CO4	Analyze the computational trade-offs involved in applying different AI techniques and models.
CO5	Design and develop programs in programming languages such as Prolog.

S.No.	Contents	Contact Hours
UNIT 1	**Introduction:** AI Problems, Task Domains of AI, AI Techniques: search knowledge, abstraction. Introduction to Intelligent program and Intelligent agents. **Problem Solving:** Basic Problem solving Method: state space search, problem characteristics, issues in design of Intelligent search algorithm.	8
UNIT 2	**Heuristic search Techniques:** Hill climbing techniques, Best First search, Variable Neighbourhood Descent, Beam and Tabu Search, Simulated Annealing, Genetic Algorithms, A* Search, IDA*Recursive Best First Search. **Problem Reduction:** AO* Search, Constraint Satisfaction.	9
UNIT 3	**Planning:** Forward State Space Planning, Backward State Space Planning, Goal Stack Planning, Plan Space Planning. **Game Playing:** Game Tree, Searching procedure Minimax, alpha beta pruning	8
UNIT 4	**Knowledge Representation:** Knowledge Representation issues, Knowledge Representation using Predicate Logic: Unification, resolution, Rule based Systems: Forward versus backward reasoning, conflict resolution. Structured Knowledge Representation: Semantic Nets, Frames, conceptual dependency, scripts.	9
UNIT 5	**Programming Languages:** Fundamental and concepts of Programming languages like Prolog. Relationship of languages with knowledge representation and inferences. **Applications and Case Studies:** Expert Systems, Machine Learning, Natural Language Processing, Robotics, Generative AI etc.	8
	TOTAL	42

Suggested Books:

S.No.	Name of Books/Authors/Publishers	Year of Publication
1	Khemani, D. *A First Course in Artificial Intelligence*. McGraw Hill Education, 6th Edition, ISBN: 978-9352606371.	2018
2	Rich, E., Knight, K., & Nair, S. *Artificial Intelligence*. McGraw Hill Education, 3rd Edition, ISBN: 978-1259029981.	2017
3	Russell, S., & Norvig, P. *Artificial Intelligence: A Modern Approach*. Pearson, 4th Edition, ISBN: 978-0134610993.	2022

PRACTICALS LIST	
1	Write a program to solve the 8-Puzzle problem using Generate and Test Strategy.
2	Write a program to solve the 8-Puzzle problem using DFID (Depth First Iterative Deepening) Strategy.
3	Write a program to solve the 3- SAT Problem using Variable Neighbourhood Descent Algorithm.
4	Write a program to solve the 3- SAT Problem using Stochastic Hill Climbing Algorithm.
5	Write a program to solve the 8- Puzzle using A* Algorithm.
6	Write a program to implement AO* search algorithm on any AND OR graph.
7	Write a program in Prolog to find a maximum of two/three numbers.
8	Write a program in Prolog to find the factorial of a number.
9	Write a program in Prolog to find the sum of first N numbers.
10	Write a program in Prolog to find Fibonacci sequence upto Nth term.
11	Consider the following statements of a knowledge database: • Prakash likes food if the food is edible and it tastes sweet. • Chocolates taste sweet. • Toffees taste sweet. • Gourd tastes bitter. • Chocolates are edible. • Toffees are edible. • Gourds are edible. Write a program to represent the above statements in Prolog. Further ask a question/query in Prolog such that the output of the question should be Chocolates Toffees No

Details of Course:

Course Title	Course Structure			Pre-Requisite
MC3[illegible]: Computer Graphics	L	T	P	NIL
	3	0	2	

Course Objective: To learn how various objects and backgrounds are rendered and transformed on the screen.

Course Outcome (CO):

CO1	Define and explain fundamental concepts and analyze the performance trade-offs of various scan conversion and filling algorithms.
CO2	Apply and evaluate geometric transformations on 2D/3D objects and their composite applications.
CO3	Compare and contrast the trade-offs of various clipping methods.
CO4	Analyze projections and visible surface detection techniques for 3D scene display on 2D screen.
CO5	Draw realistic scenes using illumination models and shading techniques to enhance its visualization.

S.No.	Contents	Contact Hours
UNIT 1	**Overview of Computer Graphics:** Usage of Graphics and their applications, Overview of Graphics Systems, Refreshing display devices, Random and raster scan display devices, Colour Models- RGB, HSV etc., Tablets, Joysticks, Trackballs, Mouse and light pens, plotters, printers, digitizers.	6
UNIT 2	**Output primitives:** DDA Line drawing algorithm, Bresenham's Line Drawing Algorithm, Midpoint circle algorithm, Mid-point Ellipse algorithms, Filling algorithms, Boundary fill and flood fill algorithms, Scan-line filling, Character generation, Line attributes, Fill styles, Anti- aliasing.	7
UNIT 3	**Transformations:** Basic 2D Transformations, Matrix representations & Homogeneous Coordinates, Matrix Representations for basic 2D and 3D transformations, Composite Transformations, Reflection and Shear transformations, Affine transformation, Transformations between coordinate systems.	7
UNIT 4	**Two dimensional viewing:** The viewing Pipeline, Viewing Coordinate Reference Frame, Window-to-Viewport Coordinate Transformation, Two Dimensional Viewing Functions, Barky line clipping algorithm, Algorithm for polygon clipping, Sutherland-Hodgeman polygon clipping, Cyrus Beck Algorithm, Wailer-Atherton polygon clipping, curve clipping, Text clipping.	8
UNIT 5	**Curves and Surfaces:** Representation of surfaces, Polygon meshes, Plane equations, Parametric cubic curves, Hermite Curves, Bezier Curves, 4-point and 5-point Bezier curves using Bernstein Polynomials, Conditions for smoothly joining curve segments, Bezier bi-cubic surface patch, B-Spline Curves, Cubic B-Spline curves using uniform knot vectors, Testing for first and second order continuities.	7

