Chhattisgarh Swami VivekanandTechnical University (CSVTU, NEWAI (C.G.))

SCHEME OF TEACHING AND EXAMINATION

B Tech Honours (Artificial Intelligence) (First Semester)

S.N	Board of Studies	Courses (Subject)	Course Code	Period per Week			Theory/Lab			Total Marks	Credits
				L	T	P	ESE	CT	TA		
1.	Electronics and Telecommunication	Foundations of Electronics Engineering	A000171(028)	2	1	-	100	20	20	140	3
2.	Basic Science	Engineering Mathematics-I	A000172(014)	2	1	-	100	20	20	140	3
3.	Computer Science Engineering	Learning Programming Concept with C	A000173(022)	2	1	-	100	20	20	140	3
4.	Basic Science	Fundamentals of Computational Biology	A000174(028)	2	1	-	100	20	20	140	3
5.	Civil Engineering	Environmental Science	A000175(020)	2	1	-	100	20	20	140	3
6.	Humanities	Professional Ethics and Life Skills	A000176(046)	2	-	-	50	20	20	90	2
7.	Humanities	Language & Writing Skills	A000177(046)	2	-	-	50	20	20	90	2
8.	Electronics and Telecommunication	Foundations of Electronics Engineering Lab	A000191(028)	-	-	2	40		20	60	1
9.	Computer Science Engineering	Learning Programming Concept with C Lab	A000192(022)			2	40		20	60	1
			Total	14	5	4	680	140	180	1000	21

L – Lecturer ,T – Tutorial, P – Practical , CT –ClassTest ESE – End Semester Exam TA – Teacher's Assessment

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Chhattisgarh Swami Vivekananda Technical University, Bhilai

Branch: B Tech Honours (Artificial Intelligence and Data Science) **Semester: I**

Subject: Foundations of Electronics Engineering **Subject Code: A000171(028)**

Total Theory Periods: 40 **Total Tutorial Periods: 10**

No. of Class tests to: 2(Minimum) **No. of Assignments to be submitted: One per Unit**

ESE Duration: Three Hours Maximum Marks in ESE:100 Minimum Marks in ESE:35

Modeling devices: Static characteristics of ideal two terminal and three terminal devices; Small signal models of non-linear devices. Introduction to semiconductor equations and carrier statistics: poisson's and continuity equations, Fermi-Dirac statistics and Boltzmann approximation to the Fermi-Dirac statistics. Semiconductor Diodes: Barrier formation in metal-semiconductor junctions, PN homo- and hetero- junctions; CV characteristics and dopant profiling; IV characteristics; Small signal models of diodes; Some Applications of diodes. Field Effect Devices : JFET/HFET, MIS structures and MOSFET operation; JFET characteristics and small signal models; MOS capacitor CV and concept of accumulation, depletion and inversion; MOSFET characteristics and small signal models. Bipolar transistors : IV characteristics and elers-Moll model; small signal models; Charge storage and transient response. Discrete transistor amplifiers : Common emitter and common source amplifiers; Emitter and source followers.

Text/Reference Books

1. D. A. Neamen, Semiconductor Physics and Devices (IRWIN), Times Mirror High Education Group, Chicago) 1997
2. E.S. Yang, Microelectronic Devices, McGraw Hill, Singapore, 1988
3. B.G. Streetman, Solid State Electronic Devices, Prentice Hall of India, New Delhi, 1995
4. J. Millman and A. Grabel, Microelectronics, McGraw Hill, International, 1987. A.S. Sedra and K.C. Smith, Microelectronic Circuits, Saunder's College Publishing, 1991
5. R.T. Howe and C.G. Sodini, Microelectronics : An integrated Approach, Prentice Hall International, 1997

Chhattisgarh Swami Vivekananda Technical University, Bhilai

Branch: B Tech Honours (Artificial Intelligence and Data Science) **Semester: I**

Subject: Engineering Mathematics-I **Subject Code: A000172(014)**

Total Theory Periods: 40 **Total Tutorial Periods:10**

No. of Class tests to: 2(Minimum) **No. of Assignments to be submitted: One per Unit**

ESE Duration: Three Hours Maximum Marks in ESE:100 Minimum Marks in ESE:35

Unit I: Univariate calculus **Hours 4**

Review of differentiability, Mean value theorems and Taylor's theorem (without proofs). Integrals as limits of Riemann sums, fundamental theorem of calculus (without proof), integrals by special techniques: reduction formulae, improper integrals, Gamma and Beta functions.

Unit II: Multivariate calculus **Hours 9**

Functions of several variables, partial and directional derivatives, differentiability, chain rule, local extreme values and saddle points, constrained optimization. Double and triple integrals, change of order of integration, change of variables, application to area, volumes.

Unit III: Vector Calculus **Hours 7**

Vector differentiation, gradient, divergence and curl, line and surface integrals, path independence, Green, Stokes and Gauss theorems (statements and illustrations).

UNIT IV: Complex Variables **Hours 4**

Functions of a complex variable – Analytic function – Cauchy - Riemann equations (Statement only) – Properties of analytic function (Statement only) – Construction of Analytic functions by Milne –Thomson method

Unit IV: Fourier Series and Fourier Transform **Hours 8**

Fourier series (definition), full and half range expansions of functions of arbitrary period. Fourier Integral Theorem (without proof), Fourier sine integral, Fourier cosine integral, Fourier Transform and its properties, Fourier sine and cosine transform, Inverse Fourier Transform.

Text Books

1. Thomas' Calculus (12th edition) by Maurice D. Weir, Joel Hass, Frank R. Giordano, Pearson Education.
2. Advanced Engineering Mathematics (10th edition) by Erwin Kreyszig, Wiley eastern Ltd.

Reference Books

1. Calculus for Scientists and Engineers by K.D Joshi, CRC Press.
2. A Course in Calculus and Real Analysis (1st edition) by SudhirGhorpade and BalmohanLimaye, Springer-Verlag, New York.
3. Advanced Engineering Mathematics by C.R. Wylie, McGraw Hill Publications, New Delhi.

4. Advanced Engineering Mathematics (7th edition) by Peter V. O' Neil, Thomson.Brooks /Cole, Singapore.

Chhattisgarh Swami Vivekananda Technical University, Bhilai

Branch: B Tech Honours (Artificial Intelligence and Data Science) **Semester: I**

Subject: Learning Programming Concept with C **Subject Code: A000173(022)**

Total Theory Periods: 40 **Total Tutorial Periods:10**

No. of Class tests to: 2(Minimum) **No. of Assignments to be submitted: One per Unit**

ESE Duration: Three Hours Maximum Marks in ESE:100 Minimum Marks in ESE:35

Unit I: Introduction to Programming **08 Hours**

Basics: Basic program structure; Variables, Constants, I/O Operators; Decision control and blocks; Loop control; Problems using basic concepts.

Unit II: Introduction to Problem Solving **04 Hours**

Understanding a problem; Framing a problem in simple terms – mathematical, graphical, other abstractions; Problem solving heuristics; Conveying the solution in a formal language – using pseudo-code, unplugged exercises Decisions and loops in pseudo-code and flowcharts; Sub-program concept and its representation in pseudocode and flow-charts.

Unit III: Array and Strings **08 Hours**

Concept and requirement of arrays; Defining arrays –one, two and multi-dimensional; Problems using arrays; Strings as arrays of characters; Implementing important string functions; Problems using strings; String library functions.

Unit IV: Function and Recursion **08 Hours**

Concept of subprogram: Declaration, Definition, Calling, Arguments, Local variables; Global and Static variables; Pre and Post conditions; Important problems using functions; Parameter passing mechanisms, Concept of recursion; Essential components of a recursive program; Recursion v/s iteration; Factorial, fibonnaci, towers of hanoi, permutations, combinations using recursion.

Unit V: Pointers **06 Hours**

Pointers and addresses; Types of pointers; Pointer arithmetic; Dangling pointers; Use of pointers for passing variables; Pointers and arrays; Dynamic allocation and its application; Garbage memory.

Unit IV: Structures and File Handling **06 Hours**

Structures; Pointers and structures; Structures and Functions; Self-referential structures; Introduction to linked lists and data structures; Concept of a file. Basics of file handling (Text files); Command line Arguments.

Text Book

1. B. Kernighan, D. Ritchie, "The C Programming Language", Prentice Hall of India, Second Edition, ISBN 81-203-0596-5

Reference Books

1. How to solve it by Computer by R.G. Dromey, Pearson Education
2. Programming in ANSI C by E. Balguruswamy, Tata Mc-Graw Hill

3. Problem Solving Techniques , Stephen G. Krantz, Universities Press.
4. Computer Programming in 'C' by V. Rajaraman , Prentice Hall

Chhattisgarh Swami Vivekananda Technical University, Bhilai

Branch: B Tech Honours (Artificial Intelligence and Data Science) **Semester: I**

Subject: Fundamentals of Computational Biology **Subject Code: A000174(028)**

Total Theory Periods: 40 **Total Tutorial Periods:10**

No. of Class tests to: 2(Minimum) **No. of Assignments to be submitted: One per Unit**

ESE Duration: Three Hours Maximum Marks in ESE:100 Minimum Marks in ESE:35

Unit I: Introduction mathematical modelling: dependent variable, independent variable, vectors, functions, matrix, ordinary differential equations, Bacterial growth model, estimation of product production and substrate decay.

Unit II : Basic biological models: Lotka-Volterra model, population dynamics models, modelling infectious diseases and vaccination efficiency, cancerous cell spread.

Unit III : Visualization: Graph theory, basic graphical representation for biological data- bar plots, scatter plot, line plot, area plot, surface plot, heat map, 3-D plots, distribution plot using excel and MATLAB programming.

Unit IV : Modelling and simulations:Use of python or MATLAB for writing modelling scripts, Modelling of biochemical reactions, reaction mechanisms, respiration, blood/fluid modelling, Fick's law.

Unit V : Biological processes: Molecular switch, flux balance analysis, mutational studies in population.

Text books

1) Advance Engineering Mathematics, BS Grewal.
2) Modelling in Computational Biology and Biomedicine by Oliver Faugeras and Joel Janin
3) Computational cell biology by Christopher fall
4) An introduction to systems biology by Uri Alon

Chhattisgarh Swami Vivekananda Technical University, Bhilai

Branch: B Tech Honours (Artificial Intelligence and Data Science) **Semester: I**

Subject: Environmental Science **Subject Code: A000175(020)**

Total Theory Periods: 40 **Total Tutorial Periods:10**

No. of Class tests to: 2(Minimum) **No. of Assignments to be submitted: One per Unit**

ESE Duration: Three Hours Maximum Marks in ESE:100 Minimum Marks in ESE:35

Unit 1: The Global environmental issues **02 Hours**

Human population and environment : Population growth, Environment and human health, Women andchild welfare, Social issues and environment : People and environment, Social consequences ofdevelopment and Environmental changes

Unit : 2 Natural resources **02 Hours**

Concept, spheres, Direct & Indirect utilization of natural resources, Types - Renewable and nonrenewable,Overexploitation & pollution, Conservation - 3R principle

Unit :3 Ecosystem **04 Hours**

Concept, Types – Terrestrial & aquatic with subtypes, Function, Food chain & web, Energy pyramid,Niche, Ecotone

Unit :4 Biodiversity **04 Hours**

Introduction, levels, Types, Distribution & Magnitude, Threats, Conservation.

Unit :5 Pollution **04 Hours**

Concept, Types & Sources, Direct & indirect Impacts, Prevention, control and mitigation measures,Disaster management

Unit :6 Environmental rules and regulations **04 Hours**

Concepts, Local, national and Global level framework, tools like Environmental Impact Assessment,Environmental Management System, Certifications, Role of an engineer in environmentalmanagement

Reference books:

1) Bharucha E. (2013) Textbook of Environmental Studies for Undergraduate Courses.

2) Carson, Rachel (1962) The Silent Spring

3) Leelakrishnan, P. (2006) Environmental Law Case Book (IInd Edition) LexisNexis Butterworths (Student Series) 466 p.

4) McKibben, Bill (1989) The end of Nature

Chhattisgarh Swami Vivekananda Technical University, Bhilai

Branch: B Tech Honours (Artificial Intelligence and Data Science) **Semester: I**

Subject: Professional Ethics and Life Skills **Subject Code: A000176(046)**

Total Theory Periods: 40 **Total Tutorial Periods:10**

No. of Class tests to: 2(Minimum) **No. of Assignments to be submitted: One per Unit**

ESE Duration: Three Hours Maximum Marks in ESE:50 Minimum Marks in ESE:18

UNIT 1: HUMAN VALUES -

Definition of ethics-Morals values and ethics – integrity-Work ethics- Service Learning-Civic Virtue- Respect for others- Caring-Sharing-Honesty-Courage - Valuing time-Cooperation-Commitment- Empathy-Self-confidence-Character-Spirituality-Introduction to Yoga and meditation for professional excellence and stress management.

Self-Study: Case study of Discovery failure

UNIT 2: ENGINEERING ETHICS

Senses of 'Engineering Ethics' – Variety of moral issues – Types of inquiry – Moral dilemmas – Moral Autonomy – Kohlberg's theory – Gilligan's theory – Consensus and Controversy – Models of professional roles - Theories about right action – Self-interest – Customs and Religion – Uses of Ethical Theories.

Self-study: Study the Bhopal gas tragedy

UNIT 3: SAFETY, RESPOSIBILITIES AND RIGHTS

Safety and Risk – Assessment of Safety and Risk – Risk Benefit Analysis and Reducing Risk - Respect for Authority – Collective Bargaining – Confidentiality – Conflicts of Interest – Occupational Crime – Professional Rights – Employee Rights – Intellectual Property Rights (IPR) – Discrimination.

Self-study: Chernobyl explosion, Nuclear and thermal power plant issues

UNIT 4: LIFE SKILLS

Definition, Relevance, Types of values, changing concepts of values-aims and values of value

education- basic etiquette-morals and values in life-dealing with people. Personal values – Self –

Strengths (self-confidence, self-assessment, self-reliance, self-discipline, determination, self-restraint, contentment, humility, sympathy and compassion, gratitude, forgiveness) Weaknesses.

Self-study: Influences - Peer pressure, familial and societal expectations, media.

UNIT 5: SOCIETIES IN PROGRESS

Definition of society; Units of society; Communities – ancient and modern – Agents of change – Sense of survival, security, desire for comfort and ease sense of belonging, social consciousness and responsibility.

Self-study: Personal value and professional value of Engineers on society's perception

Text Books

1. Subramanian R., Professional ethics, Oxford University press, 2010.

2.Manoharan P.K., Education and Personality Development, APH Publishing Corporation, New Delhi, 2008

Reference Books

1. Megan J. Murphy (Editor), Lorna Hecker (Editor), Ethics and Professional Issues in Couple and Family Therapy.

2. Andrew Belsey (Editor), Ruth Chadwick (Editor), Ethical Issues in Journalism and the Media (Professional Ethics).

3. Warwick Fox (Editor), Ethics and the Built Environment (Professional Ethics).

4. RuchikaNath, Value Education, APH Publishing Corporation, New Delhi, 2008.

Chhattisgarh Swami Vivekananda Technical University, Bhilai

Branch: B Tech Honours (Artificial Intelligence and Data Science) **Semester: I**

Subject: Language & Writing Skills **Subject Code: A000177(046)**

Total Theory Periods: 40 **Total Tutorial Periods:10**

No. of Class tests to: 2(Minimum) **No. of Assignments to be submitted: One per Unit**

ESE Duration: Three Hours **Maximum Marks in ESE:50** **Minimum Marks in ESE:18**

Unit 1: **02 Hours**

Communication as a skill: types of communication, barriers to communication, need for effective communication in English for Engineers.

Unit 2: **06 Hours**

Foundation of language: Communicative Grammar and its appropriateness, Revision of Tenses, use of conjunctions, use of prepositions, speech, word order, sentence structure.

Unit 3: **04 Hours**

Listening: nature of listening, stages of listening (pre, while and post), types of listening, barriers to listening, ways to overcome barriers, ways to practice effective listening, practice listening comprehension.

Unit 4: **02 Hours**

Vocabulary Building and Enhancement of word power, idiomatic expressions, Business English vocabulary, activities on synonyms/antonyms/homonyms/newly coined words.

Unit 5: **04 Hours**

Speaking: Aspects of Speech like pronunciation, stress, intonation and pauses and their need, formal and informal speeches, various expressions used in speech, situational speech, general discussions, group discussions, basics of presentation skill, practice one minute speech, impromptu speeches, prepared speeches.

Unit 6: **06 Hours**

Reading: Types of reading, reading between and beyond the lines, importance of reading for effective communication, practice loud reading and reading comprehension

Writing: nature of writing, stages of writing (pre, while and post), qualities of effective writing, developing drafting and summarizing, format for formal letters, practice writing formal letters, formal report writing.

Text Books:

1. Enhancing employability at soft skills by ShaliniVerma, Pearson publications.

Reference Books:

1. Essential English Grammar (Intermediate) Raymond Murphy (CUP)
2. Communication for Business: A Practical Approach by Shirley Tailor (Longman)
3. Written Communication in English by Saran Freeman (Orient Longman)
4. Business Correspondence and Report Writing, R. C. Sharma & Krishna Mohan (Tata McGraw Hill)

Chhattisgarh Swami Vivekananda Technical University, Bhilai

Branch: B Tech Honours (Artificial Intelligence and Data Science) **Semester: I**

Subject: Foundations of Electronics Engineering Lab **Subject Code: A000191(028)**

Total Marks in End Semester Exam: 40

List of Experiments:

1. P-N Junction Diode Characteristics Part A: Germanium Diode (Forward bias & Reverse bias) Part B: Silicon Diode (Forward bias only)
2. Zener Diode Characteristics Part A: V-I Characteristics Part B: Zener Diode act as a Voltage Regulator
3. Rectifiers (without and with c-filter) Part A: Half-wave Rectifier Part B: Full-wave Rectifier
4. BJT Characteristics (CE Configuration) Part A: Input Characteristics Part B: Output Characteristics
5. FET Characteristics (CS Configuration) Part A: Drain (Output) Characteristics Part B: Transfer Characteristics
6. SCR Characteristics
7. UJT Characteristics
8. CRO Operation and its Measurements
9. BJT-CE Amplifier
10. Emitter Follower-CC Amplifier
11. FET-CS Amplifier

Chhattisgarh Swami Vivekananda Technical University, Bhilai

Branch: B Tech Honours (Artificial Intelligence and Data Science) **Semester: I**

Subject: Learning Programming Concept with C Lab **Subject Code: A000192(022)**

Total Marks in End Semester Exam: 40

List of Experiments:

1. Basic problem solving – (Various ``unplugged" exercises)

2. Basic C program -- (Using variables, constants and simple I/O statements)

3.Arithmetic operators and simple arithmetic expressions – (Unit Conversion, Simple Interest, Basic Physics and Mathematics Formulae)

4. Swapping two values, rotating three values.

5. Simple character handling – (Recognition, Case change, Counting)

6. Decision control and blocks – (Tests of Divisibility, Triangularity, Nature of Quadratic Roots, Leap year, Calculator)

7. Loop control – (Arithmetic and geometric progressions, Trigonometric ratios using power series, Power, Factorial, Fibonacci series, Pattern generation)

8. Arrays – (Declaration, Initialisation and Access, Generating value tables, Simple Data processing – Summation of array elements, Average of elements, Maximum and Minimum.)

9. Sorting -- (Bubble, Insertion and Selection sorting algorithms)

10. Searching -- (Linear and Binary search)

11. 2-D Arrays – (Basic matrix operations, Matrix multiplication)

12. Strings – (Initialization and usage, Important string functions, String matching, String reversal)

13. Basics of functions -- (Declaration, Definition and Usage – previously solved problems like unit conversion, trigonometric ratios, etc. can be re-done using functions)

14. Arrays and functions – (Sorting and Searching with functions)

15. Recursive Functions -- (Summation, Power, Fibonacci series)

16. Use of Pointers for Indirect Access

17. Use of Pointers for passing variables

18. Use of Pointers for passing arrays and strings.

19. Dynamic memory allocation

20. Structures – (Basics of Structures -- definition, declaration and usage)

21. Arrays of Structures -- (Student Database, Telephone Directory)

22. Passing Structures to Functions

23. Pointer to Structure and Passing Structure using Pointers

24. Self-Referential Structure (Basics – definition, declaration and usage)

25 .File Handling – (Reading and Writing into Text Files with standard functions)

Chhattisgarh Swami VivekanandTechnical University (CSVTU, NEWAI (C.G.))

SCHEME OF TEACHING AND EXAMINATION

B Tech Honours (Artificial Intelligence) (Second Semester)

S.N	Board of Studies	Courses (Subject)	Course Code	Period per Week			Theory/Lab			Total Marks	Credits
				L	T	P	ESE	CT	TA		
1.	Basic Science	Engineering Mathematics-II	A000271(014)	2	1	-	100	20	20	140	3
2.	Computer Science Engineering	Data Structure Using C	A000272(022)	2	1	-	100	20	20	140	3
3.	Computer Science Engineering	Object Oriented Programming	A000273(022)	2	1	-	100	20	20	140	3
4.	Electronics and Telecommunication	Digital Logic & Design	A000274(028)	2	1	-	100	20	20	140	3
5.	Computer Science Engineering	Python for Data Science	A000275(022)	2	1	-	100	20	20	140	3
6	Humanities	Entrepreneurship	A000276(046)	2	-	-	40	-	20	60	2
7	Computer Science Engineering	Data Structure Using C Lab	A000291(022)	-	-	2	40	-	20	60	1
8.	Computer Science Engineering	Object Oriented Programming Lab	A000292(022)		-	2	40	-	20	60	1
9	Computer Science Engineering	Python for Data Science Lab	A000293(022)		-	2	40	-	20	60	1
10	Electronics and Telecommunication	Digital Logic & Design Lab	A000294(028)			2	40		20	60	1
			Total	12	5	8	700	100	200	1000	21

L – Lecturer ,T – Tutorial, P – Practical , CT –Class Test ESE – End Semester Exam TA – Teacher's Assessment

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Chhattisgarh Swami Vivekananda Technical University, Bhilai

Branch: B Tech Honours (Artificial Intelligence and Data Science) **Semester: II**

Subject: Engineering Mathematics-II **Subject Code: A000271(014)**

Total Theory Periods: 40 **Total Tutorial Periods: 10**

No. of Class tests to: 2(Minimum) **No. of Assignments to be submitted: One per Unit**

ESE Duration: Three Hours Maximum Marks in ESE:100 Minimum Marks in ESE:35

UNIT – I LINEAR ALGEBRA 8 Hours

Systems of linear equations and their solutions using Gauss-elimination; vector space, subspace, spanning sets, linearly independence and dependence, basis and dimension, Rank of matrix; inner product, Gram - Schmidt process.

