DEVI AHILYA VISHWAVIDYALAYA, INDORE

FACULTY OF ENGINEERING

SCHEME OF EXAMINATION

II B.Tech Programme (As Per AICTE Guideline and NEP 2020)

(Computer Science and Business Systems)

INSTITUTE OF ENGINEERING & TECHNOLOGY

(www.ietdavv.edu.in)

DEVI AHILYA VISHWAVIDYALAYA, INDORE

INSTITUTE OF ENGINEERING & TECHNOLOGY

SCHEME OF EXAMINATION FOR II B.Tech PROGRAMME

(As per AICTE guideline and NEP 2020)

Semester-IV

S. No	Subject code	Subject Name	Type	CI-LI-(TW+SL) (Hours/Semester)	Credits* (Total Hrs/30)
1.	4RBPC1	Operating Systems + Lab (Unix)	PC	20-10-20-70	4
2.	4RBPC2	Design And Analysis of Algorithms + Lab	PC	20-10-20-70	4
3.	4RBPC3	Software Engineering + Lab	PC	20-10-20-70	4
4.	4RBHS1	Introduction to Innovation, IP Management and Entrepreneurship	HS	20-10-00-60	3
5.	4RBHS2	Design Thinking	HS	10-10-00-40	2
6.	4RBES1	Operations Research + Lab	ES	20-10-20-70	4
7.	4RBIK1	Essence of Indian Traditional Knowledge	IK	10-00-00-20	1
TOTAL CREDITS					**22**

*****This is as per the new National Credit Framework, which accounts for 30 hrs. of learning as equivalent to 1 credit.* **Legend:**

a) BS-Basic Science, ES-Engineering Science, HS-Humanities and Social Science including Management, PC-Programme Core, IK- Indian Knowledge System
b) CI: Classroom Instruction (Includes different instructional/implementation strategies i.e. Lecture (L), Tutorial (T), Case method, Demonstrations, Video demonstration, Problem based learning etc. to deliver theoretical concepts)
c) LI: Laboratory Instruction (Includes experiments/practical performances /problem based experiences in laboratory, workshop, field or other locations using different instructional/Implementation strategies)
d) TW: Term work (includes assignments, seminars, micro projects, industrial visits, any other student activities etc.)
e) SL: Self Learning, MOOCs, spoken tutorials, online educational resources etc. (If provided in curriculum structure.)

<table>
<tr><td colspan="4">Devi Ahilya Vishwavidhyalaya, Indore, India
Institute of Engineering and Technology</td><td colspan="3">II Year B.Tech. (Computer Science and Business Systems) IV Sem</td></tr>
<tr><td>Course Code & Name</td><td colspan="6">Instructions Hours per Semester and Credits</td></tr>
<tr><td rowspan="3">4RBPC1: Operating Systems + Lab (Unix)</td><td colspan="2">Classroom Instruction (CI)</td><td>Lab Instruction (LI)</td><td>Term Work (TW) and Self Learning (SL)</td><td>Total no. of Hours Per Semester</td><td>Total Credits (Total Hours/30)</td></tr>
<tr><td>L</td><td>T</td><td>P</td><td>TW+SL</td><td rowspan="2">120</td><td rowspan="2">4</td></tr>
<tr><td>20</td><td>10</td><td>20</td><td>70</td></tr>
</table>

Course Learning Objectives:

- To understand the fundamental concepts, architecture, and services of operating systems, including process management, memory management, file systems, and I/O systems.
- To develop the ability to analyse and implement scheduling, synchronization, deadlock handling, and resource management techniques for efficient system performance.

Prerequisites: Basic knowledge of computer architecture, programming in C or similar languages, and fundamental concepts of data structures and algorithms.

COURSE CONTENTS

Unit I

Introduction: Concept of Operating Systems, Generations, Types, Services of Operating System, Interrupt Handling and System Calls, Basic Architectural Concepts of Operating System, Concept of Virtual Machine, Resource Manager View, Process View and Hierarchical View of an Operating System. Processes: Definition, Process Relationship, Different States of a Process, Process State Transitions, Process Control Block, Context Switching. Thread: Definition, Various States, Benefits of Threads, Types of Threads, Concept of Multithreads.

CO Mapped: CO1

Unit II

Process Scheduling: Foundation and Scheduling Objectives, Types of Schedulers, Scheduling Criteria: CPU Utilization, Throughput, Turnaround Time, Waiting Time, Response Time. Scheduling Algorithms: Preemptive and Non Preemptive, First Come First Serve, Shortest Job First, Round Robin; Multiprocessor Scheduling: Real Time Scheduling Rate Monotonic Scheduling and Earliest Deadline First.