UNIT 6	**Projection:** Parallel Projection, Oblique Projection on XY plane, Isometric Projection, Perspective Projection, One Vanishing Point (V.P.) projection, Generation of 2 V.P. Projection, planar geometric projections. **Shading and Hidden Surface Removal:** Shading, Illumination Model for diffused Reflection, Effect of ambient lighting, distances, Specular Reflection Model, Computing Reflection Vector, Curved Surfaces, Polygonal Approximations, Guard Shading, Phong Model, Hidden Surface Removal, Back Face Detection, Depth Buffer (Z-Buffer, A-Buffer) Method, Scan Line Method, Depth Sorting Method, Area Subdivision Method.	7
	TOTAL	**42**

Suggested Books:

S.No.	Name of Books/Authors/Publishers	Year of Publication / Reprint
1	Hearn, D., & Baker, M. P. *Computer graphics*. Prentice Hall, 2nd Edition, ISBN: 978-0-13-161530-4.	1994
2	Plastock, R., & Kalley, G. *Theory and Problems of Computer Graphics*. Schaum's Series, McGraw Hill, 1st Edition, ISBN: 978-0070502571.	1986
3	Foley, J., van Dam, A., Feiner, S., & Hughes, J. *Computer Graphics: Principles & Practice*. Addison Wesley, 2nd Edition, ISBN: 978-0201848403.	1999

PRACTICALS LIST	
1	Write a program on a platform of your choice that displays any scene or any object like car, house trees, flowers, cartoon, etc.
2	Write a program to draw a hut using DDA algorithm.
3	Write a program to draw a car (without tyres) using Mid-Point algorithm
4	Write a program to draw sun using the Midpoint Circle drawing algorithm.
5	Write a program to draw a teddy bear using the Midpoint algorithm for drawing an Ellipse.
6	Write a program to clip lines using Cohen Sutherland Algorithm.
7	Write a program to clip lines using Cyrus Beck Algorithm.
8	Write a menu-driven program to fill the Concave polygon using a) Boundary Fill method b) Flood Fill method and c) Scan Fill method.
9	Write a menu-driven program to perform various 2D transformations on an object.
10	Write a program to perform concave polygon clipping using a) Sutherland-Hodgeman polygon clipping and b) Wailer-Atherton polygon clipping algorithms.
11	Write a program to implement the Z-buffer algorithm. Perform the algorithm on a set of at least 5 objects in a viewing coordinate system.

Details of Course:

Course Title	Course Structure			Pre-Requisite
MC309: Number Theory	L	T	P	Elementary School Level number theory
	3	1	0	

Course Objective: Even though number theory is one of the oldest disciplines in mathematics, it has recently contributed to many practical problems such as coding theory, cryptography or other tools in modern information technology. The aim is to impart knowledge of numbers theory and its applications.

Course Outcome (CO):

CO1	Apply Euclid's algorithm in divisibility/daily life problems
CO2	Solve linear congruence equations. Apply the congruence properties in finding divisibly of a number by 2,3,4 etc. and other daily life problems
CO3	Describe various arithmetical functions like Euler phi function and apply these in simplifying various arithmetical problems.
CO4	Analyse relation between Quadratic residue and Legendre's symbols and solve quadratic congruences.
CO5	Generate encrypted information and decrypt it.

S.No.	Contents	Contact Hours
UNIT 1	**Divisibility and factorization:** Division algorithm, greatest common divisor, Euclid's algorithm, linear equations and its theorem, fundamental theorem of arithmetic.	7
UNIT 2	**Congruences:** Linear congruence theorem, solution of linear congruence, simultaneous linear congruences, Chinese Remainder Theorem, Wilson's theorem, Fermat's theorem, Euler's theorem.	8
UNIT 3	**Arithmetic functions:** Arithmetic function, multiplicative functions Moebius function, Moebius inversion formula, Euler phi function, Euler's formula, τ - function, σ - function, perfect numbers, characterization of even perfect numbers.	9
UNIT 4	**Prime numbers and Quadratic reciprocity:** Prime number, Euclid's theorem, Fermat primes, Mersenne primes, Dirichlet's theorem on primes, Legendre and Jacobi symbols, Euler's criterion, Gauss's lemma, law of quadratic reciprocity.	9
UNIT 5	**Cryptology:** Character cipher, public key encryption, some algorithm for encryption and decryption, RSA crypto system.	9
	TOTAL	42

17/2/25

Suggested Books:

S.No.	Name of Books/Authors/Publishers	Year of Publication
1.	David M. Burton; Elementary Number Theory, McGraw Hill Education, 7th Edition.	2012
2.	Joseph H. Silverman; A friendly Introductory Number Theory, Pearson, 3rd Edition.	2009
3.	K.H. Rosen; Elementary Number Theory and its Application, McGraw Hill,5th Edition ISBN 0-21-87073-8	2015
4.	G.A. Jones and J.M. Jones; Elementary Number Theory, Springer	1998
5.	I Niven, H. Zuckerman, and H. Montgomery; An Introduction to the Number Theory, Wiley, 5th Edition ESBN: 0-471625469.	1991

Details of Course:

Course Title	Course Structure			Pre-Requisite
MC310: Machine Learning	L	T	P	Probability and Statistics, Linear Algebra
	3	0	2	

Course Objective: This course provides a comprehensive introduction to machine learning, covering fundamental concepts, techniques, and applications. Students will learn about supervised and unsupervised learning, model evaluation, and practical implementation using popular programming tools.