Linear Transformation, Kernel and images of a linear map, Rank-Nullity Theorem (statement and illustration); eigenvalues and eigenvectors, diagonalization of matrices, Jordan canonical form, quadratic forms: positive definiteness

UNIT-II MULTIPLE INTEGRALS 4 Hours

Double integration – Cartesian and polar co-ordinates – Change of order of integration. Area as a double integral – Triple integration in Cartesian coordinates – Volume as a triple integral – Change of variables between Cartesian and polar coordinates.

UNIT – IIIORDINARY DIFFERENTIAL EQUATIONS 08 Hours

Review of first order differential equations, linear differential equations, homogeneous higher order linear differential equations, non- homogeneous higher order linear differential equations with constant coefficients and reducible to differential equations with constant coefficients (method of undetermined coefficients and method of variation of parameters), systems of differential equations, applications to electrical circuits.

UNIT – IVPARTIAL DIFFERENTIAL EQUATIONS 5 Hours

Introduction to the partial differential equations, classification of second order PDE, method of separation of variable, solution of one dimensional heat equation and wave equation.

UNIT V LAPLACE TRANSFORMS 7 Hours

Laplace transforms its properties, Unit step function, Dirac delta functions, Convolution theorem, Inverse Laplace transform and its properties, solving differential equations using Laplace transform.

Text Books

1. Introduction to Linear Algebra (2nd edition) by Serge Lang,Springer.
2. Advanced Engineering Mathematics (10th edition) by Erwin Kreyszig, Wiley easternLtd.

Reference Books

1. Schaum's outlines of Linear Algebra (5th edition) by Seymour Lipschutz, Marc Lipson, McGraw-Hill Education (India) Private Limited, New Delhi.
2. Linear Algebra by Hoffmanand Kunze,(2nd edition) Prentice Hall Publication ,New Delhi.
3. Differential Equations with Applications and Historical notes by George Simmons, Tata Mc-Graw Hill publishing company Ltd, NewDelhi.
4. Advanced Engineering Mathematics by C.R.Wylie, McGraw Hill Publications, NewDelhi.
5. Advanced Engineering Mathematics (7thedition) by Peter V.O'Neil, Thomson. Brooks/Cole, Singapore.

Chhattisgarh Swami Vivekananda Technical University, Bhilai

Branch: B Tech Honours (Artificial Intelligence and Data Science) **Semester: II**

Subject: Data Structure Using C **Subject Code: A000272(022)**

Total Theory Periods: 40 **Total Tutorial Periods: 10**

No. of Class tests to: 2(Minimum) **No. of Assignments to be submitted: One per Unit**

ESE Duration: Three Hours Maximum Marks in ESE:100 Minimum Marks in ESE:35

Prerequisites:

1. C Programming
2. Foundations of Computer Science

Course Objectives :

1. To teach how to design a new user defined, efficient, data types array, stack, queue, list, tree, graph,
   etc. abstract data types and reusable code using object based design techniques.
2. To demonstrate good programming practices, coding standards, modular programming, procedural and object-based way of thinking.
3. To emphasize the design aspects of a new data structure for solving any real life problems.
4. To lay strong emphasis on time complexity analysis techniques and algorithm design techniques.

Course Outcomes :

Student will be able to

1. Analyze data objects, data structures and related concepts.
2. Implement problems using different data structures.
3. Design and implement a database schema for a given problem-domain.
4. Understand and implement trees and graphs.
5. Do Programming in PL/SQL including stored procedures, stored functions, cursors and packages.
6. To appreciate the impact of analytics and big data on the information industry and the external ecosystem for analytical and data services.

UNIT – I FUNDAMENTAL CONCEPTS 04 Hours

Introduction to Data Structures: Data, Data Objects, Data Types ,Abstract Data Type (ADT) and data structures, Concepts of static and dynamic, linear and nonlinear data structures. Introduction to Algorithms: Definition and Characteristics of an algorithm. Algorithm design tools – flowcharts and pseudo code, notations – algorithm header, purpose, conditions and selection, loops, procedures and sub-algorithms.
Program development: Analysis, Design, Coding, Testing and Verification.

UNIT – II LINEAR DATA STRUCTURES USING SEQUENTIAL ORGANIZATION, SEARCHING AND SORTING 07 Hours

Concept of sequential organization, arrays as ADT, Storage representation of array, Matrix operations using arrays, String operations (Length, Concatenation, Copy, Palindrome, Reverse, Compare, Substring) without using library functions, Searching: linear and binary search algorithms. Sorting: General concepts–Bubble sort, Insertion sort, Selection sort, Heap sort, Merge sort, Quick sort.

UNIT – III LISTS **08 Hours**

List as ADT, Concept of linked organization of data against linked list. Singly linked list, doubly linked list, circular linked list. Representation & manipulations of polynomials/sets using linked lists. Dynamic memory management. Representation of sparse matrix. Addition and transpose of sparse matrix.

UNIT – IV STACKS AND QUEUES **08 Hours**

Stack and queue as ADT. Operations on stack and queue. Implementations using arrays and dynamic memory allocation. Application of stack for expression evaluation, expression conversion. Recursion and stacks

UNIT – V TREES AND GRAPHS **08 Hours**

Basic terminology. Binary trees and its representation. Binary tree traversals (recursive and non-recursive) and various operations. Insertion and deletion of nodes in binary search tree. Representation of graphs using adjacency matrix, adjacency list. Implementation of algorithms for traversals; implementing Kruskal's, Prim's algorithms. Single source shortest paths using Dijkstra's algorithm. Applications of graphs and trees.

UNIT – VI ALGORITHM ANALYSIS AND ALGORITHM DESIGN STRATEGIES **08 Hours**

Algorithm Analysis: Time Complexity–Bigoh'O',Omega'Ω', Theta'θ',Best, Average and Worst case analysis: binary search, quick sort, merge sort, insertion sort.

Algorithmic Strategies: Divide and Conquer (quick sort and Tower of Hanoi),Backtracking(n-queens problem), greedy (job scheduling), dynamic programming, branch and bound.

Text Books

1. Y. Langsam, M. Augenstin and A. Tannenbaum, "Data Structures using C", Pearson Education Asia, First Edition, 2002, ISBN 978-81-317-0229-1.

Reference Books

1. E.Horowitz,S.Sahni,S.Anderson-freed,"FundamentalsofDataStructuresinC",SecondEdition, University Press, ISBN 978-81-7371-605-8
2. c, Prentice Hall of India, Second Edition, ISBN81-203-0596-5
3. Ellis Horowitz, S. Sahni, D. Mehta "Fundamentals of Data Structures in C++", Galgotia Book Source, New Delhi.
4. Jean-Paul Tremblay, Paul. G. Soresan, "An introduction to data structures with Applications", Tata Mc- Graw Hill International Editions, 2nd edition 1984,ISBN-0-07-462471-7.

Chhattisgarh Swami Vivekananda Technical University, Bhilai

Branch: B Tech Honours (Artificial Intelligence and Data Science) **Semester: II**

Subject: Object Oriented Programming **Subject Code: A000273(022)**
Total Theory Periods: 40 **Total Tutorial Periods: 10**

No. of Class tests to: 2(Minimum) **No. of Assignments to be submitted: One per Unit**

ESE Duration: Three Hours Maximum Marks in ESE:100 Minimum Marks in ESE:35

UNIT – I INTRODUCTION 06 HOURS

Object oriented programming, Introduction, Application, characteristics, difference between object oriented and procedure programming, Comparison of C and C++, Cout, Cin, Data Type, identifiers

UNIT – II OBJECT AND CLASSES 08 HOURS

Implementation of class and object in C++, access modifiers, object as data type, constructor, destructor, Object as function arguments, default copy constructor, parameterized constructor, returning object from function,Structuresandclasses,Classesobjectsandmemory,staticclassdata,Arraysofobject,Arraysasclass Member Data, the standard C++ String class, Run time and Compile time polymorphism.

UNIT – III OPERATOR OVERLOADING AND INHERITANCE 08 HOURS

Overloading unary operators, overloading binary operators, data conversion, pitfalls of operators overloading, Concept of inheritance, Derived class and base class, access modifiers, types of inheritance, Derived class constructors, member function, public and private inheritance.

UNIT – IV POINTER AND VIRTUAL FUNCTION 08 HOURS

Addresses and pointers, the address-of operator & pointer and arrays, Pointer and Function pointer, Memory management:NewandDelete,pointerstoobjects,debuggingpointers,VirtualFunction,friendfunction,Static function, friend class, Assignment and copy initialization, this pointer, dynamic type information.

UNIT – V STREAMS AND FILES 08 Hours

Streams classes, Stream Errors, Disk File I/O with streams, file pointers, error handling in file I/O with member function, overloading the extraction and insertion operators, memory as a stream object, command line arguments, printer output, Function templates, Class templates Exceptions, Containers, exception handling.

Text Books

1. E. Balaguruswami," Object Oriented Programming in C++",TMH.
2. Robert Lafore, "Object Oriented Programming in C++",Pearson.

Reference Books

1. M.T. Somashekare, D.S. Guru, "Object-Oriented Programming with C++",PHI.
2. Herbert Shildt, "The Complete Reference C++", Tata McGraw Hill publication.

Chhattisgarh Swami Vivekananda Technical University, Bhilai

Branch: B Tech Honours (Artificial Intelligence and Data Science) **Semester: II**

Subject: Digital Logic & Design **Subject Code: A000274(028)**

Total Theory Periods: 40 **Total Tutorial Periods: 10**

No. of Class tests to: 2(Minimum) **No. of Assignments to be submitted: One per Unit**

ESE Duration: Three Hours Maximum Marks in ESE:100 Minimum Marks in ESE:35

UNIT – I

Boolean Algebra and DeMorgan's Theorem, Logic Simplification SOP &POS forms, Canonical forms, Karnaugh maps, Binary codes, Code Conversion.

UNIT – II

Combinational Logic Design: Half and Full Adders, Subtractors, Serial and Parallel Adders, BCD Adder, Comparators, Multiplexers, De-multiplexers, Encoder, Decoder, Display, Barrel shifter and ALU. Concept of PLDs like PAL, PLA, CPLDs, FPGA etc. Logic implementation using Programmable Devices (ROM, PLA).

UNIT – III

Sequential Logic Design: Building blocks like S-R, JK and Master-Slave JK FF, Edge triggered FF, Ripple and Synchronous counters, Shift registers, Finite state machines, Design of synchronous FSM, Algorithmic State Machines charts. Designing synchronous circuits like Pulse train generator, Pseudo Random Binary Sequence generator, Clock generation.

UNIT – IV

Logic Families and Semiconductor Memories: TTL NAND gate, Specifications, Noise margin, Propagation delay, fan-in, fan-out, Tristate TTL, ECL, CMOS families and their interfacing, Memory elements.

UNIT – V

VLSI Design flow: Design entry: Schematic, FSM & HDL, different modeling styles in Verilog HDL, Data types and objects, Dataflow, Behavioral and Structural Modeling, Synthesis and Simulation. Verilog constructs and codes for combinational and sequential circuits.

Text Books/ Reference Books:

1. M. Morris Mano, "Digital Design with Verilog HDL" Pearson Education.
2. Stephan Brown, "Fundamentals of Digital Logic with Verilog Design", Tata Mc Graw Hill.
3. R.P. Jain, "Modern digital Electronics", Tata McGraw Hill.
4. Gothman, "Digital Electronics-An introduction to theory and practice", Pearson Education
5. Douglas-Hall, "Digital Circuits and Systems", Tata McGraw Hill
6. Samir Palnitkar, "Verilog HDL: A guide to Digital Design and Synthesis", Suns of tPress

Chhattisgarh Swami Vivekananda Technical University, Bhilai

Branch: B Tech Honours (Artificial Intelligence and Data Science) **Semester: II**

Subject: Python for Data Science **Subject Code: A000275(022)**

Total Theory Periods: 40 **Total Tutorial Periods: 10**

No. of Class tests to: 2(Minimum) **No. of Assignments to be submitted: One per Unit**

ESE Duration: Three Hours Maximum Marks in ESE:100 Minimum Marks in ESE:35

UNIT 1: INTRODUCTION TO DATA SCIENCE AND PYTHON PROGRAMMING

Introduction to Data Science - Why Python? - Essential Python libraries - Python Introduction- Features, Identifiers, Reserved words, Indentation, Comments, Built-in Data types and their Methods: Strings, List, Tuples, Dictionary, Set - Type Conversion- Operators.

Decision Making- Looping- Loop Control statement- Math and Random number functions. User defined functions - function arguments & its types.

UNIT 2: FILE, EXCEPTION HANDLING AND OOP

User defined Modules and Packages in Python- Files: File manipulations, File and Directory related methods- Python Exception Handling.

OOPs Concepts -Class and Objects, Constructors – Data hiding- Data Abstraction- Inheritance.

UNIT 3: INTRODUCTION TO NUMPY

NumPy Basics: Arrays and Vectorized Computation- The Num Pynd array- Creating ndarrays- Data Types fornd arrays- Arithmetic with Num Py Arrays- Basic Indexing and Slicing - Boolean Indexing- Transposing Arrays and Swapping Axes.

Universal Functions: Fast Element-Wise Array Functions- Mathematical and Statistical Methods- Sorting-Unique and Other Set Logic.

UNIT 4: DATA MANIPULATION WITH PANDAS

Introduction to pandas Data Structures: Series, DataFrame, Essential Functionality: Dropping Entries- Indexing, Selection, and Filtering- Function Application and Mapping- Sorting and Ranking.

Summarizing and Computing Descriptive Statistics- Unique Values, Value Counts, and Membership.

Reading and Writing Data in Text Format.

UNIT 5: DATA CLEANING, PREPARATION AND VISUALIZATION

Data Cleaning and Preparation: Handling Missing Data - Data Transformation: Removing Duplicates, Transforming Data Using a Function or Mapping, Replacing Values, Detecting and Filtering Outliers- StringManipulation: Vectorized String Functions in pandas.

Plotting with pandas: Line Plots, Bar Plots, Histograms and Density Plots, Scatter or Point Plots.

Text Books:

1. Y. Daniel Liang, “Introduction to Programming using Python”, Pearson, 2012.
2. Wes McKinney, “Python for Data Analysis: Data Wrangling with Pandas, NumPy, and IPython”,O’Reilly, 2nd Edition,2018.
3. Jake VanderPlas, “Python Data Science Handbook: Essential Tools for Working with Data”, O’Reilly,2017.

4. Miller, Bradley, and David Ranum. Problem Solving with Algorithms and Data Structures Using Python. 2nd ed. Franklin, Beedle & Associates, 2011. ISBN: 9781590282571.

Reference Books:

1. Wesley J. Chun, “Core Python Programming”, Prentice Hall,2006.
2. Mark Lutz, “Learning Python”, O’Reilly, 4th Edition, 2009.

E Books

1. https://www.programmer-books.com/introducing-data-science-pdf/
2. https://www.cs.uky.edu/~keen/115/Haltermanpythonbook.pdf
3. http://math.ecnu.edu.cn/~lfzhou/seminar/[Joel_Grus]_Data_Science_from_Scratch_First_Princ.pdf

MOOC

1. https://www.edx.org/course/python-basics-for-data-science
2. https://www.edx.org/course/analyzing-data-with-python
3. https://www.coursera.org/learn/python-plotting?specialization=data-science-python

Chhattisgarh Swami Vivekananda Technical University, Bhilai

Branch: B Tech Honours (Artificial Intelligence and Data Science) **Semester: II**

Subject: Entrepreneurship **Subject Code: A000276(046)**

Total Theory Periods: 40 **Total Tutorial Periods: 10**

No. of Class tests to: 2(Minimum) **No. of Assignments to be submitted: One per Unit**

ESE Duration: Three Hours Maximum Marks in ESE:40 Minimum Marks in ESE:14

Assessment Criteria: Individual and Group Assignments.

Week I: Negotiation

Fundamentals of principled negotiations, Three basic people problems, Objective Criteria for negotiations, Common obstacles in negotiation.

Week II & III: Market Structures

Rationale behind studying market structures, Economic definition of market, Determinants of market structure, Economies of scale, Types of market structures.

Week IV: Market Segmentation

Target Market, Benefits of market segmentation, Types of market segmentation, Market Segmentation Strategy Creation.

Week V: Competitive Analysis

Basics of Competitive Analysis, Kinds of competitors, Selection of competitors for analysis, Competitive analysis framework.

Week VI & VII: Questionnaire Design Methods and Concerns

Qualities of a good questionnaire, Preliminary decisions in questionnaire design, Measuring change over time, Open- and closed-ended questions, Question wording, Question order, Pilot Tests and Focus Groups, Pretests.

Week VIII: Seeking Criticism and Constructive Feedback

Writing to venture capitalists, handling professional correspondence, Networking (offline and online), Participation in Business Plan Competitions to raise funding.

Week IX: Social Psychology and Entrepreneurship

Human mind and decision making, Psychological Paradoxes, Human purchase behaviour and business, Customer incentivization.

Week X: Social Entrepreneurship

Social entrepreneur and the power of new ideas, Articulation of a social problem, Understanding beneficiary experience, importance of ethnographic studies, Operation Realities Analysis, Socio-politics, Scope of venture.

Week XI: People Analytics

Data-based human resource improvement in organization, Measuring and managing performance, Engagement, Culture and Attrition, Informal Communication Management, Law and Ethics of People Analytics.

Week XII: Diversity in Workplace

Importance of Diversity in an organization, Diversity and Performance, Measurement of Diversity, Workplace discrimination, Case study.

Text Books:

1. Mindset, Carol Dweck

2. Leaders: Myth and Reality, General Stanley Mc CHRYSTAL

3. Outliers, Malcom Gladwell

4. Good to Great, Jim Collins

5. Steve Jobs, Walter Isaacson

6. The 7 habits of highly effective people, Stephen Covey

7. Thinking Fast and Slow, Daniel Kahneman

Chhattisgarh Swami Vivekananda Technical University, Bhilai

Branch: B Tech Honours (Artificial Intelligence and Data Science) **Semester: II**

Subject: Data Structure Using C Lab **Subject Code: A000291(022)**

Maximum Marks in ESE:40 **Minimum Marks in ESE:14**

List of Experiments:

1. Write a program to perform various string operations such as copy, length, reversing, palindrome, concatenation and to find occurrence of a sub-string using and without using library functions.
2. Implement the following Searching and Sorting methods:
   Searching: Sequential/Linear Search and Binary Search
   Sorting: Bubble Sort , Insertion Sort, Selection Sort, Merge Sort, Heap Sort and Quick Sort.
3. Implementation of Expression conversion and Evaluation using Stack.
4. Implementation of operations on Priority Queue.
5. Implementation of operations on Binary tree.
6. Implementation of Expression Tree Traversals.
7. Implementation of operations on Binary search tree.
8. Implementation of DFS & BFS Graph Traversals techniques.
9. Implementation of minimum spanning tree using Prime's, Kruskal's and Dijkstra'salgorithm.
10. Implementation of operations on sequential file

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Chhattisgarh Swami Vivekananda Technical University, Bhilai

Branch: B Tech Honours (Artificial Intelligence and Data Science) **Semester: II**

Subject: Object Oriented Programming Lab **Subject Code: A000292(022)**

Maximum Marks in ESE:40 **Minimum Marks in ESE:14**

List of Experiments:

1. Write a program to find out the largest number using function.
2. Write a program to find the area of circle, rectangle and triangle using function overloading.
3. Write a program to implement complex numbers using operator overloading.
4. Write a program using class and object to print bio-data of the students.
5. Write a program which defines a class with constructor and destructor which will count number of object created and destroyed.
6. Write a program to show applications of different types of inheritances.
7. Write a program to add two private data members using friend function.
8. Write a program using dynamic memory allocation to perform 2x2 matrix addition and subtraction.
9. Write a program to show the application of virtual function.
10. Write a program that store five student records in a file.
11. Write a program to show the application of class/function template.
12. Write a program to show the application of exception handling.

Chhattisgarh Swami Vivekananda Technical University, Bhilai

Branch: B Tech Honours (Artificial Intelligence and Data Science) **Semester: II**

Subject: Python for Data Science Lab **Subject Code: A000293(022)**

Maximum Marks in ESE:40 **Minimum Marks in ESE:14**

UNIT 1: INTRODUCTION TO DATA SCIENCE AND PYTHON PROGRAMMING

1. Implement basic Python programs for reading input from console.

2. Perform Creation, indexing, slicing, concatenation and repetition operations on Python built-in datatypes: Strings, List, Tuples, Dictionary, Set

3. Solve problems using decision and looping statements.

4. Apply Python built-in data types: Strings, List, Tuples, Dictionary, Set and their methods to solve anygiven problem

5. Handle numerical operations using math and random number functions

6. Create user-defined functions with different types of function arguments.

UNIT 2: FILE, EXCEPTION HANDLING AND OOP

1. Create packages and import modules from packages.

2. Perform File manipulations- open, close, read, write, append and copy from one file to another.

3. Handle Exceptions using Python Built-in Exceptions

4. Solve problems using Class declaration and Object creation.

5. Implement OOP concepts like Data hiding and Data Abstraction.

6. Solve any real-time problem using inheritance concept.

UNIT 3: INTRODUCTION TO NUMPY

1. Create NumPy arrays from Python Data Structures, Intrinsic NumPy objects and Random Functions.

2. Manipulation of NumPy arrays- Indexing, Slicing, Reshaping, Joining and Splitting.

3. Computation on NumPy arrays using Universal Functions and Mathematical methods.

4. Import a CSV file and perform various Statistical and Comparison operations on rows/columns.

5. Load an image file and do crop and flip operation using NumPy Indexing.

UNIT 4: DATA MANIPULATION WITH PANDAS

1. Create Pandas Series and DataFrame from various inputs.

2. Import any CSV file to Pandas DataFrame and perform the following:

(a) Visualize the first and last 10 records

(b) Get the shape, index and column details

(c) Select/Delete the records(rows)/columns based on conditions.