CO Mapped: CO2

Unit III

Inter-Process Communication: Concurrent Processes, Precedence Graphs, Critical Section, Race Conditions, Mutual Exclusion, Hardware Solution, Semaphores, Strict Alternation, Peterson's Solution, The Producer / Consumer Problem, Event Counters, Monitors, Message Passing, Classical Inter-Process Communication Problems, Deadlocks: Definition, Necessary and Sufficient Conditions for Deadlock, Deadlock Prevention, Deadlock Avoidance: Banker's Algorithm, Deadlock Detection and Recovery. Concurrent Programming, Deadlocks - Prevention, Avoidance, Detection and Recovery.

CO Mapped: CO3

Unit IV

Memory Management: Basic Concept, Logical and Physical Address Maps, Memory Allocation: Contiguous Memory Allocation – Fixed and Variable Partition–Internal and External Fragmentation and Compaction. Virtual Memory: Basics of Virtual Memory – Hardware and Control Structures – Locality of Reference, Page Allocation, Partitioning, Paging, Page Fault, Working Set, Segmentation, Demand Paging, Page Replacement Algorithms: Optimal, First in First out, Second Chance, Not Recently Used and Least Recently Used. I/O Hardware: I/O Devices, Device Controllers, Direct Memory Access, Principles of I/O.

CO Mapped: CO4

Unit V

File Management: Concept of File, Access Methods, File Types, File Operation, Directory Structure, File System Structure, Allocation Methods, Free-Space Management, Directory Implementation, Efficiency and Performance. Disk Management: Disk Structure, Disk Scheduling - First Come First Serve, Shortest Seek Time First, Elevator Algorithm, Circular Scan, Disk Reliability, Disk Formatting, Boot-Block, Bad Blocks. Case Study: Unix File System, Shell, Filters, Shell Programming, Programming with the Standard I/O, Unix System Calls.

CO Mapped: CO5

Course Outcomes (CO):

CO. No.	CO
CO1	Understand the fundamental concepts, structure, and functions of Operating Systems, including process, memory, file, and I/O management
CO2	Analyse process scheduling, synchronization, and deadlock handling techniques to ensure efficient and reliable system performance.
CO3	Apply concepts of memory allocation, paging, and virtual memory to optimize resource utilization in computing systems.
CO4	Demonstrate the use of UNIX/Linux environment for shell programming, process control, and system call implementation.
CO5	Integrate theoretical understanding of operating systems with real-world applications in modern computing and distributed systems.

Books Recommended:

[1] A. S. Tanenbaum and A. S. Woodhull, Operating Systems: Design and Implementation, 3rd ed. Pearson, 2006
[2] A. Silberschatz, P. B. Galvin, and G. Gagne, Operating System Concepts, 9th ed. Wiley, 2012.
[3] A. S. Tanenbaum, Modern Operating Systems, 4th ed. Pearson, 2014.
[4] M. Russinovich and D. Solomon, Windows Internals, Microsoft Press, 2009
[5] W. Stallings, Operating Systems: Internals and Design Principles, 8th ed. Pearson, 2014.

CO-PO-PSO Relationship:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
4RBPC1.CO1	**3**	**2**										3	2	1
4RBPC1.CO2	**3**	**3**		**2**								2	3	1
4RBPC1.CO3	**3**	**2**		**3**	**2**							3	2	1
4RBPC1.CO4					**3**	**1**			**2**			2	3	1
4RBPC1.CO5	**2**	**2**			**3**							3	2	1

- *CO (Rows) mention Nil / Very Small / Insignificant Contribution to the PO (Column)
- 1: Relevant and Small Significant 2: Medium or Moderate and 3: Strong

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</table>

Course Learning Objectives:

- To understand fundamentals of computer algorithms and algorithmic design paradigms.
- To demonstrate a familiarity with major algorithms and data structures.
- To make the students be able to perform analysis of algorithms using asymptotic and empirical approaches.
- To introduce various designing techniques and methods for algorithms.
- To develop ability to analyse the algorithms using time and space complexities.

Prerequisites: Discrete mathematics, Data structure and programming language**.**

COURSE CONTENTS

Unit I

Introduction: Characteristics of Algorithm. Analysis of Algorithm: Asymptotic analysis of Complexity Bounds – Best, Average and Worst-Case behavior; Performance Measurements of Algorithm, Time and Space Trade-Offs, Analysis of Recursive Algorithms through Recurrence Relations: Substitution Method, Recursion Tree Method, and Masters' Theorem.

CO Mapped: CO1

Unit II

Fundamental Algorithmic Strategies: Brute-Force, Heuristics, Greedy, Dynamic Programming, Branch and Bound and Backtracking methodologies; Illustrations of these techniques for Problem-Solving, Bin Packing, Knapsack, Travelling Salesman Problem.

CO Mapped: CO2

Unit III

Graph and Tree Algorithms: Traversal algorithms: Depth First Search (DFS) and Breadth First Search (BFS); Shortest path algorithms, Transitive closure, Minimum Spanning Tree, Topological sorting, Network Flow Algorithm.