Course Outcome (CO):

CO1	Recall the fundamental problems in Machine Learning (ML) and key ML tasks. Identify different types of learning techniques.
CO2	Explain the components of ML and describe the working principles of various ML algorithms.
CO3	Implement and apply supervised and unsupervised learning algorithms to solve real-world classification problems.
CO4	Analyze and identify their strengths and weaknesses in solving specific types of problems. Critique on supervised and unsupervised learning algorithms
CO5	Design and develop the ML algorithms related to real-world case studies.

S.No.	Contents	Contact Hours
UNIT 1	**Introduction:** Introduction to Machine Learning (ML), Fundamental Problems in ML, Examples of Automatic ML System. Overview of Different ML Tasks: Supervised Learning, Unsupervised Learning, Reinforcement Learning. Components of ML.	7
UNIT 2	**Supervised Learning:** K-Nearest Neighbors, Bayesian Classification, Naïve Bayes, Linear Discriminant Analysis, Linear Regression, Logistic Regression, Multilayer Perceptron, Support Vector Machine, Decision Trees.	12
UNIT 3	**Algorithm Independent Machine Learning:** No Free Lunch Theorem, Minimum Description Length Principle, Overfitting Avoidance and Occam's Razor, Bias and Variance. **Estimating and Comparing Classifiers:** Cross Validation, Maximum Likelihood Model Comparison, Bayesian Model Comparison. **Ensemble Methods:** Ada Boost, Random Forest Classifier.	7
UNIT 4	**Unsupervised Learning:** Hierarchical Clustering, K-Means Clustering, Mixture Densities And Identifiability, Expectation Maximization, Graph Theoretic Models for Clustering, Principal Component Analysis, Low Dimensional Representation and Multidimensional Scaling.	8

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UNIT 5	**Reinforcement Learning:** Markov Decision Processes (MDP), Bellman's Equations, Value Iteration and Policy Iteration, Value Function Approximation, Q Learning. Review on Deep Learning Models.	**8**
	TOTAL	**42**

Suggested Books:

S.No.	Name of Books/Authors/Publishers	Year of Publication
1	Mitchell, T. *Machine Learning*. McGraw Hill, ISBN: 978-0070428079.	1997
2	Bishop, C. *Pattern Recognition and Machine Learning*. Springer, ISBN: 978-0387310732.	2006
3	Murphy, K. *Machine Learning: A Probabilistic Perspective*. MIT Press, ISBN: 978-0262018029.	2012
4	Hastie, T., Tibshirani, R., & Friedman, J. *The Elements of Statistical Learning*. Springer, ISBN: 978-0387848570.	2011
5	Sutton, R. S., & Barto, A. G. *Reinforcement Learning: An Introduction*. MIT Press, ISBN: 978-0262039246.	2018

PRACTICALS LIST	
1	Write a program to implement K-Nearest Neighbor classifier and find its accuracy on a given dataset.
2	Write a program to implement Naive Bayes classifier and find its accuracy on a given dataset.
3	Write a program to implement Linear Discriminant Analysis for a given dataset.
4	Write a program to implement Linear Regression and find its accuracy on a given dataset.
5	Write a program to implement Logistic Regression and find its accuracy on a given dataset.
6	Write a program to implement Multilayer Perceptron and find its accuracy on a given dataset.
7	Write a program to implement Support Vector Machine and find its accuracy on a given dataset.
8	Write a program to evaluate and compare above implemented algorithms for a set of given datasets using Cross Validation.
9	Write a program to implement K-Means Clustering and find its accuracy on a given dataset
10	Write a program to implement Expectation Maximization and find its accuracy on a given dataset.
11	Write a program to implement Principal Component Analysis and find its accuracy on a given dataset.

Details of Course:

Course Title	Course Structure			Pre-Requisite
MC311: Numerical Linear Algebra	L	T	P	Linear Algebra, Scientific Computing
	3	1	0	

Course Objective: The objective of this course is to develop a comprehensive understanding of numerical methods in linear algebra, students will gain proficiency in algorithm implementation and sensitivity analysis for efficient, stable solutions.

Course Outcome (CO):

CO1	Compute the condition number and analyze the numerical stability, demonstrating an understanding of error propagation.
CO2	Perform sensitivity analysis on linear systems and least squares problems by evaluating the impact of perturbations in data and model parameters, including sensitivity of eigenvalues, eigenvectors, singular values and singular vectors.
CO3	Implement and apply various matrix factorization techniques such as LU decomposition, Cholesky decomposition, and QR factorization to solve linear systems and least squares problems.
CO4	Evaluate and compare the efficiency and numerical stability of different algorithms for solving linear systems, least squares problems, and the eigenvalue problem using matrix norms.
CO5	Implement iterative methods such as Gauss-Seidel, Successive Over Relaxation (SOR), Conjugate Gradient, and Krylov Subspace Methods for large-scale linear systems and eigenvalue problems.