(d) Perform ranking and sorting operations.

(e) Do required statistical operations on the given columns.

(f) Find the count and uniqueness of the given categorical values.

(g) Rename single/multiple columns.

UNIT 5: DATA CLEANING, PREPARATION AND VISUALIZATION

1.Import any CSV file to Pandas DataFrame and perform the following:

(a) Handle missing data by detecting and dropping/ filling missing values.

(b) Transform data using apply() and map() method.

(c) Detect and filter outliers.

(d) Perform Vectorized String operations on Pandas Series.

(e) Visualize data using Line Plots, Bar Plots, Histograms, Density Plots and Scatter Plots.

Chhattisgarh Swami Vivekananda Technical University, Bhilai

Branch: B Tech Honours (Artificial Intelligence and Data Science) **Semester: II**

Subject: Digital Logic & Design Lab **Subject Code: A000294(028)**

Maximum Marks in ESE:40 **Minimum Marks in ESE:14**

List of Experiments:

1. To verify
   a) DeMorgan's Theorem for 2variables
   b) The sum-of product and product-of-sum expressions using universal gates
2. To design and implement
   a) Full Adder using basic logic gates.
   b) Full Subtractors using basic logic gates.
3. To design and implement 4-bit Parallel Adder/ Subtractors using IC7483.
4. Design and Implementation of 4-bit Magnitude Comparator using IC7485.
5. To realize
   a) 4:1 Multiplexer using gates
   b) 3-variable function using IC 74151(8:1MUX)
6. Realize 1:8 Demultiplexers and 3:8 Decoder usingIC74138
7. To realize the following flip-flops using NAND Gates.
   a) Clocked SR Flip-Flop
   b) JK Flip-Flop
8. To realize the following shift registers usingIC7474
   (a) SISO (b) SIPO (c)PISO
9. To realize the Ring Counter and Johnson Counter usingIC7476.
10. To realize the Mod-N Counter usingIC7490.
11. Simulate Full- Adder using simulation tool.
12. Simulate Mod-8 Synchronous UP/DOWN Counter using simulation tool

Chhattisgarh Swami Vivekanand Technical University (CSVTU, NEWAI (C.G.))

SCHEME OF TEACHING AND EXAMINATION

B Tech Honours (Artificial Intelligence) (Third Semester)

S.N	Board of Studies	Courses (Subject)	Course Code	Period per Week			Theory/Lab			Total Marks	Credits
				L	T	P	ESE	CT	TA		
1.	Computer Science Engg.	Probability and Statistics	B127371(022)	2	1	-	100	20	20	140	3
2.	Computer Science Engg.	Analysis & Design of Algorithm	B127372(022)	2	1	-	100	20	20	140	3
3.	Computer Science Engg.	Computer Organization and Architecture	B127373(022)	2	1	-	100	20	20	140	3
4.	Computer Science Engg.	Discrete Structure	B127374(022)	2	1	-	100	20	20	140	3
5.	Computer Science Engg.	Database Management System	B127375(022)	2	1	-	100	20	20	140	3
6.	Computer Science Engg.	Analysis & Design of Algorithm Lab	B127391(022)	-	-	2	40	-	20	60	1
7.	Computer Science Engg.	Database Management System Lab	B127392(022)	-	-	2	40	-	20	60	1
8.	Computer Science Engg.	Independent Project	B127393(022)	-	-	8	120	-	40	160	4
9.	Non Credit Course	Personality Development	B127394(022)	-	-	2	-	-	20	20	-
Total				**10**	**5**	**14**	**700**	**100**	**200**	**1000**	**21**

L – Lecturer ,T – Tutorial, P – Practical , CT –Class Test, ESE – End Semester Exam, TA – Teacher's Assessment

Chhattisgarh Swami Vivekananda Technical University, Bhilai (C.G.)

Branch: B Tech Honours (Artificial Intelligence) **Semester: III**
Subject: Probability and Statistics **Subject Code: B127371(022)**
Total Theory Periods: 40 **Total Tutorial Periods: 10**
No. of Class tests to: 2 (Minimum) **No. of Assignments to be submitted: One per Unit**
ESE Duration: Three Hours, Maximum Marks in ESE: 100 **Minimum Marks in ESE: 35**

UNIT – I: PROBABILITY AND RANDOM VARIABLES
Axioms of Probability- Bayes' Theorem -Random variables – Moments – Moment generating functions.

UNIT – II: STANDARD DISTRIBUTIONS
Binomial, Poisson, Geometric, Uniform, Exponential, Gamma and Normal distributions.

UNIT – III: TWO-DIMENSIONAL RANDOM VARIABLES
Joint distribution – Marginal and conditional distribution – Co-variance – Correlation and Regression.

UNIT – IV: TESTING OF HYPOTHESIS
Sampling distributions – Testing of Hypothesis – Small samples – t Test, F Test and Chi-square Test –Large samples – Single mean – Difference in means – single proportion and difference in proportions.

UNIT – V: DESIGN OF EXPERIMENTS
Analysis of variance – One Way Classification – Completely Randomized block design – Two Way Classification – Randomized block design – Latin Square design.

TEXT BOOKS:

1. Milton. J. S. and Arnold. J.C., "Introduction to Probability and Statistics", Tata McGraw Hill, 4th Edition, 2007.
2. Johnson. R.A. and Gupta. C.B., "Miller and Freund's Probability and Statistics for Engineers", Pearson Education, Asia, 7th Edition, 2007.
3. A. Chandrasekaran, G. Kavitha, "Probability, Statistics, Random Processes and Queuing Theory", Dhanam Publications, 2014.
4. Raj Kumar Bansal, Ashok Kumar Goel, Manoj Kumar Sharma, "MATLAB and its Applications in Engineering", Pearson Publication, Second Edition, 2016.

REFERENCE BOOKS:

1. Spiegel. M.R., Schiller. J. and Srinivasan. R.A., "Schaum's Outline of Theory and Problems of Probability and Statistics", Tata McGraw Hill Edition, 2004.
2. Devore. J.L., "Probability and Statistics for Engineering and the Sciences", Cengage Learning, New Delhi, 8th Edition, 2012.
3. Dean G. Duffy., "Advanced Engineering Mathematics with MATLAB", CRC Press, Third Edition 2013.

E BOOKS:
1. http:// nptel.ac.in/courses/ IIT-MADRAS/ Principles_of_Communication1/ Pdfs/ 1_5.pdf
2. https://www.khanacademy.org

MOOC:
1. https://www.edx.org/course/intr

Chhattisgarh Swami Vivekananda Technical University, Bhilai (C.G.)

Branch: B Tech Honours (Artificial Intelligence) **Semester: III**
Subject: Analysis & Design of Algorithm **Subject Code: B127372(022)**
Total Theory Periods: 40 **Total Tutorial Periods: 10**
No. of Class tests to: 2 (Minimum) **No. of Assignments to be submitted: One per Unit**
ESE Duration: Three Hours, Maximum Marks in ESE: 100 Minimum Marks in ESE: 35

UNIT – I: INTRODUCTION TO ALGORITHM

Algorithm Definition and its properties, requirement to study algorithm, Algorithm vs. Program, Algorithm design techniques, Asymptotic Notations and their properties, recurrence relation, Fundamentals of the Analysis of Algorithmic Efficiency, Time and Space complexity analysis of Recursive and Non-recursive algorithms.

UNIT – II: ANALYSIS OF SORTING ALGORITHMS

Insertion sort, Merge Sort, Quick Sort, Introduction to Binary Heap- Building Heap, Heapify Operation, Heap Sort, Heap-Extract-MIN, Heap-Decrease-Key, and Heap-Insert operations, Sorting techniques in linear time- Counting sort and Radix Sort.

UNIT – III: GREEDY METHODS

Introduction to Greedy methodology, Fractional Knapsack problem, Huffman Encoding, Task/Job Scheduling problem, Optimal Merge Pattern, Introduction and real-time applications of Graph, Tree, and Shortest Path, Minimum Spanning Tree (MST) Algorithm- Prim's and Kruskal Algorithm, Single Source Shortest Path Algorithm- Dijkstra's and Bellmen Ford algorithm.

UNIT – IV: DYNAMIC PROGRAMMING

Introduction to Dynamic programming, Matrix-Chain Multiplication, Longest Common Subsequence, 0/1 Knapsack, Sum of Subsets, Travelling salesman problem, Backtracking, All-pair shortest path Algorithm-Floyd's Warshall algorithm.

UNIT – V: OTHER RELEVANT TOPICS

Binary Search Tree- property and Tree Traversal, B-Trees, String Matching, NP-completeness, Introduction to Approximation Algorithm and Randomized Algorithms.

TEXT BOOKS:

1. Introduction to Algorithms, 3rd Edition by T. H. Cormen, C. E. Leiserson, R. L. Rivest, and C.Stein, PHI.
2. Fundamentals of Computer Algorithms, 2nd Edition by Ellis Horowitz, SartajSahni, and S. Rajasekaran, Silicon Press, USA.

Chhattisgarh Swami Vivekananda Technical University, Bhilai (C.G.)

Branch: B Tech Honours (Artificial Intelligence) **Semester: III**
Subject: Computer Organization and Architecture **Subject Code: B127373(022)**
Total Theory Periods: 40 **Total Tutorial Periods: 10**
No. of Class tests to: 2 (Minimum) **No. of Assignments to be submitted: One per Unit**
ESE Duration: Three Hours, Maximum Marks in ESE: 100 **Minimum Marks in ESE: 35**

UNIT – I:

CPU Architecture, instruction format, control signals in CPU, micro program control unit and hard wired control unit, ALU & sequencer, look ahead carry generator. Arithmetic, Integer Arithmetic, multiplication, Booth's Algorithm, Floating point number representation, floating point arithmetic, division algorithm. Memory: Dynamic RAM organization, CACHE memory & it's mapping, cache organization in multicore Processor, virtual memory, secondary storage, IDE, SCSI, RAID, CD, DVD.

UNIT – II:

Interrupt structure of 8086, closely coupled and loosely coupled multiprocessor systems, bus arbitration, co-processor, key board & video RAM, character generator ROM, Display Card Instruction Pipelining, Introduction to the basic features & architecture of RISC & CISC processors, super scalar processor. OS Support: Component of OS, example of MS-DOS, IT'S LOADING, DOS, and BIOS interrupts.

TEXT BOOKS:

1. W. Stallings, "Computer organization and architecture," PEI.
2. C. Hamacher*et al*., "Computer organization," TMH.

Chhattisgarh Swami Vivekananda Technical University, Bhilai (C.G.)

Branch: B Tech Honours (Artificial Intelligence) **Semester: III**
Subject: Discrete Structure **Subject Code: B127374(022)**
Total Theory Periods: 40 **Total Tutorial Periods: 10**
No. of Class tests to: 2 (Minimum) **No. of Assignments to be submitted: One per Unit**
ESE Duration: Three Hours, Maximum Marks in ESE: 100 **Minimum Marks in ESE: 35**

UNIT– I: Set Theory and Logic

Set, Combination of sets, Finite and Infinite sets, Un-countably infinite sets, Principle of inclusion and exclusion, Mathematical Induction, strong Induction.
Propositions, Conditional Propositions, Logical Connectivity, Propositional calculus, Universal and Existential Quantifiers, First order logic, Applications of Propositional Logic to System Specifications, Boolean Searches.

Relations, Recurrence Relations: Definitions, Equivalence Relations and partitions, Partial ordering relations and lattices, Chains and Anti chains, Warshall's Algorithm & transitive closure, Recurrence relations.

UNIT– II: Number Theory

Basics of Modulo Arithmetic, Basic Prime Number Theory, Factorization, GCD, Divisibility, Euclid's algorithm Congruence relation and its applications: Hashing function, Pseudorandom Numbers, Chinese Remainde Theorem.

Introduction to Counting

Basic Counting Techniques, Pigeonhole and Generalized Pigeonhole Principle, Permutations and Combinations..

UNIT– III: Graphs & Trees

Basic terminology, multi graphs and weighted graphs, paths and circuits, shortest path Problems, Euler and Hamiltonian paths and circuits, factors of a graph, planar graph and Kuratowski's graph, independent sets, graph coloring, Trees, rooted trees, path length in rooted trees, binary search trees, spanning trees and cut set, circuits, minimal spanning trees, Kruskal's and Prim's algorithms for minimal spanning tree. Applications of Graph Theory: In Switching and Coding Theory, Electrical Network Analysis.

UNIT– IV: Algebraic Systems Hours 6

Algebraic Systems, Groups, Semi Groups, Monoids, Subgroups, Permutation Groups, Codes and group codes, Isomorphism and Automorphisms, Homomorphism and Normal Subgroups, Ring, Field.

TEXT BOOKS:

1. C. L. LIU, "Elements of Discrete Mathematics", 2nd Edition, Tata McGraw-Hill, 2002, ISBN: 0-07-043476-X.
2. Kenneth H. Rosen, Discrete Mathematics and Its Appications, Tata McGraw-Hill Edition, 2015.
3. G. Shanker Rao, "Discrete Mathematical Structures", New Age International, 2002, ISBN: 81-224-1424-9.
4. Bernanrd Kolman, Robert C Busby, S.Ross, Discrete Mathematical Structures, PHI Learning, 2008.

Chhattisgarh Swami Vivekananda Technical University, Bhilai (C.G.)

Branch: B Tech Honours (Artificial Intelligence) **Semester: III**
Subject: Database Management System **Subject Code: B127375(022)**
Total Theory Periods: 40 **Total Tutorial Periods: 10**
No. of Class tests to: 2 (Minimum) **No. of Assignments to be submitted: One per Unit**
ESE Duration: Three Hours, Maximum Marks in ESE: 100 **Minimum Marks in ESE: 35**

Course Objectives :

The focus of this course is on database design, architecture, and relational models. Normal forms, internal schema design would also be explored.

Course Outcomes:

Learner would appreciate the systematic design and principals involved in any database development.

The importance of canonical normal forms and its design in large scale database systems would be a secondary outcome of this course.

UNIT – I: **(4 HOURS)**
Introduction: Basic concepts, Advantages of a DBMS over file-processing systems, Data abstraction, Data Models and data independence, Components of DBMS and overall structure of DBMS, Data Modeling, entity, attributes, relationships, constraints, keys E-R diagrams, Components of E-R Model.

UNIT – II: **(4 HOURS)**
Relational Mode: Relational Model: Basic concepts. Attributes and domains, concept of integrity and referential constraints, schema diagram. Relational Query Languages: Relational Algebra and Relational Calculus: Tuple relational and domain relational calculus.

UNIT – III: **(4 HOURS)**
SQL: Introduction to SQL, Characteristics and advantages of SQL, SQL Data Types and Literals, DDL, Tables: Creating, modifying ,deleting, Views: Creating, dropping, Updating using Views, DML, SQL Operators, SQLDML queries, SELECT query and clauses, Set Operations ,Predicates and Joins, Set membership, Tuple variables, set comparison, ordering of tuples, aggregate functions, nested queries, Database modification using SQL Insert, Update and Delete queries, Dynamic and Embedded SQL and concept of stored procedures, Query-by- example.

UNIT – IV: **(4 HOURS)**
Relational Database Design: Notion of normalized relations, functional dependency, decomposition and properties of decomposition, Normalization using functional dependency, Multi-valued dependency and Join dependency. Storage and File Systems: Secondary Storage, RAID, File Organization, Indices, Static and Dynamic Hashing, B-trees and B+ Trees.

UNIT –V: **(4HOURS)**
Query Management and Transaction Processing: Measures of query cost, Selection operation, sorting and join operation, Transaction Concept, Components of transaction management, Concurrency and recovery system, Different concurrency control protocols such as timestamps and locking, validation, Multiple granularity, Deadlock handling, Different crash recovery methods such as log-based recovery, shadow paging, Buffer management and Remote backup system.

TEXT BOOKS:

1. Abraham Silberschatz, Henry F.Korth ,S.Sudarshan ,"Database system concepts" , 5th Edition, McGraw Hill International Edition.
2. Raghu Ramkrishnan, Johannes Gehrke, "Database Management Systems", Second Edition, McGraw Hill International Editions.

Chhattisgarh Swami Vivekananda Technical University, Bhilai (C.G.)

Branch: B Tech Honours (Artificial Intelligence) **Semester: III**

Subject: Analysis & Design of Algorithm Lab **Subject Code: B127391(022)**

Maximum Marks in ESE: 40

List of Experiments:-

1. To implement insertion sort, merge sort and bubble sort.
2. To implement maximum sum of sub array problem.
3. To implement heap sort program.
4. To implement radix sort and bucket sort.
5. To implement Fibonacci sequence, linear search and binary search.
6. To implement local minima in array and local minima in grid problem.
7. To implement matrix multiplication and GCD (Greatest common Divisor).
8. To implement range minima problem.
9. To implement binary tree and binary search tree.
10. To implement shortest path in grid and majority element problem.
11. To implement multiplication of 2 numbers (using divide and conquer approach), counting inversions and quick sort.

Chhattisgarh Swami Vivekananda Technical University, Bhilai (C.G.)

Branch: B Tech Honours (Artificial Intelligence) **Semester: III**

Subject: Database Management System Lab **Subject Code: B127392(022)**

Maximum Marks in ESE: 40

List of Experiments:

1. ER diagrams exercise and SQL, PL-SQL: Modeling exercises for ER Diagrams, Identification of Attributes & Keys. Design Discussions. SQL Commands and Queries (20-25 Queries to be written and data retrieved).
2. Writing SQL Triggers &Assertions.
3. Mini Project implementation (Details of following are given to the students with functional components with project tasks:
4. Draw ER Diagram, Schema of each table required in Project, Normalize all table up to 3NF, Implementation Task: User Interface creation and Report generation.
5. The logical design performs the following tasks: Map the ER/EER diagrams to a relational schema. Be sure to underline all primary keys, include all necessary foreign keys and indicate referential integrity constraints.
6. Perform physical design based above logical design using Oracle/MSSQL on Windows platform and MySQL/Postgre SQL on Linux platform.
7. PerformDMLandDDLusingallpossibleSQLcommandsandwiththehelpanyonehost languages like C, C++, VB, etc. (i.e. embedded SQL).
8. Perform DML and DLL using PL/SQL and PL/pg SQL for the above problems.
9. Assignment based on object based database.
10. Assignment based on Indexing.
11. Design a mini project for any live problem as per SE constraints and implement using the techniques studied for above assignments.

Chhattisgarh Swami Vivekanand Technical University (CSVTU, NEWAI (C.G.))

SCHEME OF TEACHING AND EXAMINATION

B Tech Honours (Artificial Intelligence) (Fourth Semester)

S.N	Board of Studies	Courses (Subject)	Course Code	Period per Week			Theory/Lab			Total Marks	Credits
				L	T	P	ESE	CT	TA		
1.	Computer Science Engg.	Computer Network	B127471(022)	2	1	-	100	20	20	140	3
2.	Computer Science Engg.	Artificial Intelligence: Principles and Applications	B127472(022)	2	1	-	100	20	20	140	3
3.	Computer Science Engg.	Operating System	B127473(022)	2	1	-	100	20	20	140	3
4.	Computer Science Engg.	Theory of Computation	B127474(022)	2	1	-	100	20	20	140	3
5.	Computer Science Engg.	R for Data Science	B127475(022)	2	1	-	100	20	20	140	3
6	Computer Science Engg.	Data Visualization	B127476(022)	2	1	-	80	20	20	120	3
7	Computer Science Engg.	Computer Network Lab	B127491(022)	-	-	2	40	-	20	60	1
8.	Computer Science Engg.	Data Visualization Lab	B127492(022)	-	-	2	40	-	20	60	1
9.	Computer Science Engg.	R for Data Science Lab	B127493(022)	-	-	2	40	-	20	60	1
Total				**12**	**6**	**6**	**700**	**120**	**180**	**1000**	**21**

L – Lecturer, T – Tutorial, P – Practical, CT –Class Test, ESE – End Semester Exam, TA – Teacher's Assessment

Chhattisgarh Swami Vivekananda Technical University, Bhilai (C.G.)

Branch: B Tech Honours (Artificial Intelligence) **Semester: IV**
Subject: Computer Network **Subject Code: B127471(022)**
Total Theory Periods: 40 **Total Tutorial Periods: 10**
No. of Class tests to: 2 (Minimum) **No. of Assignments to be submitted: One per Unit**
ESE Duration: Three Hours, Maximum Marks in ESE: 100 Minimum Marks in ESE: 35

UNIT– I: INTRODUCTION:
Network applications, network hardware, network software, reference models: OSI, TCP/IP, Internet, Connection oriented network - X.25, frame relay. THE PHYSICAL LAYER: Theoretical basis for communication, guided transmission media, wireless transmission, the public switched telephone networks, mobile telephone system.

UNIT– II: THE DATA LINK LAYER:
Design issues, error detection and correction, elementary data link protocols, sliding window protocols, example data link protocols - HDLC, the data link layer in the internet. THE MEDIUM ACCESS SUBLAYER: Channel allocations problem, multiple access protocols, Ethernet, Data Link Layer switching, Wireless LAN, Broadband Wireless, Bluetooth.