CO Mapped: CO3

Unit IV

Tractable and Intractable Problems: Computability of Algorithms, Computability classes – P, NP, NP-complete and NP-hard. Cook's theorem, Standard NP-complete problems, and Reduction techniques.

CO Mapped: CO4

Unit V

Advanced Topics: Approximation algorithms, Randomized algorithms, Class of problems beyond NP – P SPACE, Introduction to Quantum Algorithms.

CO Mapped: CO5

Course Outcomes (CO):

CO. No.	CO
CO1	Analyze the time and space complexity of algorithms using asymptotic notations and solve recurrence relations.
CO2	Apply and contrast fundamental algorithmic strategies (Greedy, Dynamic Programming, Backtracking, etc.) to solve computational problems.
CO3	Implement and analyze key graph algorithms, including traversals (DFS, BFS), Minimum Spanning Trees, and shortest paths.
CO4	Classify computational problems into P, NP, NP-Complete, and NP-Hard classes and understand reduction techniques.
CO5	Describe the principles of advanced topics, including approximation, randomized, and quantum algorithms, to address intractable problems.

Books Recommended:

[1] Fundamental of Computer Algorithms, E. Horowitz and S. Sahni. 2nd Edition. 1992.
[2] The Design and Analysis of Computer Algorithms, A. Aho, J. Hopcroft and J. Ullman. Original edition. 1974.
[3] Introduction to Algorithms. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, and Clifford Stein. 4th Edition. 2022.

CO-PO-PSO Relationship:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
4RBPC2.CO1	3	3	1	2	1							3	2	1
4RBPC2.CO2	3	3	3	2	1							3	3	2
4RBPC2.CO3	3	3	3	2	3							3	3	3
4RBPC2.CO4	3	3	2	3	1							2	3	3
4RBPC2.CO5	3	3	3	3	2	1	1					2	2	3

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List of Practicals:

1. **Analysis of Time Complexity:**
   - **Task:** Implement Linear Search and Binary Search.
   - **Objective:** Run both algorithms on inputs of varying sizes (n) and plot the execution time. Empirically verify their time complexities (O(n) for linear, O(log n) for binary).

2. **Recursive Algorithm Analysis:**
   - **Task:** Implement Merge Sort and Quick Sort.
   - **Objective:** Compare their performance on different datasets (sorted, reverse-sorted, random) to observe their best-case, average-case (O(n log n)), and worst-case ($O(n^2)$ for Quick Sort) behaviors.

3. **Greedy Strategy:**
   - **Task:** Implement a solution for the Fractional Knapsack Problem or the Activity Selection Problem.
   - **Objective:** Demonstrate the greedy-choice property.

4. **Dynamic Programming (DP):**
   - **Task:** Implement a solution for the 0/1 Knapsack Problem using Dynamic Programming.
   - **Objective:** Compare this to a recursive brute-force solution to see the DP speedup.

5. **Dynamic Programming (DP):**
   - **Task:** Implement the algorithm to find the Longest Common Subsequence (LCS) of two strings.
   - **Objective:** Understand the use of a 2D table to store results of overlapping subproblems.

6. **Backtracking:**
    - **Task:** Implement a solution for the N-Queens Problem or the Sum of Subsets Problem.
    - **Objective:** Demonstrate the use of a state-space tree and pruning.

7. **Graph Traversal:**
    - **Task:** Implement Depth First Search (DFS) and Breadth-First Search (BFS) for a graph represented by an adjacency list.
    - **Objective:** Use your DFS implementation to detect cycles in the graph.

8. **Minimum Spanning Tree (MST):**
    - **Task:** Implement Prim's Algorithm or Kruskal's Algorithm to find the MST of a given weighted graph.
    - **Objective:** Handle graph data structures (like priority queues or disjoint sets).

9. **Shortest Path Algorithm:**
    - **Task:** Implement Dijkstra's Algorithm to find the single-source shortest path in a weighted graph.
    - **Objective:** Use a priority queue for efficient implementation.

10. **String Matching (Optional/Brute-Force):**
    - **Task:** Implement the Naive (Brute-Force) String Matching algorithm.
    - **Objective:** Analyze its worst-case performance (e.g., "AAAAA" in "AAAAAAAAAAAAAAAAB").

Devi Ahilya Vishwavidhyalaya, Indore, India Institute of Engineering and Technology			**II Year B.Tech. (Computer Science and Business Systems) IV Sem**			
Course Code & Name	**Instructions Hours per Semester and Credits**					
4RBPC3: Software Engineering + Lab	**Classroom Instruction (CI)**		**Lab Instruction (LI)**	**Term Work (TW) and Self Learning (SL)**	**Total no. of Hours Per Semester**	**Total Credits (Total Hours/30)**
	L	**T**	**P**	**TW+SL**	**120**	**4**
	20	**10**	**20**	**70**		

Course Learning Objectives:

- Understand the Principles, Concepts, and Practices of Software Engineering for Large-Scale Project Development.
- Learn Various Software Development Life Cycle (SDLC) Models and Project Management Techniques.
- Apply and Understand Software Requirement and Requirement Analysis, Design, Testing, and Maintenance, Methods Effectively.
- Explore Agile Methodologies and Computer Aided Software Engineering (CASE) tools for Modern Software Development.