S.No.	Contents	Contact Hours
UNIT 1	Floating point computations, IEEE floating point arithmetic, analysis of round off errors, Sensitivity analysis and condition numbers, Linear systems, Gaussian elimination with partial pivoting, Gauss-Jacobi, LU decompositions, Gauss-Seidel and successive over relaxation methods.	10
UNIT 2	Banded systems, positive definite systems, Cholesky decomposition - sensitivity analysis, Gram-Schmidt orthonormal process, Householder transformation. Solution of linear least squares problems.	8
UNIT 3	Normal equations, singular value decomposition (SVD), Moore-Penrose inverse, Rank deficient least squares problems, Sensitivity analysis of least squares problems, Sensitivity of eigenvalues and eigenvectors.	9
UNIT 4	Reduction to Hessenberg and tridiagonal forms; Power, inverse power and Rayleigh quotient iterations, Explicit and implicit QR algorithms for symmetric and non-symmetric matrices.	8
UNIT 5	Reduction to bi-diagonal form, Sensitivity analysis of singular values and singular vectors, Krylov subspace methods, conjugate gradient method.	7
	TOTAL	42

Suggested Books:

S.No.	Name of Books/Authors/Publishers	Year of Publication
1	B.N. Datta, Numerical Linear Algebra and Applications, 2nd Edition, SIAM.	2010
2	G. H. Golub and C. F. Van Loan, Matrix Computations, 4th edition, John Hopkins University Press.	2013
3	Lloyd N. Trefethen and D. Bau, Numerical Linear Algebra, SIAM.	1997
4	M. K. Jain, S. R. K. Iyengar, R. K. Jain, Numerical Methods for Scientific and Engineering Computation, New Age International Publishers.	2022

Details of Course:

Course Title	Course Structure			Pre-Requisite
MC312: Wireless and Mobile Computing	L	T	P	NIL
	3	1	0	

Course Objective: To understand the concept of wireless communication, mobile computing paradigm, its novel applications and limitations.

Course Outcome (CO):

CO1	Explain the wireless and cellular telephone concepts.
CO2	Analyze security, energy efficiency, mobility, scalability, and their unique characteristics in wireless networks.
CO3	Compare various security and routing protocols for wireless networks.
CO4	Describe wireless networking protocols and their architecture.
CO5	Develop various mobile computing applications along with their computation methods and algorithms.

S.No.	Contents	Contact Hours
UNIT 1	**Introduction**: Issues in mobile computing, overview of wireless telephony: cellular concept, GSM: air-interface, channel structure, location management: HLR, VLR, hierarchical, handoffs, channel allocation in cellular systems, Cellular telephone, Digital Cellular Standards, Call Routing in GSM , Satellite Technology, FDMA, TDMA, CDMA and GPRS.	8
UNIT 2	**Wireless Networking:** Wireless LAN Overview: MAC issues, PCF, DCF, Frame types, addressing, IEEE 802.11 standards, Bluetooth: Architecture , Layers and protocols, Wireless multiple access protocols, TCP over wireless, Wireless applications, data broadcasting, Mobile IP, WAP: Architecture, protocol stack, application environment, applications, WAP application environment(WAE), WML, WSP, WTP and WTLS, Software Defined Networks.	9
UNIT 3	**Data management**: Issues, data replication for mobile computers, Replication through data allocation, User profile replication scheme, optimistic replication and active replication, adaptive clustering for mobile wireless networks. **Mobile Agents computing:** Introduction, Advantages, Application Domains; security and fault tolerance: Protecting server, code signalling, Firewall approach; security techniques and algorithms: DES, 3DES, AES, Diffie Hellman, RSA and Elliptic curve.	9
UNIT 4	**Ad Hoc networks:** Localization, Routing protocols: Global state routing (GSR), Destination sequenced distance vector routing (DSDV), Fisheye state routing(FSR), Dynamic source routing (DSR), ABR, Route Discovery, Route Repair/Reconstruction, Establishment, Maintenance; Ad Hoc on demand distance vector routing (AODV).	9
UNIT 5	**Transaction processing in mobile computing environment:** Structure, properties, Data consistency, Transaction relation, Recovery and wireless data Dissemination. Temporary ordered routing algorithm (TORA), Quality of Service in Ad Hoc Networks and applications, Advancements in Mobile Computing.	7
	TOTAL	42

Suggested Books:

S.No.	Name of Books/Authors/Publishers	Year of Publication
1	Kamal, R. *Mobile Computing*. Oxford Press, 3rd Edition, ISBN: 978-0199455416.	2018
2	Kute, V. *Adhoc and Wireless Networks*. Notion Press, 1st Edition	2023
3	Athawale, S. V. *Ad-Hoc and Wireless Sensor Network*. Pearson, 1st Edition	2022
4	Olin, B. *Handbook of Wireless and Mobile Communications*. Willford Press, 1st Edition	2016

Details of Course:

Course Title	Course Structure			Pre-Requisite
MC313: Operations Research	L	T	P	NIL
	3	0	2	

Course Objective: The objective of the course is to identify and develop operational research models from the verbal description of the real system. Understand the mathematical tools that are needed to solve optimization problems. Use mathematical software to solve the proposed models.

Course Outcome (CO):

CO1	Solve linear programming problems using appropriate techniques and optimization solvers, interpret the results obtained.
CO2	Analyze any real-life system with limited constraints and depict it in a model form.
CO3	Determine optimal strategy for Minimization of Cost of shipping of products from source to Destination/Maximization of profits of shipping products using various methods, Finding initial basic feasible and optimal solution of the Transportation problems.
CO4	Analyze network scheduling problems and find its optimal solutions using various operational research techniques.
CO5	Employ the analytical and practical skills in real life acquired during the course.