UNIT– III: THE NETWORK LAYER:
Network layer design issues, routing algorithms, Congestion control algorithms, Internetworking, the network layer in the internet (IPv4 and IPv6), Quality of Service.

UNIT– IV: THE TRANSPORT LAYER:
Transport service, elements of transport protocol, Simple Transport Protocol, Internet transport layer protocols: UDP and TCP.

UNIT– V: THE APPLICATION LAYER:
Domain name system, electronic mail, World Wide Web: architectural overview, dynamic web document and http. APPLICATION LAYER PROTOCOLS: Simple Network Management Protocol, File Transfer Protocol, Simple Mail Transfer Protocol, Telnet.

TEXT BOOKS:
1. A. S. Tanenbaum (2003), Computer Networks, 4th edition, Pearson Education/ PHI, New Delhi, India.

REFERENCE BOOKS:
1. Behrouz A. Forouzan (2006), Data communication and Networking, 4th Edition, McGraw-Hill, India.
2. Kurose, Ross (2010), Computer Networking: A top down approach, Pearson Education, India.

Chhattisgarh Swami Vivekananda Technical University, Bhilai (C.G.)

Branch: B Tech Honours (Artificial Intelligence) **Semester: IV**
Subject: Artificial Intelligence: Principles and Applications **Subject Code: B127472(022)**
Total Theory Periods: 40 **Total Tutorial Periods: 10**
No. of Class tests to: 2 (Minimum) **No. of Assignments to be submitted: One per Unit**
ESE Duration: Three Hours, Maximum Marks in ESE: 100 Minimum Marks in ESE: 35

Prerequisites: Basic concepts in design of algorithms, including hashing, sorting, searching, and complexity analysis of algorithms.

1. **Fundamental Issues in Intelligent Systems**
    a. Describe Turing test and Chinese Room Thought Experiment
    b. Definitions of AI; Difference between optimum reasoning/behavior and human-like behavior/reasoning
2. **Basic Search Strategies**
    a. Formulate efficient problem/search spaces for a number of problems
    b. Combinatorial explosion of search spaces in most problems of interest
    c. Usefulness of heuristics, completeness, optimality, time/space complexity during search
    d. Uninformed search algorithms
    e. Informed Search Algorithms, admissibility, monotonicity, Design a solution using A* search
    f. Constraint satisfaction problems, algorithms for their solution
    g. Game playing and game tree search, minimax, alpha-beta search
    h. Intro to Game Theory
    i. Genetic Algorithms as search, hill climbing, simulated annealing, gradient descent as paradigms for search
3. **Basic Knowledge Representation**
    a. Introduction to First Order Predicate Calculus (FOPC)
    b. Representation of simple English sentences in FOPC
    c. Convert FOPC formulas into clauses
    d. Inference rules for FOPC, Resolution, Resolution-refutation, answer-extraction
4. **Reasoning with uncertainty**
    a. Probabilistic reasoning
    b. Bayes theorem
    c. Bayesian Networks
    d. Temporal Probability Models; Hidden Markov Models
    e. Fuzzy sets and reasoning
5. **Basic Machine Learning**
    a. Differences between supervised, unsupervised, and reinforcement learning
    b. Classification tasks
    c. Naïve Bayes classifier, overfitting, performance of a classifier
    d. Introduction to clustering, scalability issues in learning
    e. Descriptive Data Summarization; Central tendency (Mean, median, mode), measures of dispersion (variance, box-plots, quartiles, normal and skewed distributions).
6. **Reinforcement Learning**

7. **Data Visualization**
    a. Visualization of data dispersion, box-plot analysis, quantile-plot, quantile-quantile plots, scatter plot, simple regression, Loess curve fitting, demo for these ideas using available standard toolboxes.
    b. Visual exploration and analysis of spatial, temporal, multidimensional relational data.

Text Book:

- Artificial Intelligence – A Modern Approach, 3rd edition. Author: Stuart Russell and Peter Norvig, Publisher: Prentice Hall.

Chhattisgarh Swami Vivekananda Technical University, Bhilai (C.G.)

Branch: B Tech Honours (Artificial Intelligence) **Semester: IV**
Subject: Operating System **Subject Code: B127473(022)**
Total Theory Periods: 40 **Total Tutorial Periods: 10**
No. of Class tests to: 2 (Minimum) **No. of Assignments to be submitted: One per Unit**
ESE Duration: Three Hours, Maximum Marks in ESE: 100 **Minimum Marks in ESE: 35**

UNIT – I: INTRODUCTION

Operation System objective and function, The Evolution of operating Systems, time sharing and real time Systems, Protection. Operating System Structure, System Components, operating system service, System structure. Distributed Computing, The Key Architecture Trend; Parallel Computation.

UNIT – II: CONCURRENT PROCESSES

Process concept: Introduction, Definitions of "Process", Process States, Process State Transitions, The process Control Block, Operations on Processes, Interrupt Processing. Mutual Exclusion, the Producer / Consumer problem, the critical section problem, Semaphores, Classical problems in concurrency, inter process communication. Asynchronous Concurrent Process: introduction, parallel Processing, A Control Structure for indicating parallelism. CPU scheduling: concepts, performance criteria, and scheduling Algorithms. Algorithm evaluation, Multiprocessor scheduling.

UNIT – III: DEADLOCKS

System model, Deadlock characterization. Prevention, Avoidance and Detection, Recovery from deadlock, Combined approach.

UNIT – IV: MEMORY MANAGEMENT

Base machine, resident Monitor, multiprogramming with fixed partition, Multiprogramming with variable Partitions, Paging, Segmentation, paged - segmentation, virtual Memory concepts, Demand paging, performance, page Replacement algorithms, Allocation of frames, Thrashing, cache memory organization impact on performance.

UNIT – V: I/O MANAGEMENT &DISK SCHEDULING

I/O device and the organization of the I/O function, I/O Buffering, Disk I/O, Operating system Design issues. File system: File Concepts – File organization and Access mechanism.

Text Books/ Reference Books:

1. Operating System concepts by Silberscatz A and Peterson, J.L, PE-LPE.
2. Operating System Design & Implementation by Tanenbaum, A.S., PHI.
3. Operating system concepts Galvin by Silberscatz, John Weiley & Sons.
4. Operating systems by H.M. Deital, Pearson Education.
5. Operating System in Depth Design and Programming by Thomas Doeppner, Wiley India.
6. Operating System Concept & Design, Milenkovic M, McGraw Hill.
7. Operation System, Stalling William, Maxwell MCMillan International Editions.

Chhattisgarh Swami Vivekananda Technical University, Bhilai (C.G.)

Branch: B Tech Honours (Artificial Intelligence) **Semester: IV**
Subject: Theory of Computation **Subject Code: B127474(022)**
Total Theory Periods: 40 **Total Tutorial Periods: 10**
No. of Class tests to: 2 (Minimum) **No. of Assignments to be submitted: One per Unit**
ESE Duration: Three Hours, Maximum Marks in ESE: 100 **Minimum Marks in ESE: 35**

UNIT – I:
Introduction: Automata, Computability, and Complexity, Strings and languages: symbol, alphabet, string/ word. Language - Definition, language states, difference between natural and formal language.
FSM without output: Definition and Construction-DFA, NFA, NFA with epsilon-Moves, Minimization Of FA, Equivalence of NFA and DFA, Conversion of NFA with epsilon moves to NFA, Conversion of NFA With epsilon moves to DFA. FSM with output: Definition and Construction of Moore and Mealy Machines, Inter-conversion between Moore and Mealy Machines.

UNIT – II:
Definition and Identities of Regular Expressions, Construction of Regular Expression of the given L, Construction of Language from the RE, Construction of FA from the given RE using direct method, Conversion of FA to RE using Arden's Theorem, Pumping Lemma for RL, Closure properties of RLs, Applications of Regular Expressions.

UNIT – III:
Introduction, Formal Definition of Grammar, Notations, Derivation Process: Leftmost Derivation, Rightmost Derivation, derivation trees, Context Free Languages, Ambiguous CFG, Removal of ambiguity, Simplification of CFG, Normal Forms, Chomsky Hierarchy, Regular grammar, equivalence of RG (LRG and RLG) and FA.

UNIT – IV:
Push Down Automata: Introduction and Definition of PDA, Construction (Pictorial/ Transition diagram) of PDA, Instantaneous Description and ACCEPTANCE of CFL by empty stack and final state, Deterministic PDA Vs Nondeterministic PDA, Closure properties of CFLs, pumping lemma for CFL. Post Machine- Definition and construction.

UNIT – V:
Formal definition of a Turing machine, Recursive Languages and Recursively Enumerable Languages, Design of Turing machines, Variants of Turing Machines: Multi-tape Turing machines, Universal Turing Machine, Nondeterministic Turing machines. Comparisons of all automata.

Text Books :
1. Michael Sipser, Introduction to the Theory of Computation, CENGAGE Learning, 3rd edition ISBBN 13:978-81-315-2529-6.
2. John E Hopcroft, Rajeev Motwani, J D Ullman, "Introduction to Automata theory, Languages, and Computations", Pearson Education Publisher, 3rd edition, 2009.
3. Vivek Kulkarni, Theory of Computation, Oxford University Press, ISBN-13: 978-0-19-808458-7.

Reference Books:
1. E. V. Krishnamurthy, "Theory of computer science", Affiliated East Press Publications, 2004.
2. Dexter C. Kozen, Automata and Computability, Springer Verlag Publications, 1997.
3. Harry Lewis, Christos H. Papadimitriou, "Elements of the Theory of Computation," Prentice-Hall Publications, 2nd edition, 1997.
4. John Martin, "Introduction to Languages and Theory of Computations", McGraw-Hill Publications, 4th edition, 2010.India, ISBN: 9788126520107.

Chhattisgarh Swami Vivekananda Technical University, Bhilai (C.G.)

Branch: B Tech Honours (Artificial Intelligence) **Semester: IV**
Subject: R for Data Science **Subject Code: B127475(022)**
Total Theory Periods: 40 **Total Tutorial Periods: 10**
No. of Class tests to: 2 (Minimum) **No. of Assignments to be submitted: One per Unit**
ESE Duration: Three Hours, Maximum Marks in ESE: 100 Minimum Marks in ESE: 35

UNIT– I: OVERVIEW OF R:

History and Overview of R- Basic Features of R-Design of the R System- Installation of R- Console and Editor Panes-Comments- Installing and Loading R Packages- Help Files and Function Documentation-Saving Work and Exiting R-Conventions- R for Basic Math- Arithmetic- Logarithms and Exponentials-E-Notation- Assigning Objects- Vectors-Creating a Vector- Sequences, Repetition, Sorting, and Lengths- Subsetting and Element Extraction- Vector-Oriented Behaviour.

UNIT– II: MATRICES AND ARRAYS:

Defining a Matrix – Defining a Matrix- Filling Direction- Row and Column Bindings- Matrix Dimensions-Sub setting- Row, Column, and Diagonal Extractions- Omitting and Overwriting- Matrix Operations and Algebra- Matrix Transpose- Identity Matrix- Matrix Addition and Subtraction- Matrix Multiplication-Matrix Inversion-Multidimensional Arrays- Subsets, Extractions, and Replacements.

UNIT– III: NON-NUMERIC VALUES:

Logical Values- Relational Operators- Characters- Creating a String- Concatenation- Escape Sequences-Substrings and Matching- Factors- Identifying Categories- Defining and Ordering Levels- Combining and Cutting.

UNIT– IV: LISTS AND DATA FRAMES:

Lists of Objects-Component Access-Naming-Nesting-Data Frames-Adding Data Columns and
Combining Data Frames-Logical Record Subsets-Some Special Values-Infinity-NaN-NA-NULL Attributes-Object-Class-Is-Dot Object-Checking Functions-As-Dot Coercion Functions.

UNIT– V: BASIC PLOTTING:

Using plot with Coordinate Vectors-Graphical Parameters-Automatic Plot Types-Title and Axis Labels-Color-Line and Point Appearances-Plotting Region Limits-Adding Points, Lines, and Text to an Existing Plot-ggplot2 Package-Quick Plot with qplot-Setting Appearance Constants with Geoms-- READING AND WRITING FILES- R-Ready Data Sets- Contributed Data Sets- Reading in External Data Files- Writing Out Data Files and Plots- Ad Hoc Object Read/Write Operations.

TEXT BOOKS:

1. TilmanM. Davies, “THE BOOK OF R - A FIRST PROGRAMMING AND STATISTICS” Library of Congress Cataloging-in-Publication Data, 2016.

REFERENCE BOOKS:

1. Roger D. Peng,"R Programming for Data Science "Lean Publishing, 2016.

2. Hadley Wickham, Garrett Grolemund," R for Data Science", OREILLY Publication, 2017.

3. Steven Keller, "R Programming for Beginners", CreateSpace Independent Publishing Platform 2016.

4. Kun Ren ,"Learning R Programming", Packt Publishing, 2016.

E BOOKS:

1. https://web.itu.edu.tr/~tokerem/The_Book_of_R.pdf

MOOC:

1. https://online-learning.harvard.edu/subject/r

2. https://www.udemy.com/course/r-basics/

3. https://www.datacamp.com/courses/free-introduction-to-r

Chhattisgarh Swami Vivekananda Technical University, Bhilai (C.G.)

Branch: B Tech Honours (Artificial Intelligence) **Semester: IV**
Subject: Data Visualization **Subject Code: B127476(022)**
Total Theory Periods: 40 **Total Tutorial Periods: 10**
No. of Class tests to: 2 (Minimum) **No. of Assignments to be submitted: One per Unit**
ESE Duration: Three Hours, Maximum Marks in ESE: 100 **Minimum Marks in ESE: 35**

UNIT– I: INTRODUCTION TO VISUALIZATION:

Visualizing Data-Mapping Data onto Aesthetics, Aesthetics and Types of Data, Scales Map Data Values onto Aesthetics, Coordinate Systems and Axes- Cartesian Coordinates, Nonlinear Axes, Coordinate Systems with Curved Axes, Color Scales-Color as a Tool to Distinguish, Color to Represent Data Values ,Color as a Tool to Highlight, Directory of Visualizations- Amounts, Distributions, Proportions, x–y relationships, Geospatial Data.

UNIT– II: VISUALIZING DISTRIBUTIONS:

Visualizing Amounts-Bar Plots, Grouped and Stacked Bars, Dot Plots and Heatmaps, Visualizing Distributions: Histograms and Density Plots- Visualizing a Single Distribution, Visualizing Multiple Distributions at the Same Time, Visualizing Distributions: Empirical Cumulative Distribution Functions and Q-Q Plots-Empirical Cumulative Distribution Functions, Highly Skewed Distributions, Quantile-Quantile Plots, Visualizing Many Distributions at Once-Visualizing Distributions Along the Vertical Axis, Visualizing Distributions Along the Horizontal Axis.

UNIT– III: VISUALIZING ASSOCIATIONS & TIME SERIES:

Visualizing Proportions-A Case for Pie Charts, A Case for Side-by-Side Bars, A Case for Stacked Bars and Stacked Densities, Visualizing Proportions Separately as Parts of the Total ,Visualizing Nested Proportions- Nested Proportions Gone Wrong, Mosaic Plots and Treemaps, Nested Pies ,Parallel Sets. Visualizing Associations Among Two or More Quantitative Variables-Scatterplots, Correlograms, Dimension Reduction, Paired Data. Visualizing Time Series and Other Functions of an Independent Variable-Individual Time Series, Multiple Time Series and Dose–Response Curves, Time Series of Two or More Response Variables.

UNIT– IV: VISUALIZING UNCERTIANITY:

Visualizing Trends-Smoothing, Showing Trends with a Defined Functional Form, Detrending and Time-Series Decomposition, Visualizing Geospatial Data-Projections, Layers, Choropleth Mapping, Cartograms, Visualizing Uncertainty-Framing Probabilities as Frequencies, Visualizing the Uncertainty of Point Estimates, Visualizing the Uncertainty of Curve Fits, Hypothetical Outcome Plots.

UNIT– V: PRINCIPLE OF PROPORTIONAL INK:

The Principle of Proportional Ink-Visualizations Along Linear Axes, Visualizations Along Logarithmic Axes, Direct Area Visualizations, Handling Overlapping Points-Partial Transparency and Jittering, 2D Histograms, Contour Lines, Common Pitfalls of Color Use-Encoding Too Much or Irrelevant Information ,Using Nonmonotonic Color Scales to Encode Data Values, Not Designing for Color-Vision Deficiency

TEXT BOOKS:

1. Claus Wilke, “Fundamentals of Data Visualization: A Primer on Making Informative and Compelling Figures”, 1st edition, O’Reilly Media Inc, 2019.

REFERENCE BOOKS:

1. Tony Fischetti, Brett Lantz, R: Data Analysis and Visualization, O’Reilly, 2016

2. Ossama Embarak, Data Analysis and Visualization Using Python: Analyze Data to Create Visualizations for BI Systems, Apress, 2018.

E BOOKS:

1. https://www.netquest.com/hubfs/docs/ebook-data-visualization-EN.pdf

MOOC:

1. https://www.coursera.org/learn/data-visualization

2. https://www.coursera.org/learn/python-for-data-visualization#syllabus

Chhattisgarh Swami Vivekananda Technical University, Bhilai (C.G.)

Branch: B Tech Honours (Artificial Intelligence) **Semester: IV**

Subject: Computer Network Lab **Subject Code: B127491(022)**

Maximum Marks in ESE: 40

List of Experiments:-

1. Basic Commands of Networking
2. Subnetting and Supernetting
3. Remote Desktop Connection
4. Virtual LAN
5. Routing Information Protocol(RIP)
6. Open Shortest Path First (OSPF) Protocol
7. Border Gateway Protocol(BGP)
8. Basics of Wireshark
9. Socket Programming

Chhattisgarh Swami Vivekananda Technical University, Bhilai (C.G.)

Branch: B Tech Honours (Artificial Intelligence) **Semester: IV**

Subject: Data Visualization Lab **Subject Code: B127492(022)**

Maximum Marks in ESE: 40

Prerequisite: Python or R

List of Experiments:-

1. Download the House Pricing dataset from Kaggle and map the values to Aesthetics
2. Use different Color scales on the Rainfall Prediction dataset
3. Create different Bar plots for variables in any dataset
4. Show an example of Skewed data and removal of skewedness
5. For a sales dataset do a Time Series Visualization?
6. Build a Scatterplot and suggest dimension reduction
7. Use Geospatial Data-Projections on datasets in http://www.gisinindia.com/directory/gis-data-for-india
8. Create the a trend line with a confidence band in any suitable dataset
9. Illustrate Partial Transparency and Jittering
10. Illustrate usage of different color codes

Reference Books:

1. Claus Wilke, “Fundamentals of Data Visualization: A Primer on Making Informative and Compelling Figures”, 1st edition, O’Reilly Media Inc, 2019.

Chhattisgarh Swami Vivekananda Technical University, Bhilai (C.G.)

Branch: B Tech Honours (Artificial Intelligence) **Semester: IV**

Subject: R for Data Science Lab **Subject Code: B127493(022)**

Maximum Marks in ESE: 40

UNIT– I:
Practical Component:

1. Develop the R program for Basic Mathematical computation –Square, Square root, exponential etc.
2. Create an object X that stores the value then overwrite the object in by itself divided by Y. Print the result to the console.
3. Create and store a sequence of values from x to y that progresses in steps of 0.3.
4. Overwrite the existing object using the same sequence with the order reversed.
5. Confirm that the length of the vector created is 20.
6. Extract the first and last elements of already created vector from, storing them as a new object.

UNIT– II:
Practical Component:

1. Create and store a three-dimensional array with six layers of a 4 X 2 matrix, filled with a decreasing sequence of values between 4.8 and 0.1 of the appropriate length.
2. Extract and store as a new object the fourth- and first-row elements, in that order, of the second column only of all layers of (1).
3. Use a fourfold repetition of the second row of the matrix formed in (2) to fill a new array of dimensions 2 X 2 X 2 X.
4. Create a new array comprised of the results of deleting the sixth layer of (1).
6. Overwrite the second and fourth row elements of the second column of layers 1, 3 and 5 of (4) with -99.

UNIT– III:
Practical Component:

1. Confirm the specific locations of elements equal to 0 in the 10 X 10 identity matrix I10
2. Store this vector of 10 values: foo <- c(7,5,6,1,2,10,8,3,8,2).Then, do the following:
   i**.** Extract the elements greater than or equal to 5, storing the result as bar.
   ii. Display the vector containing those elements from foo that remain after omitting all elements that are greater than or equal to 5.
3. Store the string "Two 6-packs for $12.99". Then do the following:
   i. Use a check for equality to confirm that the substring beginning with character 5 and ending with character 10 is "6-pack".
   ii**.** Make it a better deal by changing the price to $10.99.
4. Create a factor with levels of confidence as follows: Low for percentages [0,30]; Moderate for Percentages (30, 70]; and High for percentages (70,100].

UNIT– IV:

Practical Component:

1. Create a list that contains, in this order, a sequence of 20 evenly spaced numbers between -4 and 4; a 3 X 3 matrix of the logical vector c(F,T,T,T,F,T,T,F,F) filled column-wise; a character vector with the two strings "don" and "quixote"; and a factor vector containing the observations c("LOW","MED","LOW","MED","MED","HIGH"). Then, Extract row elements 2 and 1 of columns 2 and 3, in that order, of the logical matrix.
2. Create and store this data frame as d frame with the fiiels of person, sex, funny in your R work space. Append the two new records.
3. Write a single line of code that will extract from my data frame just the names and ages of any records where the individual is female and has a level of funniness equal to Med OR High.
4. Use your knowledge of handling character strings in R to extract all records from my data frame that correspond to people whose names start with *S*.