Prerequisites: Proficiency in at Least One Programming Language and Adaptability**.**

COURSE CONTENTS

Unit I

Introduction to Software Engineering: Programming in the Small vs. Programming in the Large; Software Project Failures and Importance of Software Quality; Software Engineering as a Discipline; Software Process Models Linear Sequential Model, Prototyping Model, Rapid Application Development (RAD) Model – Waterfall, Spiral, Iterative, Agile; Software Project Life Cycle, Software Engineering Evolution.

CO Mapped: CO1

Unit II

Software Project Management: Basic Concepts of Life Cycle Models – Different Models and Milestones; Software Project Planning – Identification of Activities and Resources; Concepts of Feasibility Study; Techniques for Estimation of Schedule and Effort; Software Cost Estimation Models and Concepts of Software Engineering Economics; Techniques of Software Project Control and Reporting.

CO Mapped: CO2

Unit III

Software Requirements and Design: Requirements Elicitation and Analysis, Software Requirements Specification (SRS), Requirement Modelling Techniques Decision Tables, Event Tables, and State Transition Tables. Introduction to Unified Modeling Language (UML), Introduction to Software Metrics and Metrics-Based Control Methods; Measures of Code and Design Concepts – Modularity, Cohesion, Coupling, Abstraction, Design Patterns, Object-Oriented Design Principles.

CO Mapped: CO3

Unit IV

Software Testing and Quality Assurance: Testing fundamentals: Verification and Validation, White Box and Black Box Testing, Unit, Integration, System, and Acceptance Testing. Software quality factors, software reliability, quality metrics, introduction to Capability Maturity Model Integration (CMMI), software Inspection, and Reviews.

CO Mapped: CO4

Unit V

Agile Software Engineering and Maintenance: Agile Methodology Concepts – Scrum, Extreme Programming; Agile Process Model - Scrum, Feature; Scenarios and Stories, Reverse engineering, re-engineering, software evolution, Computer Aided Software Engineering (CASE) tools, and software Metrics-Based Control Methods.

CO Mapped: CO5

Course Outcomes (CO):

CO. No.	CO
CO1	Understand the Principles, Concepts, and Evolution of Software Engineering and Various Software Development Life Cycle Models.
CO2	Apply Project Management Techniques Including Cost Estimation, Scheduling, Feasibility Study, and Software Project Control.
CO3	Analyse and Model Software Requirements Using Structured and Object-Oriented Techniques (UML, SRS, Metrics).
CO4	Apply Software Testing Methods, Quality Assurance Techniques, and Process Maturity Models for Improving Software Reliability.

CO5	Explore Agile methodologies, Software Maintenance Processes, and the Use of CASE Tools for Adaptive and Efficient Software Development.

Books Recommended:

[1] Ivar Jacobson, Harold "Bud" Lawson, Pan-Wei Ng, Paul E. McMahon & Michael Goedicke, The Essentials of Modern Software Engineering: Free the Practices from the Method Prisons! 1/e, ACM Books 2019.
[2] Carlo Ghezzi, Mehdi Jazayeri & Dino Mandrioli, Fundamentals of Software Engineering, 1/e, Prentice Hall 1991; 2/e, Pearson 2002.
[3] Michael Jackson, Software Requirements and Specification: A Lexicon of Practice, Principles and Prejudices, 1/e, ACM Press 1995.
[4] Ivar Jacobson, Grady Booch & James Rumbaugh, The Unified Software Development Process, 1/e, Addison-Wesley 1999.
[5] Erich Gamma, Richard Helm, Ralph Johnson & John Vlissides, Design Patterns: Elements of Object-Oriented Reusable Software, 1/e, Addison-Wesley 1994.
[6] Norman E. Fenton & Shari Lawrence Pfleeger, Software Metrics: A Rigorous and Practical Approach, 2/e, International Thomson Computer Press 1997.