S.No.	Contents	Contact Hours
UNIT 1	Introduction to Operations Research, Linear Programming Problems: basic concepts, general and standard forms of LPP, Mathematical formulation, Feasible region, extreme points and basic feasible solutions, Optimal solution determination by using Graphical method and Simplex method, Two phase method, Big M method.	10
UNIT 2	Duality in LPP: Dual problem, Duality theorems, Strong and Weak Duality Complementary slackness, Economic interpretation of duality, Dual simplex method, Sensitivity analysis (Post Optimality Analysis).	10
UNIT 3	Integer programming Problems: Problem formulation, Branch and bound method, Cutting plane algorithm, Applications of LPP and ILPP.	8
UNIT 4	Transportation and Assignment models: Transportation Problem, Duality of Transportation problem, Degeneracy in transportation problem, Solution of Transportation problem (by stepping stone and modified distribution methods), assignment problem, Hungarian method, Travelling salesman Problem.	7
UNIT 5	Network Scheduling: Network and basic components, Network construction, Critical path method (CPM), Program evaluation and review techniques (PERT), Cost of completing project.	7
	TOTAL	42

Suggested Books:

S.No.	Name of Books/Authors/Publishers	Year of Publication
1	Operations Research: An Introduction Hamdy A. Taha, Pearson Education Inc.	2007
2	Numerical Optimization with Applications, Suresh Chandra, Jayadeva and Aparna Mehra, Narosa Publication.	2008
3	Practical Optimization and Engineering Application, Antonions amd L.W. Sheng, New Age Publications.	2010
4	Introduction to Operations Research, Frederick S. Hiller & Gerald J. Lieberman, McGraw-Hill.	2009
5	Linear Programming, G Hadley, Narosa Publications.	1963

PRACTICALS LIST	
1	Solving Linear Programming Problem using Simplex Method in Tora.
2	Solving Linear Programming Problem using Two Phase Method in Tora.
3	Solving Linear Programming Problem using Big M Method in Tora.
4	Solving Linear Programming Problem using Dual Simplex Method in Tora.
5	Solving LPP problem and apply sensitivity analysis on Tora software.
6	Solving IPP (Integer Programming Problem) problem on Tora software.
7	To solve transportation problem in Tora. Finding Initial basic feasible solution using: 1) N-W corner method 2) Least cost method 3) Vogel's Approximation method
8	To solve Assignment problem in Tora.
9	To implement Critical path method using Tora.
10	To implement project evaluation & review technique using Tora.

Details of Course:

Course Title	Course Structure			Pre-Requisite
MC314:	L	T	P	Linear Algebra
Quantum Information Theory	3	1	0	

Course Objective: The Objective of the course is to provide elementary or introductory knowledge of quantum information theory.

Course Outcome (CO):

CO1	Apply the knowledge of abstract Hilbert space in the field of quantum information theory.
CO2	Demonstrate an understanding of the basic concept of quantum computing.
CO3	Describe the physical properties of a quantum states that allow them to encode information in it.
CO4	Identify the effect of quantum noise.
CO5	Demonstrate an understanding of the theory of entanglement that has no classical analogue.

S.No.	Contents	Contact Hours
UNIT 1	Formalism of quantum information: Hilbert space and Dirac notation, Operators on Hilbert space, Postulates of quantum mechanics, Composite systems.	8
UNIT 2	Quantum Computation: Qubits, Quantum gates, Universal gate sets, The quantum Fourier transform, Some quantum algorithms.	8
UNIT 3	Density operator: Ensembles of quantum states, General properties, Bloch sphere representation, Reduced density operator, Schmidt decomposition and purification.	9
UNIT 4	Quantum Noise and Quantum Operations: Environments, Operator sum representation, Kraus representation theorem, Freedom in the operator sum representation, Examples of single qubit quantum noise.	9
UNIT 5	Theory of Entanglement: EPR paradox, Bell's inequality, Maximally and non-maximally entangled state, Non-locality, Separability problem, Entanglement measures, Entanglement as a resource in quantum communication.	8
	TOTAL	42

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Suggested Books:

S.No.	Name of Books/Authors/Publishers	Year of Publication / Reprint
1	Quantum Computation and Quuantum Information – M. A.Nielsen And I. L. Chuang, Cambridge University Press.	2002
2	Quantum Information Theory- Mark. M. Wilde, Cambridge University Press.	2017
3	Quantum information: An introduction to basic theoretical concepts and experiments - G. Alber, T. Beth, M. Horodecki, P. Horodecki, R. Horodecki, M. Rotteler, H. Weinfurter, R. Werner, and A. Zeilinger, Springer.	2003
4	Introduction to quantum computation and information - H. K. Lo, T. Spiller, & S. Popescu, World Scientific.	1998
5	Elements of information theory –Thomas M. Cover, Joy.A. Thomas, New York: Wiley Interscience.	2006
6	Quantum Computing- A Gentle Introduction, E. Rieffel, W. Polak, MIT Press.	2011

Details of Course:

Course Title	Course Structure			Pre-Requisite
MC315: Partial Differential Equations	L	T	P	Ordinary differential equations, multivariable calculus, Fourier series and Fourier transforms.
	3	1	0	

Course Objective: The Objective of the course is to introduce Partial Differential Equations, apply analytical methods, and interpret solutions in a physical context.

Course Outcome (CO):

CO1	Classify and form partial differential equations (PDEs), apply a range of techniques to find solutions of first order partial differential equations.
CO2	Identify the initial and boundary values problems for second and higher-order PDEs, transform second-order PDEs to canonical or normal form, distinguish qualitative differences between elliptic, parabolic and hyperbolic equations, solve second-order equations using various methods.
CO3	Demonstrate capacity to model physical phenomena using classical PDEs such as the wave equation, the Laplace equation and the heat (diffusion) equation.
CO4	Determine accurate and efficient use of Fourier analysis techniques and their applications in the theory of PDEs for some standard second-order PDEs.
CO5	Apply problem-solving using concepts and techniques from PDEs like Duhamel principle, maximum and minimum principles etc. and Fourier analysis applied to diverse situations in physics, engineering and in other mathematical contexts.