UNIT– V:

Practical Component:

1. Create a database with the fields of weight,height and sex then create a plot of weight on the x-axis and height on the y-axis. Use different point characters or colors to distinguish between males and females and provide a matching legend. Label the axes and give the plot a title.
2. create a plot using ggplot2 for the same database consists of weight on the x-axis and height on the y- axis. Use different point characters or colors to distinguish between males and females and provide a matching legend. Label the axes and give the plot a title.
3. Write R code that will plot education on the x-axis and income on the y-axis, with both x- and y-axis limits fixed to be [0;100]. Provide appropriate axis labels. For jobs with a prestige value of less than or equal to 80, use a black * as the point character. For jobs with prestige greater than 80, use a blue @.

Chhattisgarh Swami Vivekanand Technical University (CSVTU, NEWAI (C.G.))

SCHEME OF TEACHING AND EXAMINATION

B Tech Honours (Artificial Intelligence) (Fifth Semester)

S.N	Board of Studies	Courses (Subject)	Course Code	Period per Week			Theory/Lab			Total Marks	Credits
				L	T	P	ESE	CT	TA		
1.	Computer Science Engg.	Machine Learning	C127571(022)	3	1	-	100	20	20	140	4
2.	Computer Science Engg.	Predictive Modeling and Analytics	C127572(022)	3	1	-	100	20	20	140	4
3.	Computer Science Engg.	Cryptography and Network Security	C127573(022)	3	1	-	100	20	20	140	4
4.	Computer Science Engg.	Artificial Neural Networks	C127574(022)	3	1	-	100	20	20	140	4
5.	*Professional Elective – I*			3	1	-	100	20	20	140	4
6.	Computer Science Engg.	Machine Learning Lab	C127591(022)	-	-	2	40	-	20	60	1
7.	Computer Science Engg.	Predictive Modeling and Analytics Lab	C127592(022)	-	-	2	40	-	20	60	1
8.	Computer Science Engg.	Artificial Neural Networks Lab	C127593(022)	-	-	2	40	-	20	60	1
9	Computer Science Engg.	Minor Project-I based on Industrial Training	C127594(022)	-	-	10	80	-	40	120	5
Total				**15**	**4**	**14**	**700**	**100**	**200**	**1000**	**28**

L – Lecturer, T – Tutorial, P – Practical, CT –Class Test, ESE – End Semester Exam, TA – Teacher's Assessment

Table – I (Professional Elective – I)

S.N.	Board of Studies	Course Code	Subject
1	Computer Science Engineering	C127531(022)	Advanced Computer Network
2	Computer Science Engineering	C127532(022)	Computational Complexity
3	Computer Science Engineering	C127533(022)	Distributed Computing

Note: (1) 1/4th of total strength of students subject to minimum of 20 students is required to offer and elective in the college in a particular academic session.

(2) Choice of elective course once made for an examination cannot be changed in future Examinations.

Chhattisgarh Swami Vivekananda Technical University, Bhilai (C.G.)

Branch: B Tech Honours (Artificial Intelligence) **Semester: V**
Subject: Machine Learning **Subject Code: C127571(022)**
Total Theory Periods: 40 **Total Tutorial Periods: 10**
No. of Class tests to: 2 (Minimum) **No. of Assignments to be submitted: One per Unit**
ESE Duration: Three Hours, Maximum Marks in ESE: 100 **Minimum Marks in ESE: 35**

UNIT-I: INTRODUCTION

Machine Learning Fundamentals –Types of Machine Learning - Supervised, Unsupervised, Reinforcement- The Machine Learning process. Terminologies in ML- Testing ML algorithms: Overfitting, Training, Testing and Validation Sets-Confusion matrix -Accuracy metrics- ROC Curve- Basic Statistics: Averages, Variance and Covariance, The Gaussian- The Bias-Variance trade off- Applications of Machine Learning.

UNIT-II: SUPERVISED LEARNING

Regression: Linear Regression – Multivariate Regression- Classification: Linear Discriminant Analysis, Logistic Regression- K-Nearest Neighbor classifier. Decision Tree based methods for classification and Regression- Ensemble methods.

UNIT-III: UNSUPERVISED LEARNING

Clustering- K-Means clustering, Hierarchical clustering - The Curse of Dimensionality –Dimensionality Reduction - Principal Component Analysis - Probabilistic PCA- Independent Components analysis

UNIT-IV: ARTIFICIAL NEURAL NETWORKS AND KERNEL MACHINES

Perceptron- Multilayer perceptron- Back Propagation – Initialization, Training and Validation Support Vector Machines(SVM) as a linear and non-linear classifier - Limitations of SVM

UNIT-V: PROBABILISTIC GRAPHICAL MODELS

Bayesian Networks - Learning Naive Bayes classifiers-Markov Models – Hidden Markov Models Sampling – Basic sampling methods – Monte Carlo -Reinforcement Learning

TEXT BOOKS:

1. Kevin P. Murphy, “Machine Learning: A Probabilistic Perspective”, MIT Press, 2012.
2. Stephen Marsland, “Machine Learning –An Algorithmic Perspective”, CRC Press, 2009.
3. SaikatDutt, Subramanian Chandramouli, Amit Kumar Das, “Machine Learning”, Pearson Education, 2018.
4. Christopher Bishop, “Pattern Recognition and Machine Learning” Springer, 2011.

REFERENCE BOOKS:

1. Andreas C. Muller, “Introduction to Machine Learning with Python: A Guide for Data Scientists”, O'Reilly, 2016.
2. Sebastian Raschka, “Python Machine Learning”, Packt Publishing, 2015.
3. Hastie, Tibshirani, Friedman, “The Elements of Statistical Learning: Data Mining, Inference, and Prediction”, 2nd Edition, Springer, 2017.
4. EthemAlpaydin, “Introduction to Machine Learning”, 2nd revised edition, MIT Press, 2010.

E BOOKS:

1. https://www.ibm.com/downloads/cas/GB8ZMQZ3

MOOC:

1. https://www.edx.org/course/machine-learning-fundamentals-2
2. https://www.coursera.org/learn/machine-learning

Chhattisgarh Swami Vivekananda Technical University, Bhilai (C.G.)

Branch: B Tech Honours (Artificial Intelligence) **Semester: V**
Subject: Predictive Modeling and Analytics **Subject Code: C127572(022)**
Total Theory Periods: 40 **Total Tutorial Periods: 10**
No. of Class tests to: 2 (Minimum) **No. of Assignments to be submitted: One per Unit**
ESE Duration: Three Hours, Maximum Marks in ESE: 100 **Minimum Marks in ESE: 35**

UNIT-I: DATA PREPARTION
Introduction – Predictive Analytics in the Wild – Exploring Data types and associated Techniques - Complexities of data - Applying Models: Models and simulation, Categorizing Models, Describing, summarizing data, and decisions – Identify similarities in Data: Data Clustering, converting Raw Data into a Matrix, Identify K-groups in Data.

UNIT-II: DATA CLASSIFICATION – PART I
Background – Exploring Data classification process - Using Data Classification to predict the future: Decision tree, Algorithm for generating Decision Trees, Support Vector Machine.

UNIT-III: DATA CLASSIFICATION – PART II
Ensemble Methods to Boost Prediction Accuracy: Naive Bayes Classification Algorithm, The Markov Model, Linear Regression, Neural Networks – Deep learning.

UNIT-IV: DATA PREDICTION
Adopt predictive analytics - Processing data: identifying, cleaning, generating, reducing dimensionality of data – Structuring Data – Build predictive model: develop and test the model.

UNIT-V: DATA VISUALIZATION
Introduction to visualization tool – Evaluate the data – visualize Model's Analytical Results: hidden grouping, data classification results, outliers, decision trees, prediction – Novel visualization in Predictive Analytics.

TEXT BOOKS:
1. Anasse Bari, Mohamed Chaouchi, Tommy Jung, "Predictive Analytics For Dummies", Wiley Publisher, 2nd Edition, 2016.

REFERENCE BOOKS:
1. Bertt Lantz, Machine Learning with R: Expert techniques for predictive modeling to solve all yourdata analysis problems, Pack Publisher, 2nd Edition, 2015.
2. Aurelien,"Hands-On Machine Learning with Scikit-Learn &TensorFlow", O'Reilly Publisher, 5thEdition, 2017.
3. Max Kuhn, Kjell Johnson, " Applied Predictive Modeling" Springer, 2013.

E BOOKS:
1. https://vuquangnguyen2016.files.wordpress.com/2018/03/applied-predictive-modeling-maxkuhn-kjell-johnson_1518.pdf
2. https://www.researchgate.net/publication/329873035_Prediction_Modeling_Methodology
3. https://www.memsql.com/releases/oreilly-predictive-analytics/

MOOC:
1. https://www.coursera.org/learn/predictive-modeling-analytics
2. https://www.edx.org/course/predictive-analytics
3. https://www.udemy.com/course/machinelearningandlogisticregression/

Chhattisgarh Swami Vivekananda Technical University, Bhilai (C.G.)

Branch: B Tech Honours (Artificial Intelligence) **Semester: V**
Subject: Cryptography and Network Security **Subject Code: C127573(022)**
Total Theory Periods: 40 **Total Tutorial Periods: 10**
No. of Class tests to: 2 (Minimum) **No. of Assignments to be submitted: One per Unit**
ESE Duration: Three Hours, Maximum Marks in ESE: 100 **Minimum Marks in ESE: 35**

UNIT–I: CLASSICAL ENCRYPTION TECHNIQUES
Symmetric cipher model, Steganography, Limitations of Perfect Secrecy, Shannon's Theorem.

UNIT–II: NUMBER THEORY
Prime numbers and factoring, modular arithmetic, computations in finite fields, Discrete logarithms.

UNIT–III: PRIVATE KEY ENCRYPTION SCHEMES AND BLOCK CIPHERS
Pseudorandom Functions and Permutations, Private-Key Encryption Schemes, DES – The Data Encryption Standard, Attacks on DES, Single-Round DES, Two-Round DES, Three-Round DES, Best Known Attacks on Increasing the Key size for DES, Modes of Operation

UNIT–IV: PUBLIC KEY ASYMMETRIC CRYPTOGRAPHY
Public-Key Problems and Mathematical Background, Diffie-Hellman Key Agreement, El-Gamal Encryption Scheme, RSA Encryption, Security of RSA, Hybrid Encryption , Attacks on RSA, Private and Public-Key, Timing Attacks, Elliptic Curve Cryptography.

UNIT–V: HASH FUNTIONS
Definition and Properties, Constructions of Collision-Resistant Hash Functions, Popular Uses of Collision-Resistant Hash Functions, Random Oracle Model. Hash algorithms: SHA-512. Message Authentication: Message Authentication Codes Definitions, Constructions of Secure Message Authenticate Codes, Practical Constructions of Message Authentication Codes.

UNIT–VI:DIGITAL SIGNATURE AND APPLICATIONS AND SECURITY AT TRANSPORT LAYER

Definitions, and Public-Key Infrastructure, Combining Encryption and Signatures – SignCryption, SSL Architecture, Protocols, SSL Message formats, Transport Layer Security, Kerberos Password Management.

TEXT BOOKS:

1. "Cryptography & Network Security" by William Stallings 4th Edition, 2006,Pearson Education Asia.
2. Kahate A, "Cryptography & Network Security", Tata McGraw Hill, 2004.

REFERENCE BOOKS:

1. "Applied Cryptology" by Schiner Bruce, John Wiley & Sons,2001.
2. "Introduction to Cryptography with Coding Theory" by Wade Trappe & Lawrence C Washington, New Jersey, Pearson Education,2006.
3. Charlie Kaufman, Radia Perlman and Mike Speciner, "Network Security: Private Communication in a Public World", Prentice Hall of India PrivateLimited.
4. Behrouz A. Forouzan, "Cryptography and Network Security", McGrawHill

Chhattisgarh Swami Vivekananda Technical University, Bhilai (C.G.)

Branch: B Tech Honours (Artificial Intelligence) **Semester: V**
Subject: Artificial Neural Networks **Subject Code: C127574(022)**
Total Theory Periods: 40 **Total Tutorial Periods: 10**
No. of Class tests to: 2 (Minimum) **No. of Assignments to be submitted: One per Unit**
ESE Duration: Three Hours, Maximum Marks in ESE: 100 **Minimum Marks in ESE: 35**

UNIT-I: Introduction
Introduction to ANN Features, structure and working of Biological Neural Network, Trends in Computing Comparison of BNN and ANN.

UNIT-II: Fundamental Concepts
Fundamental concepts: neuron models and basic learning rules. Single layer neural networks. Multilayer neural networks and back-propagation.

UNIT-III: Associative Memories
Associative memories Linear Association, Basic Concepts of recurrent Auto associative memory: retrieval algorithm, storage algorithm; By directional associative memory, Architecture, Association encoding & decoding, Stability.

UNIT-IV: Self Organizing Networks
Self organizing networks Un-supervised learning of clusters, winner-take-all learning, recall mode, Initialisation of weights, reparability limitations.

UNIT-V:
Auto encoders and adversarial networks**.** Deep Neural Networks.

REFERENCE BOOKS:
1. Artificial Neural Networks – B. Yegnanarayana Prentice Hall of India P Ltd 2005
2. Neural Networks in Computer Inteligance, Li Min Fu TMH 2003
3. Neural Networks -James A Freeman David M S Kapura Pearson Education 2004.
4. Introduction to Artificial Neural Systems Jacek M. Zurada, JAICO Publishing House Ed. 2006.

Chhattisgarh Swami Vivekananda Technical University, Bhilai (C.G.)

Branch: B Tech Honours (Artificial Intelligence) **Semester: V**
Subject: Advanced Computer Network **Subject Code: C127531(022)**
Total Theory Periods: 40 **Total Tutorial Periods: 10**
No. of Class tests to: 2 (Minimum) **No. of Assignments to be submitted: One per Unit**
ESE Duration: Three Hours, Maximum Marks in ESE: 100 **Minimum Marks in ESE: 35**

UNIT-I:
Computer Networks and the Internet: What is the Internet, The Network edge, The Network core, Access Networks and Physical media, ISPs and Internet Backbones, Delay and Loss in Packet-Switched Networks, History of Computer Networking and the Internet - Foundation of Networking Protocols: 5-layer TCP/IP Model, 7-Layer OSI Model, Internet Protocols and Addressing, Equal-Sized Packets Model: ATM - Networking Devices: Multiplexers, Modems and Internet Access Devices, Switching and Routing Devices, Router Structure.

UNIT-II:
The Link Layer and Local Area Networks: Link Layer: Introduction and Services, Error- Detection and Error-Correction techniques, Multiple Access Protocols, Link Layer Addressing, Ethernet, Interconnections: Hubs and Switches, PPP: The Point-to-Point Protocol, Link Virtualization, Routing and Internetworking: Network Layer Routing, Least-Cost-Path algorithms, Non-Least-Cost-Path algorithms, Intradomain Routing Protocols, Interdomain Routing Protocols, Congestion Control at Network Layer.

UNIT-III:
Logical Addressing: IPv4 Addresses, IPv6 Addresses - Internet Protocol: Internetworking, IPv4, IPv6, Transition from IPv4 to IPv6, Multicasting Techniques and Protocols: Basic Definitions and Techniques, Intradomain Multicast Protocols, Interdomain Multicast Protocols, Node-Level Multicast algorithms, Transport and End-to-End Protocols: Transport Layer, Transmission Control Protocol (TCP), User Datagram Protocol (UDP), Mobile Transport Protocols, TCP Congestion Control, Application Layer: Principles of Network Applications, The Web and HTTP, File Transfer: FTP, Electronic Mail in the Internet, Domain Name System (DNS), P2P File Sharing, Socket Programming with TCP and UDP, Building a Simple Web Server.

UNIT-IV:
Wireless Networks and Mobile IP: Infrastructure of Wireless Networks, Wireless LAN Technologies, IEEE 802.11 Wireless Standard, Cellular Networks, Mobile IP, Wireless Mesh Networks (WMNs) - Optical Networks and WDM Systems: Overview of Optical Networks, Basic Optical Networking Devices, Large-Scale Optical Switches, Optical Routers, Wavelength Allocation in Networks, Case Study: An All-Optical Switch.

UNIT-V:
VPNs, Tunneling and Overlay Networks: Virtual Private Networks (VPNs), Multiprotocol Label Switching (MPLS), Overlay Networks, VoIP and Multimedia Networking: Overview of IP Telephony, VoIP Signaling Protocols, Real-Time Media Transport Protocols, Distributed Multimedia Networking, Stream Control Transmission Protocol - Mobile A-Hoc Networks: Overview of Wireless Ad-Hoc Networks, Routing in Ad-Hoc Networks, Routing Protocols for Ad-Hoc Networks, Wireless Sensor Networks: Sensor Networks and Protocol Structures, Communication Energy Model, Clustering Protocols, Routing Protocols.

TEXT BOOKS:
1. Computer Networking: A Top-Down Approach Featuring the Internet, *James F. Kurose, Keith W.Ross*, Third Edition, Pearson Education, 2007
2. Computer and Communication Networks, *Nader F. Mir,* Pearson Education, 2007.

REFERENCES:

1. Data Communications and Networking, *Behrouz A. Forouzan*, Fourth Edition, Tata McGraw Hill, 2007
2. Guide to Networking Essentials, *Greg Tomsho,Ed Tittel, David Johnson,*Fifth Edition, Thomson.
3. An Engineering Approach to Computer Networking *, S.Keshav,* Pearson Education.
4. Campus Network Design Fundamentals, *Diane Teare, Catherine Paquet,* Pearson Education (CISCO Press)
5. Computer Networks, *Andrew S. Tanenbaum*, Fourth Edition, Prentice Hall.
6. The Internet and Its Protocols, A. Farrel, Elsevier.

Chhattisgarh Swami Vivekananda Technical University, Bhilai (C.G.)

Branch: B Tech Honours (Artificial Intelligence) **Semester: V**
Subject: Computational Complexity **Subject Code: C127532(022)**
Total Theory Periods: 40 **Total Tutorial Periods: 10**
No. of Class tests to: 2 (Minimum) **No. of Assignments to be submitted: One per Unit**
ESE Duration: Three Hours, Maximum Marks in ESE: 100 **Minimum Marks in ESE: 35**

UNIT – I:
Computational Complexity: Polynomial time and its justification, Nontrivial examples of polynomial-time algorithms, the concept of reduction (reducibility), Class P Class NP and NP- Completeness, The P versus NP problem and why it's hard

UNIT - II:
Algorithmic paradigms: Dynamic Programming, Longest common subsequence, matrix chain multiplication, knapsack problem, Greedy – 0-1 knapsack, fractional knapsack, scheduling problem, Huffman coding, MST, Branch-and-bound – travelling sales person problem, 0/1 knapsack problem, Divide and Conquer, Merge sort, binary search, quick sort.

UNIT - III:
Randomized Algorithms: Finger Printing, Pattern Matching, Graph Problems, Algebraic Methods, Probabilistic Primality Testing, De-Randomization Advanced Algorithms.

UNIT - IV:
Graph Algorithms: Shortest paths, Flow networks, Spanning Trees; Approximation algorithms, Randomized algorithms. Approximation algorithms: Polynomial Time Approximation Schemes.

UNIT - V:
Advanced Data Structures and applications: Decision Trees and Circuits, B-Trees, AVL Trees, Red and Black trees, Dictionaries and tries, Maps, Binomial Heaps, Fibonacci Heaps, Disjoint sets, Union by Rank and Path Compression

TEXT BOOKS:

1. T. Cormen, C. Leiserson, R. Rivest and C. Stein, Introduction to Algorithms, Third Edition, McGraw-Hill, 2009.
2. R. Motwani and P. Raghavan, Randomized Algorithms, Cambridge University Press, 1995.
3. J. J. McConnell, Analysis of Algorithms: An Active Learning Approach, Jones & Bartlett Publishers, 2001.
4. D. E. Knuth, Art of Computer Programming, Volume 3, Sorting and Searching, Second Edition, Addison-Wesley Professional, 1998.
5. S. Dasgupta, C. H. Papadimitriou and U. V. Vazirani, Algorithms, McGraw-Hill, 2008.

Chhattisgarh Swami Vivekananda Technical University, Bhilai (C.G.)

Branch: B Tech Honours (Artificial Intelligence) **Semester: V**
Subject: Distributed Computing **Subject Code: C127533(022)**
Total Theory Periods: 40 **Total Tutorial Periods: 10**
No. of Class tests to: 2 (Minimum) **No. of Assignments to be submitted: One per Unit**
ESE Duration: Three Hours, Maximum Marks in ESE: 100 **Minimum Marks in ESE: 35**

UNIT-I: INTRODUCTION
Introduction: Definition-Relation to Computer System Components, Motivation, Message, Passing Systems versus Shared Memory Systems, Primitives for Distributed Communication, Synchronous versus Asynchronous Executions, Design Issues and Challenges; A Model of Distributed Computations: A Distributed Program, A Model of Distributed Executions, Models of Communication Networks, Global State of a Distributed System.

UNIT-II: LOGICAL TIME AND GLOBAL STATE
Logical Time: Physical Clock Synchronization: NTP, A Framework for a System of Logical Clocks, Scalar Time, Vector Time; Message Ordering and Group Communication: Message Ordering.
Paradigms, Asynchronous Execution with Synchronous Communication, Synchronous Program Order on Asynchronous System, Group Communication, Causal Order, Total Order; Global State and Snapshot Recording Algorithms: Introduction, System Model and Definitions, Snapshot. Algorithms for FIFO Channels.

UNIT-III: DISTRIBUTED MUTEX AND DEADLOCK
Distributed Mutual exclusion Algorithms: Introduction, Preliminaries, Lamport's algorithm, Ricart Agrawala's Algorithm, Token-Based Algorithms, Suzuki-Kasami's Broadcast Algorithm; Deadlock Detection in Distributed Systems: Introduction, System Model, Preliminaries Models of Deadlocks, Chandy-Misra-Haas Algorithm for the AND model and OR Model.