CO-PO-PSO Relationship:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
4RBPC3.CO1	3	2	1									1	3	2
4RBPC3.CO2	1	3	2								2	1	3	2
4RBPC3.CO3	2	3	3									1	3	3
4RBPC3.CO4	1		3		2	2						1	3	2
4RBPC3.CO5			1	3					2			2	3	3

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Devi Ahilya Vishwavidhyalaya, Indore, India Institute of Engineering and Technology			**II Year B.Tech. (Computer Science and Business Systems) IV Sem**			
Course Code & Name	**Instructions Hours per Semester and Credits**					
4RBHS1: Introduction to Innovation, IP management, and Entrepreneurship	**Classroom Instruction (CI)**		**Lab Instruction (LI)**	**Term Work (TW) and Self Learning (SL)**	**Total no. of Hours Per Semester**	**Total Credits (Total Hours/30)**
	L	**T**	**P**	**TW+SL**	**90**	**3**
	20	**10**	**00**	**60**		

Course Learning Objectives:

- The major emphasis of the course will be on creating, enhancing the learning system through their innovation and creative thinking skills for effective business process.
- Acquaint themselves with the special challenges of starting new ventures.
- Impart the entrepreneur skills in recognizing the new opportunities and styles required in maintaining competitive advantages.
- Provide the insights of financial aspects in planning and executing the market opportunities into a business plan.
- Emphasis on the role of IPR as an effective tool to protect their innovations and intangible assets from exploitation.

Prerequisite(s): Basic knowledge of innovation, technology, intellectual property and entrepreneurship

COURSE CONTENTS

Unit I:

The Concept of Innovation: Understanding the nature and scope of innovation within business and society; Meaning of Innovation and its Significance: Definition of innovation; importance for competitiveness, growth, value creation, and long-term sustainability; Innovation as a Core Business Process: Integration of innovation into organizational strategy, systematic processes for developing and implementing new ideas, products, or services; Knowledge-Push Innovations Vs Need-Pull Innovations: Distinction between innovations driven by new knowledge or technology (push) and those arising from identified market needs or customer demands (pull); Opportunity Recognition and Entry Strategies: Identifying market gaps, emerging trends, and viable opportunities; choosing appropriate strategies for market entry and innovation exploitation.

CO Mapped: CO1

Unit II:

Building an Innovative Organization: Principles and practices involved in establishing a culture and structure that support sustained innovation; The Creation of an Innovative Organization: Organizational design, leadership, culture, and processes that foster creativity,

experimentation, and continuous improvement; Creating New Products and Services: Techniques and stages of product/service development; idea generation, prototyping, testing, and commercialization; Understanding Open Innovation and Collaboration; Use of Innovation for Starting a New Venture; Co-operating Across Networks vs. 'Go-it-Alone' Approach.

CO Mapped: CO2

Unit III:

Entrepreneurship: Meaning and Characteristics of Entrepreneurship: Definition of entrepreneurship, key traits such as innovation, risk-taking, opportunity recognition, creativity, and resource mobilization; Entrepreneurship as a Style of Management: Entrepreneurial approach to leadership and decision-making, flexibility, proactiveness, adaptability, and strategic innovation in managing ventures; Maintaining Competitive Advantage: Strategies for sustaining market leadership through differentiation, cost efficiency, innovation, customer value, and continuous improvement; Financial Projections and Valuation; Stages of Financing: seed, startup, early-stage, growth, and expansion; Debt, Venture Capital, and Other Forms of Financing.

CO Mapped: CO3

Unit IV:

Intellectual Property Rights (IPR): Introduction to Intellectual Property Rights and the economics behind development of Intellectual Property Rights; The Business Perspective of Intellectual Property Rights; Intellectual Property Rights in India: The Genesis and the Development; International Context of Intellectual Property Rights; The Concept of Intellectual Property Management; Use of Intellectual Property Rights in Marketing.

CO Mapped: CO4

Unit V:

Types of Intellectual Property: Patent- Meaning, Procedure of Registration, Licensing and Assignment, Infringement and Penalty; Trademark- Meaning, Registration, use in marketing, Examples of Trademarks, Domain name; Geographical Indications- Meaning, Registration, Significance; Copyright- Meaning, Registration and Significance, Industrial Designs- Meaning, Registration and Significance; Major Court battles regarding Intellectual Property Rights.

CO Mapped: CO5

Course Outcomes (CO):

CO. No.	CO
CO1	**Understanding Innovation** Gain foundational knowledge about what constitutes innovation and recognize its significance in various organizational and social contexts.
CO2	**Developing Creative Thinking** Enhance the ability to think creatively by learning and practicing various techniques for idea generation, problem-solving, and opportunity identification.
CO3	**Introduction to Intellectual Property** Understand the basics of intellectual property rights, including patents, copyrights, trademarks, and their importance in protecting innovative ideas and products.
CO4	**Managing Innovations** Learn strategies to manage innovation, from idea conception to implementation, including assessing potential, navigating challenges, and commercializing outcomes.
CO5	**Fostering Entrepreneurial Skills** Develop practical entrepreneurship skills, such as business model development, market analysis, and basic financial literacy, for launching and managing new ventures.