S. No.	Contents	Contact Hours
UNIT 1	First order partial differential equation (PDEs): Origin of PDEs, classification of first order PDEs, Lagrange method, integral surface passing through a given curve, surfaces orthogonal to a given system of surfaces, Cauchy's method of characteristics, Charpit's method and Jacobi's method.	9
UNIT 2	Second order PDEs: Classification of second order PDEs, reduction to canonical or normal forms, characteristics curves of second order equations, initial and boundary value problems,method of separation of variables, Monge's method.	9
UNIT 3	Wave equation: Derivation and Physical interpretation, infinite and semi-infinite string problems, d'Alembert solution of the wave equation, Fourier series solution of the waveequation, inhomogeneous wave equation.	8
UNIT 4	Heat equation: Physical interpretation, maximum and minimum principles, Fourier series solution of the heat equation, heat conduction in finite and infinite media, solution by Fourier transforms, inhomogeneous heat equation.	8
UNIT 5	Laplace equation: Physical interpretation, boundary value problems for Laplace, maximum and minimum principles, Green's identity and fundamental solution, Dirichlet's problem for upper half plane and rectangle, Neumann problem for a rectangle and upper half plane.	8
	TOTAL	42

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Suggested Books:

S. No.	Name of Books/Authors/Publishers	Year of Publication
1	David Bleecker and George Csordas, Basic Partial Differential Equations, International Press.	2003
2	I. N. Sneddon, Elements of Partial Differential Equations, Dover Publications.	2006
3	E. Kreyszig, Advanced Engineering Mathematics, Wiley.	2020
4	Peter V. O' Neil, Advanced Engineering Mathematics, Cengage Learning.	2023
5	Phoolan Prasad and R. Ravindran, Partial Differential equations, New Age International.	2011

Details of Course:

Course Title	Course Structure			Pre-Requisite
MC3[illegible]: Computer Organization and Architecture	L	T	P	NIL
	3	1	0	

Course Objective: To provide knowledge about the principles, concepts and applications of Computer Organization and Architecture.

Course Outcome (CO):

CO1	Describe the basic structure of the computer and control unit, and also evaluate, and perform various micro-operations.
CO2	Explain and analyze memory organization and design principles for the evaluation of instruction set architecture.
CO3	Design pipeline and demonstrate and conceptualize instruction-level parallelism.
CO4	Classify and examine the concept of memory and cache mapping techniques.
CO5	Analyze and elaborate the concept of I/O organization.

S.No.	Contents	Contact Hours
UNIT 1	**Introduction:** Fundamentals of Gates and Flip Flops, Karnaugh's Map simplification, Digital computer generation, computer types and classifications, functional units and their interconnections, Bus architecture, types of buses and bus arbitration. Register, bus and memory transfer. **Register Transfer Language:** Data movement around registers, Data movement from/to memory. Arithmetic, and logic micro-operations. Concept of bus and timing in register transfer.	9
UNIT 2	**Central Processing Unit:** Addition and subtraction of signed numbers look ahead carry adders. Multiplication: Signed operand multiplication, Booth's algorithm, and array multiplier. Division and logic operations. Floating point arithmetic operation, Processor organization, general register organization, stack organization and addressing modes.	8
UNIT 3	**Control Unit:** Instruction types, formats, instruction cycles and subcycles (fetch and execute, etc.), micro-operations, execution of a complete instruction, Interrupts: interrupt hardware, types of interrupts and exceptions. RISC and CISC. **Pipelining:** instruction pipeline, performance evaluation, types of pipelines, dependencies in pipeline. **Hardwired and microprogrammed control:** Microprogrammed sequencing, wide branch addressing, and microinstruction with next address field, concept of horizontal and vertical programming.	9
UNIT 4	**Memory:** Basic concept and hierarchy, Main memory, Auxiliary memory, Associative memory, Cache memories: concept and design issues, associative mapping, direct mapping, set-associative mapping, cache writing and initialization.	8

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UNIT 5	**Input/Output Organization:** Peripheral devices, I/O interface, I/O ports, Priority Interrupt, Asynchronous Data transfer, Modes of Data Transfer: Programmed I/O, interrupt initiated I/O and Direct Memory Access. I/O channels and processors. Serial Communication: Synchronous & asynchronous communication, standard communication interfaces.	8
	TOTAL	**42**

Suggested Books:

S.No.	Name of Books/Authors/Publishers	Year of Publication
1	Mano, M. M. *Computer System Architecture*. Pearson Education, 3rd edition, ISBN: 978-9332585607.	2016
2	Patterson, D. A., & Hennessy, J. L. *Computer Organization and Design*. MK Publications, Elsevier, ISBN: 978-0124077263.	2013
3	Stallings, W. *Computer Organization and Architecture: Designing for Performance*. Pearson Education, 9th edition, ISBN: 978-0132936330.	2013

Details of Course:

Course Title	Course Structure			Pre-Requisite
MC318: Software Engineering	L	T	P	NIL
	3	1	0	

Course Objective: To introduce the fundamentals of software engineering, including requirements specifications, software design, testing and maintenance.

Course Outcome (CO):

CO1	Describe software characteristics, its components and applications, and demonstrate the ability to apply software development life cycle models in software projects.
CO2	Summarize and organize software requirements from clients, analyze, document and verify them.
CO3	Apply software design concepts to meet the specific requirements of customers with consideration of factors such as cost, reusability, maintenance, flexibility, reliability and ethics.
CO4	Demonstrate the ability to apply software project management concepts to deliver a high-quality product on time and within budget. Apply the knowledge of modelling, measurement and improvement of software reliability.
CO5	Evaluate an attribute of a program or a system by applying various testing techniques.