UNIT-IV: CONSENSUS AND RECOVERY
Consensus and Agreement Algorithms: Problem Definition, Overview of Results, Agreement in a Failure-Free System (Synchronous and Asynchronous), Agreement in Synchronous Systems with Failures; Check pointing and Rollback Recovery: Introduction, Background and Definitions, Issues in Failure Recovery, Checkpoint-based Recovery, Coordinated Check pointing Algorithm, Algorithm for Asynchronous Check pointing and Recovery

UNIT-V: CLOUD COMPUTING
Definition of Cloud Computing, Characteristics of Cloud, Cloud Deployment Models, Cloud Service Models, Driving Factors and Challenges of Cloud, Virtualization, Load Balancing, Scalability and Elasticity, Replication, Monitoring, Cloud Services and Platforms: Compute Services, Storage Services, Application Services

TEXT BOOKS:

1. Kshemkalyani Ajay D, Mukesh Singhal, "Distributed Computing: Principles, Algorithms and Systems", Cambridge Press, 2011.
2. Mukesh Singhal, Niranjan G Shivaratri, "Advanced Concepts in Operating systems", McGraw Hill Publishers, 1994.

REFERENCES:

1. George Coulouris, Jean Dollimore, Time Kindberg, “Distributed Systems Concepts and Design”, Fifth Edition, Pearson Education, 2012.
2. Pradeep L Sinha, “Distributed Operating Systems: Concepts and Design”, Prentice Hall of India, 2007.
3. Tanenbaum A S, Van Steen M, “Distributed Systems: Principles and Paradigms”, Pearson Education, 2007.
4. Liu M L, “Distributed Computing: Principles and Applications”, Pearson Education, 2004.
5. Nancy A Lynch, “Distributed Algorithms”, Morgan Kaufman Publishers, 2003.
6. Arshdeep Bagga, Vijay Madisetti, “ Cloud Computing: A Hands-On Approach”, Universities Press, 2014.

Chhattisgarh Swami Vivekananda Technical University, Bhilai (C.G.)

Branch: B Tech Honours (Artificial Intelligence) **Semester: V**

Subject: Machine Learning Lab **Subject Code: C127591(022)**

Maximum Marks in ESE: 40

List of Experiments:-

1. Installation of Python Libraries/ MATLAB tools for Machine Learning
2. Data pre-processing using Python Machine Learning libraries/ MATLAB. Suggested reading: Introduction to Machine Learning - http://nptel.ac.in/courses/106106139/
3. Design a model to predict the housing price from Boston Dataset using Multivariate Linear Regression.
4. Build a classifier using Logistic Regression, k- Nearest Neighbor / Decision Tree to classify whether the given user will purchase a product or not from a social networking dataset.
5. Segment a customer dataset based on the buying behaviour of customers using K-means/Hierarchical clustering.
6. Dimensionality reduction of any CSV/image dataset using Principal Component Analysis.
7. Recognition of MNIST handwritten digits using Artificial Neural Network.
8. Build an email spam classifier using SVM.
9. Classify the given text segment as ‘Positive’ or ‘Negative’ statement using the Naive Bayes Classifier.
10. Predict future stock price of a company using Monte Carlo Simulation.

Chhattisgarh Swami Vivekananda Technical University, Bhilai (C.G.)

Branch: B Tech Honours (Artificial Intelligence) **Semester: V**

Subject: Predictive Modeling and Analytics Lab **Subject Code: C127592(022)**

Maximum Marks in ESE: 40

List of Experiments:-

1. Healthcare Analytics Case Study: Cancer survivability predictors
2. Social and Marketing Analytics Case Study: Tweets as predictors for the stock market

    Step 1- Collecting data

    Step 2 – Exploring and preparing the Data

1. Apply Decision tree classification model on Healthcare Analytics
2. Apply Support Vector Machine model on Social and Marketing Analytics

1. Apply Naive Bayes Classification Algorithm on Healthcare Analytics
2. Apply Linear Regression Algorithm on Social and Marketing Analytics

1. Develop and test the model for Healthcare Analytics
2. Develop and test the model for Social and Marketing Analytics

1. Visualize Data Classification results
2. Visualize the decision trees
3. Visualize the prediction

Chhattisgarh Swami Vivekananda Technical University, Bhilai (C.G.)

Branch: B Tech Honours (Artificial Intelligence) **Semester: V**

Subject: Artificial Neural Networks Lab **Subject Code: C127593(022)**

Maximum Marks in ESE: 40

List of Experiments:-

1. Write a program to implement Perceptron.
2. Write a program to implement AND OR gate using Perceptron.
3. Write a program to perform the basic matrix operations.
4. Write a program to implement classification using Back propagation.
5. Write a MatLab/ Python Script containing four functions Addition, Subtraction, Multiply and Divide functions.
6. Write a program to implement classification of linearly separable Data with a perceptron.
7. To study Long Short Term Memory for Time Series Prediction.
8. To study Convolutional Neural Network and Recurrent Neural Network.
9. To study ImageNet, GoogleNet,ResNet convolutional Neural Networks.
10. Write a program to implement following activation function (i) purelin(n), (ii) binary threshold(hardlim(n) (iii) haradlims(n)) , (iv)Tansig(n) (v) logsig(n).
11. To study the use of Long Short Term Memory / Gated Recurrent Units to predict the stock prices based on historical data.

Chhattisgarh Swami Vivekanand Technical University (CSVTU, NEWAI (C.G.))

SCHEME OF TEACHING AND EXAMINATION

B Tech Honours (Artificial Intelligence) (Sixth Semester)

S.N	Board of Studies	Courses (Subject)	Course Code	Period per Week			Theory/Lab			Total Marks	Credits
				L	T	P	ESE	CT	TA		
1	Computer Science Engg.	Project Based on Internship	C127691(022)	--	-	36	600	-	400	1000	18
Total						**36**	**600**		**400**	**1000**	**18**

L – Lecturer, T – Tutorial, P – Practical, CT –Class Test, ESE – End Semester Exam, TA – Teacher's Assessment

Chhattisgarh Swami Vivekanand Technical University (CSVTU, NEWAI (C.G.))

SCHEME OF TEACHING AND EXAMINATION

B Tech Honours (Artificial Intelligence) (Seventh Semester)

S.N	Board of Studies	Courses (Subject)	Course Code	Period per Week			Theory/Lab			Total Marks	Credits
				L	T	P	ESE	CT	TA		
1.	Computer Science Engg.	Intelligent Systems & Robotics	D127771(022)	3	1	-	100	20	20	140	4
2.	Computer Science Engg.	Business Intelligence and Analytics	D127772(022)	2	1	-	100	20	20	140	3
3.	Computer Science Engg.	Software Engineering	D127773(022)	2	1	-	100	20	20	140	3
4.	Computer Science Engg	Gaming Theory	D127774(022)	3	1	-	100	20	20	140	4
5.	*Professional Elective* – II *(Refer Table I)*			2	1	-	80	20	20	120	3
6.	*Open Elective I (Refer Table III)*			2	1		50	20	20	90	3
7.	Computer Science Engg.	Intelligent Systems & Robotics Lab	D127791(022)	-	-	2	40	-	20	60	1
8.	Computer Science Engg.	Business Intelligence and Analytics Lab	D127792(022)	-	-	2	40	-	20	60	1
9	Computer Science Engg.	Software Engineering lab	D127793(022)	-	-	2	40	-	20	60	1
10	Computer Science Engg.	Minor Project	D127794(022)	4	-	-	20	-	20	40	4
11	Humanities	Technical Communication and Soft Skill **(Non Credit)**	D127001(046)	2	-	-	-	-	10	10	-
Total				20	6	6	670	120	210	1000	27

L – Lecturer, T – Tutorial, P – Practical, CT –Class Test, ESE – End Semester Exam, TA – Teacher's Assessment

Table – I (Professional Elective – II)

S.N.	Board of Studies	Course Code	Subject
1	Computer Science Engg.	D127731(022)	Computer Vision
2	Computer Science Engg.	D127732(022)	Multimedia System and Application
3	Computer Science Engg.	D127733(022)	Image Processing
4	Computer Science Engg.	D127734(022)	High Performance Computing
5	Computer Science Engg.	D127735(022)	Crypto-currency and Block Chain Technologies

Table – I (Open Elective – I)

S.N.	Board of Studies	Course Code	Subject
1	Management	D000751(076)	Managing Innovation & Entrepreneurship
2	Management	D000752(076)	Principle of Management
3	Management	D000753(076)	Industrial Economics and Management
4	Management	D000754(076)	Entrepreneurship Development
5	Management	D000755(076)	Management Information System

Note: (1) 1/4 th of total strength of students subject to minimum of 20 students is required to offer and elective in the college in a particular academic session.

(2) Choice of elective course once made for an examination cannot be changed in future Examinations.

Chhattisgarh Swami Vivekananda Technical University, Bhilai (C.G.)

Branch: B Tech Honours (Artificial Intelligence) **Semester - VII**

Subject: Intelligent System and Robotics **Subject Code: D127771(022)**

Total Theory Periods: 40 **Total Tutorial Periods: 10**

No. of Class tests to: 2 (Minimum) **No. of Assignments to be submitted: One per Unit**

ESE Duration: Three Hours, **Maximum Marks in ESE: 100**

Minimum Marks in ESE: 35

Course Objectives

1. Gain comprehensive understanding of intelligent systems and robotics, encompassing their principles, algorithms, and technologies.
2. Explore the diverse applications of intelligent systems and robotics across various domains.
3. Develop proficiency in designing, developing, and deploying intelligent robotic systems for real-world tasks.
4. Familiarize with advanced concepts and techniques essential for effective utilization of intelligent systems in practical scenarios.
5. Acquire practical skills and theoretical knowledge necessary to address challenges and opportunities in the field of intelligent systems and robotics.

Course Outcomes

Upon successful completion of the course, students should be able to:

1. Understand the fundamental concepts of intelligent systems and robotics, including perception, cognition, and action.
2. Analyze the components and architecture of intelligent robotic systems, including sensors, actuators, and control systems.
3. Apply machine learning and artificial intelligence techniques to enable autonomous decision-making and adaptive behavior in robotic systems.
4. Design and implement algorithms for robot perception, navigation, manipulation, and interaction with the environment.
5. Develop practical robotic applications for tasks such as autonomous exploration, object recognition, manipulation, and human-robot interaction.
6. Evaluate the performance, reliability, and safety of intelligent robotic systems in real-world scenarios.

Unit 1: INTRODUCTION TO INTELLIGENT SYSTEMS AND ROBOTICS

Overview of intelligent systems and robotics: history, applications, and challenges, Principles of robotic perception, cognition, and action, Introduction to robotic hardware and software platforms, Ethical considerations and societal impacts of intelligent robotics

Unit 2: ROBOT PERCEPTION AND SENSING

Sensory modalities in robotics: vision, touch, proprioception, and environmental sensing, Sensor fusion techniques for multimodal perception, Feature extraction and object recognition in robotic vision, Localization and mapping algorithms for robot navigation.

Unit 3: ROBOT CONTROL AND DECISION MAKING

Control architectures for autonomous robots: reactive, deliberative, and hybrid approaches, Path planning and motion control techniques for robot navigation, Reinforcement learning and planning algorithms for decision-making in robotics, Human-robot interaction and collaborative robotics

Unit 4: ROBOT MANIPULATION AND INTERACTION

Robotic manipulation: kinematics, dynamics, and control of robot arms and grippers, Grasping and manipulation techniques for object manipulation, Human-robot interaction: gesture recognition, speech processing, and natural language understanding, Assistive robotics and applications in healthcare, manufacturing, and service industries

Unit 5: ADVANCED TOPICS IN ROBOTICS

Robot learning and adaptation: learning from demonstration, imitation learning, and transfer learning, Autonomous exploration and mapping in unknown environments, Swarm robotics and collective intelligence, Emerging trends and future directions in intelligent systems and robotics

TEXTBOOKS

1. "Introduction to Autonomous Robots: Mechanics, Sensors, Actuators, and Algorithms", Nikolaus Correll, Bradley Hayes, Adam Hoover, Derek Kingston, Publisher: MIT Press, 2019.
2. "Robotics: Modelling, Planning and Control", Authors: Bruno Siciliano, Lorenzo Sciavicco, Luigi Villani, Giuseppe Oriolo, Springer, 2009.

REFERENCE BOOKS

1. "Probabilistic Robotics", Authors: Sebastian Thrun, Wolfram Burgard, Dieter Fox, MIT Press , 2005
2. Robotics: Everything You Need to Know About Robotics from Beginner to Expert", Peter Mckinnon, CreateSpace Independent Publishing Platform, 2018
3. Modern Robotics: Mechanics, Planning, and Control", Kevin M. Lynch, Frank C. Park, Cambridge University Press, 2017

Chhattisgarh Swami Vivekananda Technical University, Bhilai (C.G.)

Branch: B Tech Honours (Artificial Intelligence) **Semester - VII**

Subject: Business Intelligence and Analytics **Subject Code: D127772(022)**

Total Theory Periods: 40 **Total Tutorial Periods: 10**

No. of Class tests to: 2 (Minimum) **No. of Assignments to be submitted: One per Unit**

ESE Duration: Three Hours, **Maximum Marks in ESE: 100**

Minimum Marks in ESE: 35

Course Objectives

1. Gain a comprehensive understanding of principles, techniques, and technologies for analyzing and extracting insights from business data.
2. Acquire knowledge and skills in applying artificial intelligence (AI) and data analytics techniques to address real-world business challenges.
3. Develop the ability to optimize decision-making processes through data-driven insights.
4. Learn to leverage data analytics to drive strategic initiatives within organizations.
5. Equip students with practical skills to solve business problems effectively using business intelligence and analytics tools and methodologies.

Course Outcomes

Upon successful completion of the course, students should be able to:

1. Understand the fundamental concepts of business intelligence (BI) and analytics, including data warehousing, data mining, and predictive modeling.
2. Analyze business data using various AI and analytics techniques to identify patterns, trends, and correlations.
3. Apply data visualization and reporting tools to communicate insights and facilitate decision-making processes in organizations.
4. Design and implement AI-driven analytics solutions for tasks such as customer segmentation, market basket analysis, and predictive modeling.
5. Evaluate the performance and effectiveness of BI and analytics systems in improving business outcomes and driving competitive advantage.
6. Develop strategies to address ethical and privacy considerations in the collection, analysis, and use of business data.

Unit 1: INTRODUCTION TO BUSINESS INTELLIGENCE AND ANALYTICS

Overview of business intelligence (BI) and analytics: concepts, principles, and applications, Data-driven decision-making in organizations, Data warehousing and ETL (Extract, Transform, Load) processes, Ethical and legal considerations in business data analytics

Unit 2: DATA EXPLORATION AND VISUALIZATION

Exploratory data analysis (EDA) techniques: summary statistics, data visualization, and outlier detection, Visualization tools and techniques for communicating insights: charts, graphs, dashboards, Interactive data exploration and drill-down capabilities, Best practices for designing effective data visualizations

Unit 3: PREDICTIVE MODELING AND MACHINE LEARNING

Introduction to predictive modeling: regression, classification, and clustering algorithms, Feature engineering and selection techniques for predictive analytics, Model evaluation and validation: cross-validation, ROC curves, precision-recall curves, Applications of machine learning in business: churn prediction, customer lifetime value estimation, fraud detection

Unit 4: BUSINESS ANALYTICS APPLICATIONS

Customer segmentation and profiling using clustering techniques, Market basket analysis and recommendation systems, Time series forecasting and demand prediction, Text analytics and sentiment analysis for customer feedback and social media data

Unit 5: ADVANCED TOPICS IN BUSINESS INTELLIGENCE

Real-time analytics and stream processing, Big data analytics: Hadoop, Spark, and NoSQL databases, Prescriptive analytics and optimization techniques, Emerging trends and future directions in business intelligence and analytics

TEXTBOOKS

1. Business Intelligence Guidebook: From Data Integration to Analytics", Rick Sherman, Morgan Kaufmann, 2015.
2. Data Science for Business: What You Need to Know about Data Mining and Data-Analytic Thinking", Foster Provost, Tom Fawcett, O'Reilly Media, 2013.

REFERENCE BOOKS

1. "The Data Warehouse Toolkit: The Definitive Guide to Dimensional Modeling", Ralph Kimball, Margy Ross, Wiley, 2013.
2. "Predictive Analytics: The Power to Predict Who Will Click, Buy, Lie, or Die", Eric Siegel Wiley, 2013.
3. “Big Data Analytics: From Strategic Planning to Enterprise Integration with Tools, Techniques, NoSQL, and Graph", David Loshin, Morgan Kaufmann, 2013.

Chhattisgarh Swami Vivekananda Technical University, Bhilai (C.G.)

Branch: B Tech Honours (Artificial Intelligence) **Semester - VII**

Subject: Software Engineering **Subject Code: D127773(022)**

Total Theory Periods: 40 **Total Tutorial Periods: 10**

No. of Class tests to: 2 (Minimum) **No. of Assignments to be submitted: One per Unit**

ESE Duration: Three Hours, **Maximum Marks in ESE: 100**

Minimum Marks in ESE: 35

Course Objectives

1. Develop a comprehensive understanding of software development principles, methodologies, and practices.
2. Acquire knowledge and skills essential for designing, developing, and maintaining high-quality software systems.
3. Emphasize the application of software engineering best practices within the realm of artificial intelligence (AI) applications.
4. Gain proficiency in implementing software engineering techniques tailored for AI-centric projects.
5. Prepare students to effectively design, develop, and manage software solutions by integrating software engineering principles with AI technologies.

Course Outcomes

Upon successful completion of the course, students should be able to:

1. Understand the fundamental concepts and principles of software engineering, including requirements engineering, software design, and testing.
2. Apply software development methodologies, such as agile, iterative, and incremental approaches, to plan and manage software projects effectively.
3. Design and implement software systems using appropriate programming languages, frameworks, and tools, with a focus on AI applications.
4. Apply software engineering best practices for ensuring software quality, reliability, and maintainability in AI systems.
5. Collaborate effectively in software development teams, practicing communication, teamwork, and project management skills.
6. Demonstrate ethical and professional responsibility in software development, adhering to legal and ethical standards and considering societal impacts.

Unit 1: INTRODUCTION TO SOFTWARE ENGINEERING

Overview of software engineering: concepts, principles, and software development life cycle, Software processes and methodologies: waterfall, agile, scrum, and kanban, Requirements engineering: elicitation, analysis, specification, and validation, Ethical and professional considerations in software engineering.

Unit 2: SOFTWARE DESIGN AND ARCHITECTURE

Principles of software design: abstraction, modularity, cohesion, and coupling, Architectural styles and patterns: client-server, layered architecture, and micro services, Design principles for AI systems: modifiability, scalability, and adaptability, Software modelling techniques: UML diagrams, entity-relationship diagrams, and data flow diagrams.

Unit 3: IMPLEMENTATION AND TESTING

Programming paradigms and languages for software development, Coding standards, conventions, and best practices, Unit testing, integration testing, and system testing techniques, Test-driven development (TDD) and behaviour-driven development (BDD) practices.

Unit 4: SOFTWARE MAINTENANCE AND EVOLUTION

Software maintenance activities: corrective, adaptive, and perfective maintenance, Version control systems and configuration management, Software refactoring and code quality improvement techniques, Legacy system modernization and migration strategies.

Unit 5: SOFTWARE PROJECT MANAGEMENT

Project planning and estimation techniques: work breakdown structure (WBS), effort estimation models, Agile project management frameworks: scrum, kanban, and extreme programming (XP), Risk management and mitigation strategies in software projects, Software documentation and knowledge management practices.

TEXTBOOKS

1. Title: "Software Engineering: A Practitioner's Approach", Author: Roger S. Pressman, Publisher: McGraw-Hill Education, Year: 2020.
2. Title: "Clean Code: A Handbook of Agile Software Craftsmanship", Author: Robert C. Martin, Publisher: Prentice Hall, Year: 2008.

REFERENCE BOOKS

1. Title: "Agile Software Development: Principles, Patterns, and Practices", Author: Robert C. Martin, Publisher: Prentice Hall, Year: 2002.
2. Title: "Introduction to the Art of Programming Using Scala", Author: Mark C. Lewis, Publisher: CRC Press, Year: 2012.
3. Title: "Continuous Delivery: Reliable Software Releases through Build, Test, and Deployment Automation", Authors: Jez Humble, David Farley, Publisher: Addison-Wesley Professional, Year: 2010.

Chhattisgarh Swami Vivekananda Technical University, Bhilai (C.G.)

Branch: B Tech Honours (Data Science) **Semester - VII**

Subject: Gaming Theory **Subject Code: D127774(022)**
Total Theory Periods: 40 **Total Tutorial Periods: 10**

No. of Class tests to: 2 (Minimum) **No. of Assignments to be submitted: One per Unit**

ESE Duration: Three Hours, **Maximum Marks in ESE: 100**

Minimum Marks in ESE: 35

Course Objectives

1. To understand the fundamental principles and concepts of game theory and its application in AI and data science.
2. To explore strategic interactions among rational decision-makers using game-theoretic approaches.
3. To analyze and solve games using various solution concepts like Nash equilibrium and dominant strategies.
4. To apply game theory to model real-world scenarios in AI, including multi-agent systems, auctions, and bargaining.
5. To develop the ability to design and implement algorithms that incorporate game-theoretic concepts in AI systems.

Course Outcomes

1. Students will be able to understand and apply the fundamental concepts of game theory in strategic decision-making scenarios.
2. Students will be able to analyze and solve different types of games using appropriate solution concepts such as Nash equilibrium and dominant strategies.
3. Students will be able to model real-world AI problems, including multi-agent systems, using game-theoretic approaches.
4. Students will be able to design and implement game-theoretic algorithms for various AI applications, including auctions, bargaining, and reinforcement learning.
5. Students will be able to critically evaluate and apply game-theoretic methods in advanced AI and data science problems, including adversarial machine learning and mechanism design.