Books Recommended:

[1] Intellectual Property Management for Start-ups: Enhancing Value and Leveraging the Potential by Martin A. Bader, Sevim Süzeroğlu-Melchiors, 1st Edition (2023), Published by Springer Nature.
[2] Innovation Management: Strategy and Implementation using the Pentathlon Framework by Keith Goffin, Rick Mitchell, 4th Edition (2025), Published by Bloomsbury Publishing.
[3] Handbook of Innovation and Intellectual Property Rights by Several expert contributors, Latest Edition (2024), Published by Edward Elgar Publishing.
[4] Innovation and Entrepreneurship by Peter F. Drucker, Classic text, available in reprint (Latest widely used 2015 Edition), Published by Routledge.
[5] Intellectual Property and Innovation Management in Small Firms by Robert Blackburn, 1st Edition (2007), Published by Routledge.
[6] Exploiting Intellectual Property to Promote Innovation and Create Value, Published by World Scientific.
[7] The Management of Innovation by Alberto Galasso, 2024 Edition, Published by University of Toronto Press.

CO-PO-PSO Relationship:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
4RBHS1.CO1	2					1						3	2	1
4RBHS1.CO2		1	2	2								3	2	1
4RBHS1.CO3	2				1							3	3	1
4RBHS1.CO4		2	1								2	3	2	1
4RBHS1.CO5	-	-	-	-	-	2	-	-	2	-	-	3	2	1

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Course Code & Name	**Instructions Hours per Semester and Credits**					
4RBHS2: **Design Thinking**	**Classroom Instruction (CI)**		**Lab Instruction (LI)**	**Term Work (TW) and Self Learning (SL)**	**Total no. of Hours Per Semester**	**Total Credits (Total Hours/30)**
	L	**T**	**P**	**TW+SL**	**60**	**2**
	10	**10**	**00**	**40**		

Course Learning Objectives:

- To provide new ways of creative thinking.
- Learn the innovation cycle of Design Thinking process.
- Develop innovative products which are useful for a student in preparing for an engineering career.

Prerequisites: Openness to Empathy, Curiosity, and a Collaborative, Action-Oriented Mindset.

COURSE CONTENTS

Unit I

Basics of Learning, Memory, Understanding, Expression:

Understanding the Learning Process, Assessing, and Interpreting, Memory process, Problems in retention, Memory enhancement techniques, Understanding, Expression.
CO Mapped: CO1

Unit II

Basics of Design Thinking:

Need for Design Thinking, Objective of Design Thinking, Concepts & Brainstorming, Stages of Design Thinking Process (explain with examples) – Empathize, Define, Ideate, Prototype, Test, Implement.
CO Mapped: CO2

Unit III

Key Principles and Design Thinking Tools:

Understanding Creative thinking process, Understanding Problem Solving, Experimentation, Creative Problem Solving, Design Thinking Tools.
CO Mapped: CO3

Unit IV

Process of Product Design:

Process of Engineering Product Design, Design Thinking Approach, Stages of Product Design, Collaboration, Creativity, Solution development.

CO Mapped: CO4

Unit V

Customer Centricity, Feedback, Research and Re-create:

Practical Examples of Customer Challenges, Use of Design Thinking to Enhance Customer Experience, Parameters of Product experience, Feedback loop, Focus on User Experience, Address ergonomic challenges, User focused design, Final Presentation- "Solving Practical Engineering Problem through Innovative Product Design & Creative Solution".
CO Mapped: CO5

Course Outcomes (CO):

CO. No.	CO
CO1	Compare and classify the various learning styles and memory techniques and apply them in their engineering education.
CO2	Analyse experience and expressions to better understand users while designing innovative products.
CO3	Develop new ways of creative thinking and learn the innovation cycle of Design Thinking process for developing innovative products.
CO4	Propose real-time innovative engineering product designs and choose appropriate frameworks, strategies, techniques during prototype development.
CO5	Perceive individual differences and their impact on everyday decisions and further create better customer experience.

Books Recommended:

[1] E Bala Guruswamy (2022), Developing Thinking Skills (The way to Success), Khanna Book Publishing Company.
[2] "Design Thinking" by Tim Brown (Harvard Business Review)
[3] "The Design Thinking Handbook" by IDEO

CO-PO-PSO Relationship:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
4RBHS2.CO1	2	1	1									1	1	3
4RBHS2.CO2	2	1	1		1							2	2	3
4RBHS2.CO3	2	1				1						1	1	3

4RBHS2.CO4			1		1	1		1				2	2	3
4RBHS2.CO5	1					1						1	1	3

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Devi Ahilya Vishwavidhyalaya, Indore, India Institute of Engineering and Technology				**II Year B.Tech. (Computer Science and Business Systems) IV Sem**		
Course Code & Name	**Instructions Hours per Semester and Credits**					
4RBES1: Operations Research + Lab	**Classroom Instruction (CI)**		**Lab Instruction (LI)**	**Term Work (TW) and Self Learning (SL)**	**Total no. of Hours Per Semester**	**Total Credits (Total Hours/30)**
	L	**T**	**P**	**TW+SL**	**120**	**4**
	20	**10**	**20**	**70**		

Course Learning Objectives:

- Formulate mathematical models and apply optimization methods such as linear programming, analyze and interpret solutions using sensitivity, simulation, and decision analysis tools.
- Analyse project scheduling using PERT/CPM to identify critical paths and completion times.
- Apply inventory models (EOQ, safety stock, multi-period) to optimize stock and cost decisions.
- Evaluate service systems using queuing models to assess waiting times, capacity, and performance
- Use OR software to model, solve, and interpret decision problems

Prerequisites: Basic knowledge of differentiation & integration of functions, vector algebra, determinants & matrices and calculus of finite difference.