S.No.	Contents	Contact Hours
UNIT 1	**Introduction:** Software characteristics, software components, software applications, software engineering principles, software engineering challenges. Software process models - waterfall model, V model, incremental model, iterative enhancement model, rapid application development model, evolutionary process models, prototyping, spiral model, concurrent models, agile.	8
UNIT 2	**Software Requirements:** Requirement engineering process, types of requirements, requirements elicitation techniques, requirements analysis, requirements documentation, and requirements validation, models for requirements analysis: data flow diagrams, entity relationship diagrams, and data dictionaries.	6
UNIT 3	**Software Design:** Conceptual and technical designs, objectives of design, design principles: problem partitioning, abstraction, modularity, top-down and bottom-up design strategies; coupling and cohesion. Function oriented design, Object oriented design. **Software metrics:** categories of metrics, token count, data structure metrics, information flow metrics, size estimation: Lines of code, function count.	8
UNIT 4	**Software Project Management:** project management concepts, cost estimation, project planning, project scheduling, COCOMO model, Putnam resource allocation model, software risk management. **Reliability and Quality Assurance:** Software reliability concepts, software quality models, software reliability models, capability maturity model.	10

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UNIT 5	**Software Testing:** Terminologies, testing process, verification and validation, alpha and beta testing, acceptance testing, functional testing, structural testing, validation testing, debugging. Levels of testing: unit testing, integration testing, and system testing. **Software Maintenance:** Maintenance process, structured and unstructured maintenance, maintenance models, maintenance cost estimation, reverse engineering, software re-engineering, configuration management. Use case for product development.	10
	TOTAL	**42**

Suggested Books:

S.No.	Name of Books/Authors/Publishers	Year of Publication
1	Pressman, R. S. *Software Engineering: A Practitioner's Approach*. McGraw Hill, 9th Edition, ISBN: 978-1259872976.	2020
2	Sommerville, I. *Software Engineering*. Pearson, 9th Edition, ISBN: 978-0137035151.	2016
3	Jalote, P. *An Integrated Approach to Software Engineering*. Narosa, 3rd Edition, ISBN: 978-8173197024.	2005
4	Aggarwal, K. K., & Singh, Y. *Software Engineering*. New Age International, 2nd Edition, ISBN: 978-8122416381.	2005
5	Peter, J., & Pedrycz, W. *Software Engineering: An Engineering Approach*. Wiley, ISBN: 978-0471713456.	2007

Details of Course:

Course Title	Course Structure			Pre-Requisite
MC320: Web Technology	L	T	P	NIL
	3	0	2	

Course Objective: Understand the Internet and the Web, including their evolution, development, and ongoing research in the field.

Course Outcome (CO):

CO1	Identify fundamental networking principles and describe their role in web communication.
CO2	Explain the concepts of email, Telnet, and Usenet, and examine the evolution of the web from Web 1.0 to Web 3.0 by comparing key advancements.
CO3	Design responsive web pages and develop dynamic websites using modern web development technologies.
CO4	Implement database connectivity with web applications for dynamic content management.
CO5	Utilize web search strategies, analyze web mining techniques, and construct efficient workflows for extracting and processing web data.

S.No.	Contents	Contact Hours
UNIT 1	**Inter-Networking:** Internet, Growth of Internet, Owners of the Internet, Anatomy of Internet, APRANET and Internet history of the World Web, Basic Internet Terminology, Net etiquette. Working of Internet: Packet switching technology. **Internet Protocols:** TCP/IP, Router. Internet Addressing Scheme: Machine Addressing (IP address), E-mail Address, Resource Addresses.	6
UNIT 2	**Internet Applications:** E-mail, file transfer (FTP), telnet, usenet, Internet chat, Web. Evolution of Web: Web 1.0, Web 2.0: From 1.0 to 2.0, Web 3.0: From 2.0 to 3.0; Semantic Web: What, How, Why; From Web 3.0 to Web 4.0.	6
UNIT 3	**Web Development:** Phases; Web Page, Website, and Web Application: Example, Technology Framework for development. **Client-side technology:** HTML (HTML 5). Client-side scripting: JavaScript.	9
UNIT 4	**Server-side technologies:** PHP, Node.js, React, and Angular. Introduction to Microservices and Web Services.	12
UNIT 5	**Database Connectivity:** JDBC, ODBC; Database-to web connectivity. **Recent trends on web:** Web search and mining, search engine optimization, web mining taxonomy, web mining frameworks, and social web mining.	9
	TOTAL	42

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Suggested Books:

S.No.	Name of Books/Authors/Publishers	Year of Publication
1	Kumar, A. *Web Technology: Theory and Practice*. Chapman & Hall/CRC, 1st Edition, ISBN: 978-1138550438.	2018
2	Gopalan, N. P., & Akilandeswari, J. *Web Technology: A Developer's Perspective*. PHI Publication, 2nd Edition, ISBN: 978-8120350069.	2014
3	Levene, M. *An Introduction to Search Engines and Web Navigation*. Pearson Education, ISBN: 978-0470526842.	2010
4	Sarukkai, R. R. *Foundations of Web Technology*. Kluwer Academic Publishers, ISBN: 978-0792376445.	2002
5	Willard, W. *HTML: A Beginner's Guide*. Tata McGraw-Hill, ISBN: 978-0071496299.	2009

PRACTICALS LIST	
1	Getting files from server via HTTP using request, response, general and entity headers.
2	Post messages to the server via electronic mail using PHP or Node.js.
3	Post messages to server via SMTP
4	Design a webpage with HTML, document features and tag attributes having facilities for inserting table, form and text boxes.
5	Design a multimedia-rich webpage with images, audio, and video.
6	Design a webpage for enrollment of students which accepts complete details of students.
7	Create a web page with all types of Cascading style sheets.
8	Write a java script function to display current date and time dynamically.
9	Design a simple Calculator by using HTML, CSS, and JavaScript.
10	Develop a User Registration and Login System using server-side technologies and database.