UNIT 1: INTRODUCTION TO GAME THEORY

Definition and scope of game theory, Types of games: Cooperative and Non-Cooperative, Zero-Sum, and Non-Zero-Sum, Pure and Mixed strategies, Payoff matrices and extensive form games, Nash equilibrium: concept and applications, Examples of classical games: Prisoner's Dilemma, Matching Pennies, etc.

UNIT 2: STRATEGIC FORM GAMES

Dominant strategies and iterated elimination of dominated strategies, Mixed strategy Nash equilibrium, The minimax theorem and its implications, Bayesian games and incomplete information, Correlated equilibria, Applications in AI: strategic bidding, resource allocation.

UNIT 3: EXTENSIVE FORM GAMES

Representation of extensive form games, Subgame perfect equilibrium, Repeated games and strategies, The Folk Theorem and its significance, Sequential games and backward induction, Applications in AI: decision-making in multi-agent systems, negotiation algorithms.

UNIT 4: COOPERATIVE GAME THEORY

Core, Shapley value, and bargaining solutions, Coalition formation and stability, The Nash bargaining solution and Kalai-Smorodinsky solution, The role of transferable utility in cooperative games, Application to AI: coalition formation in multi-agent systems, Case studies in cooperative AI systems.

Unit 5: Game Theory in AI and Machine Learning

Mechanism design and auctions in AI, Algorithmic game theory: complexity and approximation, Evolutionary game theory: replicator dynamics and evolutionary stable strategies, Applications of game theory in reinforcement learning, Game-theoretic approaches to adversarial machine learning, Case studies: Game theory in cybersecurity, traffic management, etc.

Textbooks

1. Osborne, Martin J. (2004). *An Introduction to Game Theory*. Oxford University Press. ISBN: 978-0195128956.

2. Myerson, Roger B. (1997). *Game Theory: Analysis of Conflict*. Harvard University Press. ISBN: 978-0674341166.

Reference Books

1. Shoham, Yoav, & Leyton-Brown, Kevin. (2008). *Multiagent Systems: Algorithmic, Game-Theoretic, and Logical Foundations*. Cambridge University Press. ISBN: 978-0521899437.

2. Fudenberg, Drew, & Tirole, Jean. (1991). *Game Theory*. MIT Press. ISBN: 978-0262061414.

3. Leyton-Brown, Kevin, & Shoham, Yoav. (2010). *Essentials of Game Theory: A Concise, Multidisciplinary Introduction*. Morgan & Claypool Publishers. ISBN: 978-1598295931.

Chhattisgarh Swami Vivekananda Technical University, Bhilai (C.G.)

Branch: B Tech Honours (Artificial Intelligence) **Semester - VII**

Subject: Intelligent System and Robotics Lab **Subject Code: D127791(022)**

Maximum Marks in ESE: 40

List of Experiments (Any 10)

1. Path Planning Algorithms: Implement algorithms such as A*, Dijkstra, or RRT to find the optimal path for a robot to navigate in a known environment.
2. PID Control: Design a PID controller to regulate the position or velocity of a robot arm or mobile robot.
3. SLAM (Simultaneous Localization and Mapping): Implement SLAM algorithms like EKF SLAM or FastSLAM for mapping and localization in robotics.
4. Reinforcement Learning for Robot Navigation: Train a robot to navigate through a maze or reach a target using reinforcement learning algorithms like Q-learning or Deep Q-Networks.
5. Object Detection and Recognition: Use deep learning frameworks like Tensor Flow or PyTorch to detect and recognize objects in images or video streams captured by a robot's camera.
6. Voice Command Recognition: Develop a system to recognize and respond to voice commands using speech recognition libraries such as Speech Recognition in Python.
7. Gesture Recognition: Implement a gesture recognition system using computer vision techniques like Open CV to interpret hand gestures and control a robot's movements.
8. Swarm Robotics Simulation: Simulate a swarm of robots using tools like ROS (Robot Operating System) or V-REP to study collective behaviours and coordination strategies.
9. Neural Network-based Robot Control: Train neural networks to control the movement or manipulation of a robotic arm or gripper using frameworks like Keras or Tensor Flow.
10. Evolutionary Robotics: Use evolutionary algorithms like Genetic Algorithms or Genetic Programming to evolve robot controllers for specific tasks.
11. Robot Localization with Kalman Filters: Implement Extended Kalman Filters (EKF) or Unscented Kalman Filters (UKF) for robot localization using noisy sensor data.
12. Mobile Robot Simulation: Simulate the movement and interaction of mobile robots in different environments using tools like Gazebo or Webots.
13. Behavior-Based Robotics: Design and implement behaviors for a robot using a behavior-based approach, combining simple reactive behaviors to achieve complex tasks.
14. Human-Robot Interaction: Develop interfaces for humans to interact with robots, such as speech interfaces, gesture interfaces, or haptic feedback using Python libraries or Matlab GUI tools.
15. Robot Soccer Simulation: Create a simulated robot soccer environment using platforms like Robo Cup Soccer Simulation or Pygame to implement robot strategies and compete against other simulated teams.

Chhattisgarh Swami Vivekananda Technical University, Bhilai (C.G.)

Branch: B Tech Honours (Artificial Intelligence) **Semester - VII**

Subject: Business Intelligence and Analytics Lab **Subject Code: D127792(022)**

Maximum Marks in ESE: 40

LIST OF EXPERIMENTS

1. Data Visualization with Tableau: Use Tableau or a similar data visualization tool to create interactive dashboards and visualizations for analyzing business data, such as sales trends, customer demographics, or product performance.
2. Exploratory Data Analysis (EDA) with Pandas: Perform exploratory data analysis on a business dataset using the Pandas library in Python, including data cleaning, summarization, and visualization of key insights.
3. Sentiment Analysis on Social Media Data: Analyze sentiment on social media platforms (e.g., Twitter, Facebook) related to a specific business or product using natural language processing (NLP) techniques to classify tweets or posts as positive, negative, or neutral.
4. Customer Segmentation Analysis: Segment customers based on demographic or behavioral attributes using clustering algorithms such as k-means clustering or hierarchical clustering, and analyze the characteristics of each segment.
5. Market Basket Analysis: Perform market basket analysis on transaction data to identify associations between products frequently purchased together, using techniques such as Apriori algorithm or FP-Growth algorithm.
6. Predictive Analytics with Regression Models: Build and evaluate regression models to predict business metrics such as sales revenue, customer churn, or product demand based on historical data, using libraries like scikit-learn in Python.
7. Time Series Forecasting: Apply time series forecasting techniques to predict future trends or patterns in business metrics, such as sales, stock prices, or website traffic, using methods like ARIMA or exponential smoothing.
8. Anomaly Detection in Business Data: Detect anomalies or outliers in business data that may indicate fraud, errors, or unusual behavior using statistical methods or machine learning algorithms such as isolation forest or one-class SVM.
9. Customer Lifetime Value (CLV) Analysis: Calculate and analyze customer lifetime value (CLV) metrics to understand the long-term profitability of different customer segments and inform marketing or retention strategies.
10. A/B Testing for Marketing Campaigns: Design and analyze A/B tests to compare the effectiveness of different marketing strategies or campaigns, measuring key performance indicators (KPIs) such as click-through rates, conversion rates, or revenue.

Chhattisgarh Swami Vivekananda Technical University, Bhilai (C.G.)

Branch: B Tech Honours (Artificial Intelligence) **Semester - VII**

Subject: Software Engineering Lab **Subject Code: D127793(022)**

Maximum Marks in ESE: 40

LIST OF EXPERIMENTS

1. Version Control with Git: Practice basic Git operations such as repository creation, file addition, committing changes, and pushing to a remote repository.
2. Code Review Simulation: Conduct a simulated code review session where students provide feedback on each other's code, focusing on readability, maintainability, and adherence to coding standards.
3. Unit Testing with pytest: Write and execute unit tests for Python functions using the pytest framework, covering different test cases and assertions.
4. Continuous Integration Setup: Set up a basic continuous integration (CI) pipeline using tools like GitHub Actions or Travis CI to automatically build and test code changes on every commit.
5. Code Refactoring Exercise: Identify and refactor code snippets to improve code quality, readability, and performance, focusing on techniques such as extracting methods, removing duplication, and improving naming conventions.
6. Agile Sprint Planning: Conduct a simulated sprint planning session following agile principles, where students break down user stories into tasks, estimate their effort, and allocate them for a sprint.
7. Pair Programming Activity: Pair up students to work on a programming task collaboratively, taking turns as the driver and navigator, and switch roles periodically to promote teamwork and knowledge sharing.
8. Code Documentation Practice: Write and document Python functions and classes using docstrings and generate HTML documentation using tools like Sphinx or MkDocs.
9. Mocking and Dependency Injection: Practice mocking and dependency injection techniques in Python using libraries like unittest.mock or dependency-injector to isolate and test individual components of a software system.
10. Code Review Automation: Integrate a code quality analysis tool like CodeFactor or Codacy with GitHub to automatically analyze code changes and provide feedback on code style, complexity, and potential issues.

Chhattisgarh Swami Vivekananda Technical University, Bhilai (C.G.)

Branch: B Tech Honours (Artificial Intelligence) **Semester - VII**

Subject: Technical Communication and Soft Skill **Subject Code: D127001(022)**

Maximum Marks (TA): 20

1. **Effective Communication in AI**
   Principles of effective technical communication. Written and verbal communication skills. Presentation techniques for conveying AI concepts.

2. **Teamwork and Collaboration**
   Importance of teamwork in AI projects. Collaboration tools and techniques.

3. **Problem-Solving Skills**
   Critical thinking and problem-solving strategies. Analytical skills for AI applications.

4. **Time Management and Productivity**
   Time management techniques for project completion. Prioritization and task management skills.

5. **Professional Ethics and Integrity**
   Ethical considerations in AI research and development. Maintaining integrity and professionalism in the workplace.

Chhattisgarh Swami Vivekananda Technical University, Bhilai (C.G.)

Branch: B Tech Honours (Artificial Intelligence) **Semester - VII**

Subject: Professional Training **Subject Code: D127794(022)**

Maximum Marks (TA): 100

1. **Project Management in AI**
   Introduction to project management methodologies.Project planning, scheduling, and risk management. Case Study: Implementation of AI project management techniques in a real-world scenario.

2. **Ethical and Legal Considerations in AI**
   Ethical issues in AI development and deployment.Legal frameworks and regulations.Case Study: Ethical implications of AI algorithms in decision-making processes.

3. **3.2AI Tools and Technologies**
   Hands-on training with popular AI frameworks and tools. Introduction to machine learning pipelines. Case Study: Implementation of AI models using Tensor Flow or PyTorch.

4. **Industry Case Studies**
   Analysis of AI applications across industries. Guest lectures from industry professionals. Case Study: Successful AI implementations in healthcare, finance, or retail sectors.

5. **Minor project work**

Chhattisgarh Swami Vivekananda Technical University, Bhilai (C.G.)

Branch: B Tech Honours (Artificial Intelligence) **Semester - VII**

Subject: Computer Vision (Professional Elective II) **Subject Code:** D127731(022)

Total Theory Periods: 40 **Total Tutorial Periods: 10**

No. of Class tests to: 2 (Minimum) **No. of Assignments to be submitted: One per Unit**

ESE Duration: Three Hours, **Maximum Marks in ESE: 100**

Minimum Marks in ESE: 35

Course Objectives

1. To provide students with a comprehensive understanding of computer vision fundamentals and techniques.
2. To enable students to apply computer vision algorithms to solve real-world problems in various domains.
3. To familiarize students with state-of-the-art methodologies and advancements in computer vision research.
4. To develop practical skills in image processing, feature extraction, object detection, and recognition.
5. To encourage students to critically evaluate and analyze the ethical and societal implications of computer vision applications.

Course Outcomes

1. Understand the principles and theoretical foundations of computer vision.
2. Apply various computer vision algorithms for tasks such as image classification, object detection, and image segmentation.
3. Implement computer vision techniques using programming languages and frameworks such as Python and OpenCV.
4. Analyze and evaluate the performance of computer vision models using appropriate metrics.
5. Demonstrate an understanding of ethical considerations and potential biases in computer vision applications.

Unit 1: **INTRODUCTION TO COMPUTER VISION**

Overview of computer vision concepts and applications.Image formation and representation. Color spaces and image enhancement techniques. Image filtering and convolution operations.

Unit 2: IMAGE PROCESSING AND FEATURE EXTRACTION

Image transformation and geometric operations. Image segmentation techniques (e.g., thresholding, edge detection). Feature extraction methods (e.g., corner detection, scale-invariant feature transform).

Unit 3: OBJECT DETECTION AND RECOGNITION

Introduction to object detection and localization.Popular object detection algorithms (e.g., Haar cascades, YOLO, SSD). Object recognition techniques using deep learning approaches (e.g., Convolutional Neural Networks).

Unit 4: DEEP LEARNING FOR COMPUTER VISION

Fundamentals of deep learning and neural networks. Convolutional Neural Networks (CNNs) architecture and applications in computer vision.

Transfer learning and fine-tuning pre-trained CNN models for specific tasks.

Unit 5: ADVANCED TOPICS AND APPLICATIONS

Advanced topics in computer vision (e.g., image registration, motion analysis). Applications of computer vision in fields such as healthcare, autonomous vehicles, and surveillance. Ethical considerations and societal implications of computer vision technologies.

TEXTBOOKS:

1. Title: "Computer Vision: Algorithms and Applications" Author: Richard Szeliski, Publication Details: Springer, 2010

2. Title: "Learning OpenCV 4 Computer Vision with Python 3: Get to grips with tools, techniques, and algorithms for computer vision and machine learning", Author: Joseph Howse, Joe Minichino, Prateek Joshi, Publication Details: Packt Publishing, 2018

REFERENCE BOOKS:

1. Title: "Computer Vision: A Modern Approach", Author: David A. Forsyth, Jean Ponce, Publication Details: Prentice Hall, 2002.

2. Title: "Deep Learning for Computer Vision", Author: Rajalingappaa Shanmugamani, Publication Details: Packt Publishing, 2018.

3. Title: "Python Deep Learning: Exploring deep learning techniques, neural network architectures and GANs with PyTorch, Keras and TensorFlow", Author: Ivan Vasilev, Daniel Slater, Gianmario Spacagna, Peter Roelants, Valentino Zocca, Publication Details: Packt Publishing, 2019.

Chhattisgarh Swami Vivekananda Technical University, Bhilai (C.G.)

Branch: B Tech Honours (Artificial Intelligence) **Semester - VII**

Subject: Multimedia System and Application **Subject Code: D127732(022)**

(Professional Elective II)

Total Theory Periods: 40 **Total Tutorial Periods: 10**

No. of Class tests to: 2 (Minimum) **No. of Assignments to be submitted: One per Unit**

ESE Duration: Three Hours, **Maximum Marks in ESE: 100**
Minimum Marks in ESE: 35

Course Objectives

1. To introduce students to the fundamental concepts and principles of multimedia systems.
2. To provide an understanding of multimedia data representation, compression, and transmission techniques.
3. To familiarize students with multimedia applications and their real-world implementations.
4. To develop practical skills in designing and developing multimedia systems and applications.
5. To encourage students to analyze and evaluate the performance of multimedia systems in various contexts.

Course Outcomes

1. Understand the components and architecture of multimedia systems.
2. Apply multimedia data compression techniques to optimize storage and transmission.
3. Design and develop multimedia applications using appropriate tools and technologies.
4. Analyze and evaluate the performance of multimedia systems based on quality metrics and user experience.
5. Demonstrate an understanding of ethical and legal considerations in multimedia content creation and distribution.

Unit 1: INTRODUCTION TO MULTIMEDIA SYSTEMS

Overview of multimedia concepts, components, and applications. Multimedia data types and formats. Multimedia system architecture and components.

Unit 2: Multimedia Data Representation and Compression

Digital audio and video representation. Image and video compression techniques (e.g., JPEG, MPEG). Lossy and lossless compression algorithms.

Unit 3: MULTIMEDIA COMMUNICATION AND STREAMING

Multimedia data transmission over networks. Streaming media protocols and technologies. Quality of Service (QoS) considerations in multimedia communication.

Unit 4: MULTIMEDIA APPLICATIONS AND DEVELOPMENT

Multimedia authoring tools and platforms. Design principles for interactive multimedia applications. Case studies of multimedia applications in various domains.

Unit 5: ETHICAL AND LEGAL ASPECTS OF MULTIMEDIA

Ethical considerations in multimedia content creation and distribution. Intellectual property rights and copyright issues in multimedia. Regulatory frameworks and standards for multimedia systems and applications.

TEXTBOOKS

1. Title: "Multimedia Systems and Applications", Author: Ralf Steinmetz, Klara Nahrstedt, Publication Details: Springer, 2004

2. Title: "Multimedia: Computing, Communications & Applications", Author: Ralf Steinmetz, Klara Nahrstedt, Publication Details: Prentice Hall, 2010

REFERENCE BOOKS

1. Title: "Multimedia Systems", Author: John F. Koegel Buford, J. Lennox, Publication Details: Springer, 2014

2. Title: "Introduction to Multimedia Systems", Author: Sugata Mitra, Publication Details: Chapman and Hall/CRC, 2017

3. Title: "Multimedia Systems: Algorithms, Standards, and Industry Practices", Author: Parag Havaldar, Gerard Medioni. Publication Details: Springer, 2014

Chhattisgarh Swami Vivekananda Technical University, Bhilai (C.G.)

Branch: B Tech Honours (Artificial Intelligence) **Semester - VII**

Subject: Image Processing (Professional Elective II) **Subject Code: D127733(022)**

Total Theory Periods: 40 **Total Tutorial Periods: 10**

No. of Class tests to: 2 (Minimum) **No. of Assignments to be submitted: One per Unit**

ESE Duration: Three Hours, **Maximum Marks in ESE: 100**

Minimum Marks in ESE: 35

Course Objectives

1. To introduce students to the fundamental principles and techniques of digital image processing.
2. To provide an understanding of various image enhancement and restoration methods.
3. To familiarize students with image segmentation and feature extraction techniques.
4. To develop practical skills in implementing image processing algorithms using appropriate tools and programming languages.
5. To encourage students to analyze and evaluate the performance of image processing algorithms in real-world applications.

Course Outcomes

1. Understand the theoretical foundations of digital image processing.
2. Apply various image enhancement techniques to improve image quality and visual appearance.
3. Implement image restoration algorithms to remove noise and other artifacts from images.
4. Design and implement image segmentation algorithms for object detection and recognition.
5. Analyze and evaluate the performance of image processing algorithms based on quantitative metrics and visual inspection.

Unit 1: INTRODUCTION TO DIGITAL IMAGE PROCESSING

Overview of digital image processing concepts and applications. Digital image representation and characteristics.Image acquisition and preprocessing techniques.

Unit 2: IMAGE ENHANCEMENT AND RESTORATION

Spatial domain enhancement techniques (e.g., histogram equalization, spatial filtering). Frequency domain enhancement techniques (e.g., Fourier transform, filtering in frequency domain). Image restoration techniques (e.g., image denoising, image deblurring).

Unit 3: IMAGE SEGMENTATION AND FEATURE EXTRACTION

Thresholding and region-based segmentation methods. Edge detection algorithms (e.g., Sobel, Canny). Feature extraction techniques (e.g., corner detection, texture analysis).

Unit 4: MORPHOLOGICAL IMAGE PROCESSING

Mathematical morphology operations (e.g., erosion, dilation, opening, closing). Morphological image processing for noise removal and feature extraction. Applications of morphological operations in image analysis.

Unit 5: ADVANCED TOPICS IN IMAGE PROCESSING

Image compression techniques (e.g., JPEG, wavelet-based compression).Image registration and fusion methods. Case studies and applications of image processing in various domains (e.g., medical imaging, remote sensing).

TEXTBOOKS

1. Title: "Digital Image Processing", Author: Rafael C. Gonzalez, Richard E. Woods, Publication Details: Pearson, 2017

2. Title: "Digital Image Processing Using MATLAB", Author: Rafael C. Gonzalez, Richard E. Woods, Steven L. Eddins, Publication Details: Gatesmark Publishing, 2019

REFERENCE BOOKS

1. Title: "Image Processing, Analysis, and Machine Vision", Author: Milan Sonka, Vaclav Hlavac, Roger Boyle, Publication Details: Cengage Learning, 2014

2. Title: "Principles of Digital Image Processing: Core Algorithms", Author: Wilhelm Burger, Mark J. Burge, Publication Details: Springer, 2009

3. Title: "Computer Vision: Algorithms and Applications", Author: Richard Szeliski, Publication Details: Springer, 2010

Chhattisgarh Swami Vivekananda Technical University, Bhilai (C.G.)

Branch: B Tech Honours (Artificial Intelligence) **Semester - VII**

Subject: High Performance Computing **Subject Code: D127734(022)**

(Professional Elective II)

Total Theory Periods: 40 **Total Tutorial Periods: 10**

No. of Class tests to: 2 (Minimum) **No. of Assignments to be submitted: One per Unit**

ESE Duration: Three Hours, **Maximum Marks in ESE: 100**

Minimum Marks in ESE: 35

Course Objectives

1. To introduce students to the principles and techniques of high-performance computing (HPC)
2. To provide an understanding of parallel computing architectures and programming models.
3. To familiarize students with performance optimization techniques for HPC applications.
4. To develop practical skills in designing and implementing parallel algorithms for various computational tasks.
5. To encourage students to analyze and evaluate the performance of HPC systems and applications.

Course Outcomes

1. Understand the principles of parallel computing and its relevance to high-performance computing.
2. Apply parallel programming models and techniques to solve computationally intensive problems.
3. Design and implement parallel algorithms for tasks such as matrix multiplication, sorting, and numerical simulations.
4. Optimize the performance of parallel applications using profiling, tuning, and scaling techniques.
5. Evaluate the performance and scalability of HPC systems based on metrics such as speedup, efficiency, and scalability.