COURSE CONTENTS

Unit I

Introduction to Operations Research (OR): Origin of OR and its definition. Concept of optimizing performance measure, Types of OR problems, Phases of OR problem approach – problem formulation, building mathematical model, deriving solutions, validating model, controlling and implementing solution. **Linear Programming:** Formulation & definitions, Basic feasible solutions. Geometric method: 2-variable case, Simplex Algorithm – slack, surplus & artificial variables, computational details, big-M method, identification and resolution of special cases through simplex iterations. Duality – formulation, results, fundamental theorem of duality, dual-simplex and primal-dual algorithms.

CO Mapped: CO1

Unit II

Transportation problems: Definitions – decision variables, supply & demand constraints, formulation, Balanced & unbalanced situations, Solution methods – NWCR, minimum cost

and VAM, test for optimality (MODI method), degeneracy and its resolution. **Assignment problems:** Definitions – decision variables, constraints, formulation, Balanced & unbalanced situations, Solution method – Hungarian, test for optimality (MODI method), degeneracy & its resolution.

CO Mapped: CO2

Unit III

PERT – CPM: Project definition, Project scheduling techniques – Gantt chart, PERT & CPM, Determination of critical paths, Estimation of Project time and its variance in PERT using statistical principles, Concept of project crashing/time-cost trade-off.

CO Mapped: CO3

Unit IV

Inventory Control: Functions of inventory and its disadvantages, ABC analysis, Concept of inventory costs, Basics of inventory policy (order, lead time, types), Fixed order-quantity models – EOQ, POQ & Quantity discount models. Special cases of EOQ models for safety stock with known/unknown stock out situations, models under prescribed policy, Probabilistic situations.

CO Mapped: CO4

Unit V

Queuing Theory: Definitions – queue (waiting line), waiting costs, characteristics (arrival, queue, service discipline) of queuing system, queue types (channel vs. phase). Kendall's notation, Little's law, steady state behavior, Poisson's Process & queue, Models with examples - M/M/1 and its performance measures; M/M/c and its performance measures; brief description about some special models. **Simulation Methodology:** Definition and steps of simulation, Monte-Carlo simulation and application in Scheduling, Queuing systems and Inventory systems.

CO Mapped: CO5

Course Outcome (CO):

CO. No.	CO
CO1	Students will be able to formulate real-world decision problems as mathematical models, especially linear programming models. They will apply graphical, simplex, and sensitivity analysis techniques to obtain and interpret optimal solutions.
CO2	Students will formulate transportation and assignment models to optimize cost, time, and resource allocation.
CO3	Students will construct project networks and determine activity times, paths, and dependencies. They will apply PERT and CPM techniques to identify the critical path, compute project duration, and analyse time–cost trade-offs.
CO4	Students will understand and formulate inventory models to manage stock levels under deterministic and uncertain demand. They will use analytical or software tools to evaluate inventory performance and support cost-effective inventory management.
CO5	Students will analyse queuing systems using standard models to evaluate waiting times, service capacity, and system performance. They will apply simulation techniques to model complex or stochastic systems that cannot be solved analytically.

Books Recommended:

[1] Hillier, F. S. and Lieberman, G. J. – Introduction to Operation Research, 8th ed., New York, McGraw- Hill, 2005.
[2] Taha, H. A. – Operations Research: An Introduction, 7th ed., Macmillan Publication Co., 2003.
[3] Sharma, S.D. – Operations Research, Kedarnath Ramnath & Co., Meerut, 2004.
[4] Dantzig G., Thapa M. Linear programming 1: Introduction, Springer, 1997.
[5] Gupta P K and Hira D S, Operations Research, S. Chand., 2008.
[6] Wagner H.M., Principles of OR with Application to Managerial Decisions, 2nd ed. Prentice Hall India Learning Pvt. Ltd., 1980.
[7] Wiest J.D. and Levy F.K., Management Guide to PERT/CPM, Prentice Hall, 1970.
[8] Prichard J.W. and Eagle R.H., Modern Inventory Management, John Wiley & Sons Inc., 1965.