Details of Course:

Course Title	Course Structure			Pre-Requisite
MC323: Graph Theory	L	T	P	NIL
	3	1	0	

Course Objective: The objective of this course is to introduce and elucidate fundamental concepts in graph theory, and to develop and define new graph models that effectively represent and solve standard problems in various domains.

Course Outcome (CO):

CO1	Define fundamental graph terminology.
CO2	Develop and critically analyze graph traversal algorithms, shortest path algorithms, and the Max-Flow algorithm, evaluating their efficiency and application in real-world scenarios.
CO3	Define and characterize the fundamental properties of trees, including terminology, and implement minimum spanning tree algorithms.
CO4	Illustrate the concepts of cut vertices, bridges, and edge connectivity, explaining their importance in determining and analyzing the robustness and resilience of networks.
CO5	Describe the principles of graph coloring, including chromatic number and its variants, and apply these concepts to solve practical problems.

S.No.	Contents	Contact Hours
UNIT 1	Introduction: Graphs, Sub graphs, Some basic properties of graphs and sub graphs, Isomorphism, Various types of graphs and their sub graphs , trails, walks, paths, circuits and cycles, connected graphs, disconnected graphs and components, various operations on graphs, Eulerian graphs, Hamiltonian paths and cycles, Adjacency and incidence matrices of a graph, shortest path, algorithms to find shortest path.	10
UNIT 2	Hamiltonian and Eulerian Graphs: Necessary conditions for Hamiltonian graphs, sufficient conditions for Hamiltonian graphs, traveling salesman problem, characterization of Eulerian graphs, construction of Eulerian tour, The Chinese postman problem.	8
UNIT 3	Trees: Characterization of trees, rooted and binary trees, spanning trees and their properties, spanning trees in weighted graphs, minimum spanning tree, algorithms for minimum spanning tree.	8
UNIT 4	Cut Vertices and Edge Connectivity: Cut vertices, cut sets and their properties, the max-flow min-cut theorem, max-flow algorithm, connectivity and Edge connectivity.	8
UNIT 5	Coloring of Graphs: Coloring, proper coloring, chromatic number, chromatic partitioning, a maximal independent set, matching, maximum matching in bipartite graphs and in general graphs.	8
	TOTAL	42

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Suggested Books:

S.No.	Name of Books/Authors/Publishers	Year of Publication
1	Narsingh Deo, Graph theory with Applications to engineering and computer science, Dover Publications Inc. , 1st Edition.	2016
2	G. Chatrand, and O.R. Ollermann, Applied and Algorithmic Graph Theory, McGraw Hill.	1993
3	Douglas B. West, Introduction to Graph Theory, Pearson Education India.	2015
4	J.A. Bondy, and U.S.R. Murty, Graduate Texts in Mathematics, Springer.	2010

Details of Course:

Course Title	Course Structure			Pre-Requisite
MC324	L	T	P	NIL
Fuzzy Sets and Fuzzy Logic	3	1	0	

Course Objective: Humans have a remarkable capability to reason and make decisions in an environment of uncertainty, imprecision, incompleteness of information, and partiality of knowledge, truth and class membership. The principal objective of fuzzy logic is formalization/mechanization of this capability by providing an understanding of the basic mathematical elements of the theory of fuzzy sets, fuzzy logic inference with emphasis on their use in the design of intelligent or humanistic systems. Provide an insight into fuzzy inference applications.

Course Outcome (CO):

CO1	Classify "vagueness" and "uncertainty" in knowledge formally using the systematic approach.
CO2	Analyze different applications based on fuzzy model, represent "vague" knowledge formally and describe the impact on popular dynamical systems.
CO3	Identify the fuzzy logic and fuzzy inference systems and make applications on Fuzzy logic membership function and fuzzy inference systems.
CO4	Identify the basic fuzzy theory with some of the traditional design approaches.
CO5	Create fuzzy logic based controllers and list their unique characteristics.

S.No.	Contents	Contact Hours
UNIT 1	Fuzzy sets versus crisp sets, membership functions, operations on fuzzy sets, complements, intersections, unions and their combinations, alpha-cut, fuzzy numbers, fuzzy equations.	9
UNIT 2	Crisp versus fuzzy relations, binary fuzzy relations, equivalence relations, compatibility relations, ordering relations, fuzzy relational equation, fuzzy morphisms.	8
UNIT 3	Classical logic versus fuzzy logic, multivalued logics, fuzzy propositions, fuzzy quantifiers, Linguistic Hedges, influence from conditional fuzzy propositions, conditional and qualified propositions, quantified propositions.	8
UNIT 4	Fuzzy Modus Ponens and Generalized Fuzzy Modus Ponens. Single Rule with single antecedent, Single Rule with multiple antecedents, multiple rule with multiple antecedent, Mamdani's General Model.	9
UNIT 5	Defuzzification methods, Takagi-Sugeno-Kang Inference Method, Fuzzy controllers.	9
	TOTAL	42

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Suggested Books:

S.No.	Name of Books/Authors/Publishers	Year of Publication
1	George J. Klir, Bo Yuan, Fuzzy Sets and Fuzzy Logic Theory and Applications, Prentice Hall of India Pvt. Ltd.	1995
2	H. J. Zimmerman, Fuzzy Set Theory and its Applications, Fourth edition, Springer.	2012
3	Timothy J. Ross, Fuzzy Logic with Engineering Applications, Third edition, Wiley.	2013
4	Suresh Chandra, Aparna Mehra, Abha Aggarwal, Fuzzy Sets and Applications: Modelling Logic and Decision making, First edition, Narosa publication.	2024