Unit 1: INTRODUCTION TO HIGH-PERFORMANCE COMPUTING

Overview of high-performance computing concepts, applications, and challenges. Evolution of computing architectures and the need for parallelism. Introduction to parallel computing models (e.g., SIMD, MIMD).

Unit 2: PARALLEL COMPUTING ARCHITECTURES

Classification of parallel computing architectures (e.g., shared-memory, distributed-memory). Multi-core processors, GPUs, and accelerators for parallel computing. Interconnection networks and communication overhead in parallel systems.

Unit 3: PARALLEL PROGRAMMING MODELS

Introduction to parallel programming languages and libraries (e.g., MPI, OpenMP, CUDA). Parallelization techniques for different computational tasks (e.g., data parallelism, task parallelism). Hands-on exercises with parallel programming frameworks.

Unit 4: PERFORMANCE OPTIMIZATION IN HPC

Profiling and performance analysis of parallel applications. Optimization techniques for memory access, communication, and computation.

Scalability analysis and load balancing in parallel computing environments.

Unit 5: ADVANCED TOPICS IN HIGH-PERFORMANCE COMPUTING

Parallel algorithms for specific computational tasks (e.g., numerical simulations, machine learning). High-performance computing in big data analytics and artificial intelligence. Case studies of HPC applications in scientific computing, engineering, and industry.

TEXTBOOKS

1. Title: "Introduction to High Performance Computing for Scientists and Engineers", Author: Georg Hager, Gerhard Wellein, Publication Details: CRC Press, 2010

2. Title: "Parallel Programming: Concepts and Practice", Author: Thomas Rauber, Gudula Rünger, Publication Details: CRC Press, 2010

REFERENCE BOOKS

1. Title: "High Performance Computing", Author: Charles Severance, Kevin Dowd, Publication Details: O'Reilly Media, 2018

2. Title: "Parallel and Distributed Computing: A Survey of Models, Paradigms and Approaches", Author: Claudia Leopold, Wolfgang Karl, Publication Details: Springer, 2012

3. Title: "Programming Massively Parallel Processors: A Hands-on Approach", Author: David B. Kirk, Wen-mei W. Hwu, Publication Details: Morgan Kaufmann, 2012

Chhattisgarh Swami Vivekananda Technical University, Bhilai (C.G.)

Branch: B Tech Honours (Artificial Intelligence) **Semester - VII**

Subject: Crypto-currency and Block Chain Technology

(Professional Elective II) **Subject Code: D127735(022)**

Total Theory Periods: 40 **Total Tutorial Periods: 10**

No. of Class tests to: 2 (Minimum) **No. of Assignments to be submitted: One per Unit**

ESE Duration: Three Hours, **Maximum Marks in ESE: 100**

Minimum Marks in ESE: 35

Course Objectives

1. To introduce students to the fundamental concepts and principles of cryptocurrencies and blockchain technology.
2. To provide an understanding of the underlying cryptographic techniques used in cryptocurrencies and blockchain.
3. To familiarize students with the architecture and components of blockchain systems.
4. To explore the applications and use cases of blockchain technology beyond cryptocurrencies.
5. To develop practical skills in designing and implementing blockchain-based solutions.

Course Outcomes

1. Understand the fundamentals of cryptocurrencies, including their history, characteristics, and mechanics.
2. Analyze the cryptographic techniques used in blockchain technology, such as hashing, digital signatures, and consensus mechanisms.
3. Explain the architecture and components of blockchain systems, including blocks, transactions, and distributed ledgers.
4. Identify and evaluate various applications of blockchain technology in industries such as finance, supply chain, and healthcare.
5. Design and implement basic blockchain solutions, including smart contracts and decentralized applications (DApps).

Unit 1: INTRODUCTION TO CRYPTOCURRENCIES

Overview of cryptocurrencies: history, characteristics, and benefits. Cryptographic techniques used in cryptocurrencies: hashing, digital signatures, and cryptographic hash functions. Introduction to blockchain technology and its role in cryptocurrencies.

Unit 2: BLOCKCHAIN ARCHITECTURE AND COMPONENTS

Basic principles of blockchain: decentralized consensus, immutability, and transparency. Blockchain architecture: blocks, transactions, and the structure of a blockchain. Types of blockchain networks: public, private, and consortium.

Unit 3: CRYPTOCURRENCY MECHANICS AND ECONOMICS

Mechanics of cryptocurrency transactions: wallets, addresses, and keys. Cryptocurrency mining: proof-of-work, proof-of-stake, and other consensus mechanisms. Economic aspects of cryptocurrencies: valuation, volatility, and market dynamics.

Unit 4: APPLICATIONS OF BLOCKCHAIN TECHNOLOGY

Beyond cryptocurrencies: use cases of blockchain in finance, supply chain management, healthcare, and more. Smart contracts: definition, execution, and applications. Decentralized applications (DApps) and their potential impact on various industries.

Unit 5: BLOCKCHAIN DEVELOPMENT AND IMPLEMENTATION

Blockchain development platforms and tools: Ethereum, Hyperledger, and others. Hands-on exercises with blockchain development: creating smart contracts, deploying DApps, and interacting with blockchain networks. Challenges and future directions in blockchain technology.

TEXTBOOKS

1. Title: "Mastering Bitcoin: Unlocking Digital Crypto currencies", Author: Andreas M. Antonopoulos, Publication Details: O'Reilly Media, 2017

2. Title: "Blockchain Basics: A Non-Technical Introduction in 25 Steps", Author: Daniel Drescher, Publication Details: Apress, 2017

REFERENCE BOOKS

1. Title: "Blockchain Revolution: How the Technology Behind Bitcoin and Other Crypto currencies is Changing the World", Author: Don Tapscott, Alex Tapscott, Publication Details: Portfolio, 2016

2. Title: "Ethereum: Block chains, Digital Assets, Smart Contracts, Decentralized Autonomous Organizations", Author: Henning Diedrich
Publication Details: Create Space Independent Publishing Platform, 2017

3. Title: "Mastering Blockchain: Unlocking the Power of Crypto currencies, Smart Contracts, and Decentralized Applications", Author: Imran Bashir, Publication Details: Packt Publishing, 2018

Chhattisgarh Swami Vivekananda Technical University, Bhilai (C.G.)

Branch: B Tech Honours **Semester - VII**

Subject: Managing Innovation and Entrepreneurship

(Open Elective I) **Subject Code:**

Total Theory Periods: 40 **Total Tutorial Periods: 10**

No. of Class tests to: 2 (Minimum) **No. of Assignments to be submitted: One per Unit**

ESE Duration: Three Hours, **Maximum Marks in ESE: 100**

Minimum Marks in ESE: 35

Course Objectives

1. Understand the fundamental principles of innovation and entrepreneurship
2. Analyze various models and frameworks for managing innovation.
3. Develop strategies to foster and sustain entrepreneurial ventures.
4. Evaluate the role of leadership and organizational culture in innovation.
5. Apply tools and techniques for assessing and managing business opportunities.

Course Outcomes

Upon successful completion of the course, students should be able to:

1. Demonstrate a comprehensive understanding of innovation and entrepreneurship concepts.
2. Analyze and apply various models for effective innovation management.
3. Create detailed business plans and strategies for entrepreneurial ventures.
4. Assess the impact of leadership and organizational culture on innovation.
5. Utilize tools and techniques to manage and evaluate innovation in real-world scenarios.

Unit 1: INTRODUCTION TO INNOVATION AND ENTREPRENEURSHIP

Definition and types of innovation, The entrepreneurship process, Role of innovation in business growth, Key characteristics of successful entrepreneurs, Case studies of innovative companies

Unit 2: INNOVATION MODELS AND FRAMEWORKS

Open innovation vs. closed innovation, Disruptive innovation theory, Innovation life cycle, Design thinking, Stage-gate model for innovation management.

Unit 3: ENTREPRENEURIAL STRATEGY AND PLANNING

Business model development, Market analysis and opportunity identification, Strategic planning for start-ups, Financial planning and management, Risk management and mitigation.

Unit 4: LEADERSHIP AND ORGANIZATIONAL CULTURE

Role of leadership in driving innovation, Building and sustaining an innovative culture, Change management and organizational transformation, Team dynamics and collaboration in start-ups, Leadership styles and their impact on innovation.

Unit 5: TOOLS AND TECHNIQUES FOR MANAGING INNOVATION

Innovation management software and tools, Intellectual property management, Product development processes, Metrics for measuring innovation success, Case studies on successful innovation management

TEXTBOOKS

1. Title: **" Innovation and Entrepreneurship "** Author: Peter F. Drucker , Harper Business Publication Details: Year: 1985
2. Title: **" The Lean Startup: How Today's Entrepreneurs Use Continuous Innovation to Create Radically Successful Businesses "**, Author: Eric Ries , Publication Details: Crown Business Year: 2011

REFERENCE BOOKS

1. Title: **" Managing Innovation: Integrating Technological, Market and Organizational Change "** Author: Joe Tidd, John Bessant , Wiley Publication Details: Year: 2018
2. Title: **" Entrepreneurship: Theory, Process, and Practice "** Author: Donald F. Kuratko , Donald F. Kuratko Publication Details: Year: 2016.
3. Title: **" Open Innovation: The New Imperative for Creating and Profiting from Technology "** Author: Henry Chesbrough , Harvard Business Review Press Details: Year: 2003.

Chhattisgarh Swami Vivekananda Technical University, Bhilai (C.G.)

Branch: B Tech Honours **Semester - VII**

Subject: Principle of Management

(Open Elective I) **Subject Code:**

Total Theory Periods: 40 **Total Tutorial Periods: 10**

No. of Class tests to: 2 (Minimum) **No. of Assignments to be submitted: One per Unit**

ESE Duration: Three Hours, **Maximum Marks in ESE: 100**

Minimum Marks in ESE: 35

Course Objectives

1. Understand the fundamental principles and functions of management.
2. Analyze different management theories and their applications.
3. Develop skills for effective planning, organizing, and controlling in organizations.
4. Evaluate leadership styles and their impact on team performance.
5. Apply management principles to real-world business scenarios and case studies.

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Course Outcomes

Upon successful completion of the course, students should be able to:

1. Demonstrate a clear understanding of core management principles and functions.
2. Analyze and apply various management theories to organizational scenarios.
3. Develop and implement effective planning and decision-making strategies.
4. Assess and improve organizational structures and control systems.
5. Evaluate leadership and motivation techniques to enhance team performance.

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Unit 1: INTRODUCTION TO MANAGEMENT

Definition and functions of management, Historical evolution of management theories, Management roles and skills, Types of organizations and their structures, Case studies on management practices

Unit 2: PLANNING AND DECISION MAKING

The planning process and types of plans, Decision-making models and techniques, Setting objectives and performance standards, Forecasting and risk management, Strategic planning and its importance.

Unit 3: ORGANIZING AND CONTROLLING

Organizational structure and design, Delegation of authority and responsibility, Organizational culture and change management, Control mechanisms and performance evaluation, Process of organizational control and feedback.

Unit 4: LEADERSHIP AND MOTIVATION

Theories of leadership and their application, Motivation theories and techniques, Leadership styles and their impact on team dynamics, Managing conflicts and negotiations, Building and leading effective teams

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Unit 5: MANAGEMENT IN PRACTICE

Case studies on management challenges and solutions. Application of management principles to business problems, Ethical issues in management, Trends and future directions in management, Skills development for managers

TEXTBOOKS

1. Title: **" Principles of Management "** Author: Charles W. L. Hill, Steven L. McShane McGraw-Hill Education Publication Details: Year: 2019
2. Title: **" Management: Tasks, Responsibilities, Practices "**, Author: Peter F. Drucker , Harper Business Publication Details: Crown Business Year: 1974

REFERENCE BOOKS

1. Title: **" Management: An Introduction "** Author: John R. Schermerhorn Jr., James G. Hunt, Richard N. Osborn , Wiley Publication Details: Year: 2019
2. Title: **" Contemporary Management "** Author: Gareth R. Jones, Jennifer M. George , McGraw-Hill Education Publication Details: Year: 2020.
3. Title: **" Principles of Management: A Global Perspective "** Author: Robert Kreitner, Angelo Kinicki , Cengage Learning Publication Details: Year: 2019.

Chhattisgarh Swami Vivekananda Technical University, Bhilai (C.G.)

Branch: B Tech Honours **Semester - VII**

Subject: Industrial Economics and Management

(Open Elective I) **Subject Code:**

Total Theory Periods: 40 **Total Tutorial Periods: 10**

No. of Class tests to: 2 (Minimum) **No. of Assignments to be submitted: One per Unit**

ESE Duration: Three Hours, **Maximum Marks in ESE: 100**

Minimum Marks in ESE: 35

Course Objectives

1. Understand the principles and concepts of industrial economics.
2. Analyze the impact of market structures and competition on industrial performance.
3. Evaluate the role of government policies in industrial regulation and economic development.
4. Develop strategies for effective industrial management and decision-making.
5. Apply industrial economic theories to real-world business and economic problems

Course Outcomes

Upon successful completion of the course, students should be able to:

1. Demonstrate a comprehensive understanding of industrial economics and its applications.
2. Analyze and evaluate different market structures and their effects on industry performance.
3. Assess the impact of government policies and regulations on industrial sectors.
4. Develop and implement effective industrial management strategies.
5. Apply theoretical knowledge to address contemporary issues in industrial economics.

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Unit 1: INTRODUCTION TO INDUSTRIAL ECONOMICS

Definition and scope of industrial economics, Role of industrial economics in economic development, Basic economic principles applied to industries, Market structures: perfect competition, monopoly, monopolistic competition, and oligopoly, Case studies of different industrial sectors.

Unit 2: MARKET STRUCTURES AND COMPETITION

Analysis of various market structures, Pricing strategies and output decisions, Competitive behaviors and strategic interactions, Game theory and its application to industrial competition, Impact of competition on market performance.

Unit 3: Government Policies and Regulation

Industrial policy and economic regulation, Antitrust laws and competition policy, Economic incentives and subsidies, Impact of government intervention on industries, Case studies on government policies affecting industries.

Unit 4: INDUSTRIAL MANAGEMENT AND STRATEGY

Principles of industrial management, Strategic planning and management in industries, Operations management and process optimization, Human resource management and organizational behaviour, Risk management and crisis management in industrial settings.

Unit 5: CONTEMPORARY ISSUES IN INDUSTRIAL ECONOMICS

Globalization and its impact on industrial economics, Technological advancements and innovation in industries, Sustainability and environmental considerations, Industrial economics in developing countries, Future trends and challenges in industrial economics

TEXTBOOKS

1. Title: **" Industrial Organization: Theory and Practice "** Author: Don E. Waldman, Elizabeth J. Jensen, Pearson Publication Details: Year: 2018
2. Title: **" Industrial Economics and Organization: Theory and Evidence "**, Author: John Griffiths, Stuart Wall , Oxford University Press Publication Details: Year: 2016

REFERENCE BOOKS

1. Title: **" Industrial Economics: An Introduction "** Author: Stephen Martin , Macmillan International Higher Education Publication Details: Year: 2020
2. Title: **" Principles of Industrial Economics "** Author: Richard E. Caves, Laurits R. Christensen , MIT Press Publication Details: Year: 2019.
3. Title: **" Managerial Economics and Organizational Architecture "** Author: James A. Brickley, Clifford W. Smith Jr., Jerold L. Zimmerman , McGraw-Hill Education Publication Details: Year: 2015.

Chhattisgarh Swami Vivekananda Technical University, Bhilai (C.G.)

Branch: B Tech Honours **Semester - VII**

Subject: Entrepreneurship Development
(Open Elective I) **Subject Code:**
Total Theory Periods: 40 **Total Tutorial Periods: 10**
No. of Class tests to: 2 (Minimum) **No. of Assignments to be submitted: One per Unit**
ESE Duration: Three Hours, **Maximum Marks in ESE: 100**
Minimum Marks in ESE: 35

Course Objectives

1. Understand the fundamentals of entrepreneurship and its significance in economic development.
2. Analyze the entrepreneurial process from idea generation to business establishment.
3. Develop skills for creating and evaluating business plans and models.
4. Explore strategies for financing, managing, and growing entrepreneurial ventures.
5. Assess the role of innovation and risk management in successful entrepreneurship.

Course Outcomes

Upon successful completion of the course, students should be able to:

1. Demonstrate a thorough understanding of entrepreneurship concepts and processes.
2. Create and evaluate effective business plans and models.
3. Analyze various financing options and manage financial resources for startups.
4. Develop strategies for business growth, scaling, and innovation.
5. Address and manage challenges and risks associated with entrepreneurial ventures.

Unit 1: INTRODUCTION TO ENTREPRENEURSHIP

Definition and characteristics of entrepreneurship, - Types and forms of entrepreneurship, The role of entrepreneurship in economic development, Entrepreneurial mindset and skills, Case studies of successful entrepreneurs

Unit 2: IDEA GENERATION AND BUSINESS PLANNING

Techniques for idea generation and opportunity recognition, Business model canvas and its components, Developing a comprehensive business plan, Market research and feasibility analysis, Legal and regulatory considerations for startups.

Unit 3: FINANCING AND RESOURCE MANAGEMENT

Sources of financing for startups (e.g., venture capital, angel investors, crowdfunding), Financial planning and budgeting for new ventures, Managing financial risks and controls Human resource management in start-ups, Resource allocation and operational management.

Unit 4: GROWTH AND SCALING STRATEGIES

Strategies for business growth and expansion, Market penetration and diversification, Strategic partnerships and alliances, Scaling operations and infrastructure, Innovation and technology management.

Unit 5: CHALLENGES AND OPPORTUNITIES IN ENTREPRENEURSHIP

Identifying and managing entrepreneurial risks, Overcoming common challenges faced by entrepreneurs, Ethical and social responsibilities of entrepreneurs, Future trends and opportunities in entrepreneurship, Case studies of entrepreneurial failures and lessons learned

TEXTBOOKS

1. Title: **" Entrepreneurship: Theory, Process, and Practice "** Author: Donald F. Kuratko , Cengage Learning Publication Details: Year: 2016
2. Title: **" The Lean Startup: How Today's Entrepreneurs Use Continuous Innovation to Create Radically Successful Businesses "**, Author: Eric Ries , Crown Business Publication Details: Year: 2011

REFERENCE BOOKS

1. Title: **" Entrepreneurship: Successfully Launching New Ventures "** Author: Bruce R. Barringer, Duane Ireland , Pearson Publication Details: Year: 2018
2. Title: **" The Innovator's Dilemma: When New Technologies Cause Great Firms to Fail "** Author: Clayton M. Christensen , Harvard Business Review Press Publication Details: Year: 1997.
3. Title: **" Startup Nation: The Story of Israel's Economic Miracle "** Author: Dan Senor, Saul Singer , Twelve Publication Details: Year: 2009.

Chhattisgarh Swami Vivekananda Technical University, Bhilai (C.G.)

Branch: B Tech Honours **Semester - VII**

Subject: Management Information System

(Open Elective I) **Subject Code:**

Total Theory Periods: 40 **Total Tutorial Periods: 10**

No. of Class tests to: 2 (Minimum) **No. of Assignments to be submitted: One per Unit**

ESE Duration: Three Hours, **Maximum Marks in ESE: 100**

Minimum Marks in ESE: 35

Course Objectives

1. Understand the role and significance of Management Information Systems (MIS) in organizations.
2. Analyze the components and architecture of MIS and their impact on business processes.
3. Develop skills for designing and implementing effective MIS solutions.
4. Evaluate the challenges and best practices in managing information systems.
5. Apply MIS concepts to solve real-world business problems and improve decision-making..

Course Outcomes

Upon successful completion of the course, students should be able to:

1. Demonstrate an understanding of the fundamental concepts and components of MIS.
2. Analyze and evaluate various information systems and technologies used in organizations.
3. Design and implement MIS solutions using appropriate methods and tools.
4. Manage and maintain MIS projects, addressing challenges related to security and performance.
5. Apply MIS concepts to enhance decision-making processes and business strategies..

Unit 1: INTRODUCTION TO MANAGEMENT INFORMATION SYSTEMS

Definition and purpose of MIS, Evolution and types of information systems, MIS in organizational contexts, Components of an MIS: hardware, software, data, people, and processes, Case studies of MIS implementations

Unit 2: INFORMATION SYSTEMS AND TECHNOLOGY

Overview of information technologies used in MIS, Database management systems (DBMS) and their role in MIS, Networking and communication technologies, Enterprise resource planning (ERP) systems, Cloud computing and its implications for MIS.

Unit 3: SYSTEMS ANALYSIS AND DESIGN

Systems development life cycle (SDLC), Methods and tools for systems analysis and design, Requirements gathering and analysis, System design techniques and prototyping Implementation and testing of MIS solutions.

Unit 4: MANAGING INFORMATION SYSTEMS

MIS project management and governance, Information security and privacy issues Data management and quality control, User training and support, Evaluating and maintaining MIS performance.

Unit 5: MIS AND DECISION MAKING

Role of MIS in decision-making processes, Decision support systems (DSS) and business intelligence (BI), Data analytics and visualization for decision support, Strategic use of information systems for competitive advantage, Case studies on MIS impact on business decisions.

TEXTBOOKS

1. Title: **" Management Information Systems: Managing the Digital Firm "** Author: Kenneth C. Laudon, Jane P. Laudon , Pearson Publication Details: Year: 2021.
2. Title: **" Information Systems for Managers: With Microsoft Office 2013 Updates "**, Author: Gabe Piccoli , Wiley Publication Details: Year: 2017

REFERENCE BOOKS

1. Title: **" Principles of Information Systems "** Author: Ralph M. Stair, George W. Reynolds , Cengage Learning Publication Details: Year: 2019
2. Title: **" Introduction to Information Systems: Enabling and Transforming Business "** Author: R. Kelly Rainer, Brad Prince , Wiley Publication Details: Year: 2018.
3. Title: **" Management Information Systems: A Conceptual Foundation "** Author: James A. O'Brien, George M. Marakas , McGraw-Hill Education Publication Details: Year: 2018.