CO-PO-PSO Relationship:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3	3	2	3				3			2	2	2
CO2	3	3	3	2								3	3	2
CO3	3	3	3	2	3				3		3	3	3	2
CO4	3	3	3	2	3				3		3	3	3	2
CO5	3	3	3	2	3				3		3	3	3	3

List of Practicals:

1. Solution of linear programming problem using graphical method with:
    a. Multiple constraints
    b. Unbounded solution
    c. Infeasible solution
    d. Alternative or multiple solution
2. Solution of linear programming problem with simplex method.
3. Problem solving using Big M method.
4. Problem solving using two phase method.
5. Solution on primal problem as well as dual problem.
6. Solution based on dual simplex method.
7. Solution of transportation problem.
8. Solution of assignment problem.
9. Performance measures for queuing model.
10. Performance measures for Inventory model.
11. ABC analysis.
12. Simulation by Monte Carlo method.

<table>
<tr><td colspan="4">Devi Ahilya Vishwavidhyalaya, Indore, India
Institute of Engineering and Technology</td><td colspan="3">II Year B.Tech. (Computer Science and Business Systems) IV Sem</td></tr>
<tr><td>Course Code & Name</td><td colspan="6">Instructions Hours per Semester and Credits</td></tr>
<tr><td rowspan="2">4RBIK1: Essence of Indian Traditional Knowledge</td><td colspan="2">Classroom Instruction (CI)</td><td>Lab Instruction (LI)</td><td>Term Work (TW) and Self Learning (SL)</td><td>Total no. of Hours Per Semester</td><td>Total Credits (Total Hours/30)</td></tr>
<tr><td>L</td><td>T</td><td>P</td><td>TW+SL</td><td rowspan="2">30</td><td rowspan="2">1</td></tr>
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Course Learning Objectives:

- To facilitate the students with the concepts of Indian traditional knowledge and to make them understand the importance of roots of Indian Knowledge System and its History.
- To make students acquaint with the facets of traditional Indian knowledge in area of Engineering.
- To Correlate Traditional Knowledge System with Contemporary Knowledge System and its significance in daily life.

Prerequisites: Basic knowledge of Indian History.

COURSE CONTENTS

Unit I

Introduction to Indian Knowledge Systems (IKS): About Indian Knowledge System, Definition of Indigenous/ Traditional Knowledge, Scope and Importance of Traditional Knowledge**. Ancient India:** Bharat Varsha**,** People of Ancient Bharat Varsha**,** The civilizations of the Sindhu-Saraswati valley**,** Civilizational Wisdom about nature and climate.

CO Mapped: CO1

Unit II

Ancient Indian Knowledge: The Vedas and its components-the Vedangas**,** Ancient Indian books and treaties: The Sastras**,** The Great Indian Epics: The Ramayana and The Mahabharata Epics. **Ancient education system:** Short knowledge about Gurukuls and Nalanda and Taksha-Shila University.

CO Mapped: CO2

Unit III

Indian Astronomy: Highlights of Indian Astronomy**,** Historical development of astronomy in India**,** Elements of Indian Calander**,** Aryabhatta and Siddhantic tradition**,** Panchang, Astronomical Instruments - Jantar Mantar.

CO Mapped: CO3

Unit IV

Town planning and architecture-Construction of Ancient Indian Buildings, Vastu Shastra etc, Short knowledge about Ayurveda and its components, Short knowledge about Bharatmuni's Natya Shastra**.**

CO Mapped: CO4

Unit V

Short knowledge and key elements of Artha Shastra, Niti Shastra and Nyaya Shastra.

CO Mapped: CO5

Course Outcomes (CO):

CO. No.	CO
CO1	Understand the historicity of Indian Knowledge System and ancient civilizational information of Bharat
CO2	Understand the broad classification of Indian philosophical and educational systems
CO3	Understand the basic elements of the Indian calendar and the components of Indian Panchanga.
CO4	Understand the basic elements of Ancient Indian Architecture, Health and Artistically approaches
CO5	understand the basic elements of Diplomacy, Logics and Argumentative approaches of Indian shastras

Books Recommended:

[1] Introduction to Indian Knowledge System- concepts and applications, B Mahadevan, Vinayak Rajat Bhat, Nagendra Pavana R N, 2022, PHI Learning Private Ltd, ISBN-978-93- 91818-21-0.
[2] Knowledge Traditions and Practices of India, Kapil Kapoor, Avadesh Kumar Singh, Vol. 1, 2005, DK Print World (P) Ltd., ISBN 81-246-0334**.**
[3] A. K. Bag, History of Technology in India, Vol. I, Indian National Science Academy, New Delhi, 1997.

[4] B. Datta and A. N. Singh, History of Hindu Mathematics: Parts I and II, Asia Publishing House, Bombay, 1962.

CO-PO-PSO Relationship:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
4RBIK1.CO1	3											2	2	2
4RBIK1.CO2	3					2		2				3	3	2
4RBIK1.CO3	3	2										3	3	2
4RBIK1.CO4	3	2	2				2					3	3	2
4RBIK1.CO5	3							2	2	2		3	3	3

- *CO (Rows) mention Nil / Very Small / Insignificant Contribution to the PO (Column)
- 1: Relevant and Small Significant 2: Medium or Moderate and 3: Strong