PUNYASHLOK AHILYADEVI HOLKAR

SOLAPUR UNIVERSITY, SOLAPUR

FACULTY OF ENGINEERING & TECHNOLOGY

COMPUTER SCIENCE AND ENGINEERING

CBCS NEP Syllabus for

First Year M.Tech.

w.e.f. Academic Year 2026-27

PUNYASHLOK AHILYADEVI HOLKAR SOLAPUR UNIVERSITY, SOLAPUR

FACULTY OF ENGINEERING & TECHNOLOGY
STRUCTURE OF M.Tech. (COMPUTER SCIENCE & ENGINEERING
Four Semester Course
CBCS NEP Syllabus wef 2026-27

Semester-I

First Year M.Tech (CSE) Structure 2026-27

SEMESTER I

Distribution	*Course Code*	*Name of the Course*	*Engagement Hours*			*Credits*	*FA*	*SA*			*Total*
			L	*T*	*P*		*ESE*	*ISE*	*ICA*	*OE/ POE*	
PCC	MTCSEPCC101	Applied Algorithms	3		2	4	70	30	25		125
PCC	MTCSEPCC102	Theory of Computation	3	1		4	70	30	25		125
PCC	MTCSEPCC103	Research Methodology & IPR	3	1		4	70	30	25		125
PCC	MTCSEPCC104	Machine Learning	3		2	4	70	30	25		125
PEC	MTCSEPEC105	**Program Elective Course-I**	3			3	70	30			100
PSS	MTCSEPSS106	**SEMINAR-I**			2	1		50			50
Audit Course	MTCSEAUD107	Stress Management using YOGA	2								Audit Course
		Total	**15**	**2**	**4**	**20**	**350**	**200**	**75**		**650**

Note: *L- Lectures, P-Practical, T-Tutorial, ISE- in ICA- Internal Continuous Assessment Semester Evaluation, ESE- End Semester Evaluation.*

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FACULTY OF ENGINEERING & TECHNOLOGY
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Four Semester Course
NEP Syllabus wef 2026-27

Semester-II

SEMESTER II										
Distribution	***Course Code***	***Name of the Course***	***Engagement Hours***			***Credits***	***FA***	***SA***			***Total***
			L	***T***	***P***		***ESE***	***ISE***	***ICA***	***OE/ POE***	
PCC	MTCSEPCC201	Internet of Things	3		2	4	70	30	25		125
PCC	MTCSEPCC202	Internet Routing Algorithm	3		2	4	70	30	25		125
PCC	MTCSEPCC203	Deep Learning	3		2	4	70	30	25		125
PEC	MTCSEPEC204	**Program Elective Course-II**	3		2	4	70	30	25		125
PEC	MTCSEPEC205	**Program Elective Course-III**	3	1		3	70	30	25		125
PSS	MTCSEPSS206	**SEMINAR-II**			2	1		50			50
Audit Course	MTCSEAUD207	Disaster Management	2			1					Audit Course
AEC/VEC/IKS	MTCSEIKS207	Indian Knowledge System: Indian Science and Technology	2			2		25	25		50
		Total	**19**	**1**	**10**	**23**	**350**	**225**	**150**	**0**	**725**

Note: *L- Lectures, P-Practical, T-Tutorial, ISE- in ICA- Internal Continuous Assessment Semester Evaluation, ESE- End Semester Evaluation*

- **Seminar I** shall delivered on a topic related to student's broad area of interest for dissertation work selected in consultation with the advisor after compiling the information from the latest literature. Student shall deliver seminar using modern presentation tools. A hard copy of the report (as per format specified by the department) shall be submitted to the Department before delivering the seminar. A PDF copy of the report must submitted to the advisor along with other details if any.

- **Seminar–II** shall focus on the specific research problem selected for the M.Tech dissertation. The student shall prepare and present a detailed synopsis of the proposed research work based on an in-depth review of the latest literature in the chosen area. The objective of Seminar–II is to ensure that the student clearly defines the research problem, objectives, methodology, and expected outcomes of the dissertation work. A PDF copy of the Synopsis report must submitted to the advisor along with other details if any.

AEC - Ability Enhancement Course
VEC - Value Education Course
IKS - Indian Knowledge System

- **List of Program Elective Courses for Semester I and II –**

Course Code	Program Elective-I	Course Code	Program Elective-II	Course Code	Program Elective -III
MTCSEPEC105A	Advanced Cryptography	MTCSEPEC204A	Blockchain Technology	MTCSEPEC205A	Data Science
MTCSEPEC105B	Advanced Image Processing	MTCSEPEC204B	Computer Vision	MTCSEPEC205B	Advanced Cloud computing
MTCSEPEC105C	Natural Language Processing	MTCSEPEC204C	High Performance Computing	MTCSEPEC205C	Wireless Sensor Network

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M. Tech (Computer Science & Engineering)

Semester-I

1. MTCSEPCC101 Applied Algorithms

Teaching Scheme
Lectures–3 Hours/Week, 3 Credits
Practical- 2 Hours/Week, 1 Credit

Examination Scheme
ESE –70 Marks
ISE – 30 Marks
ICA- 25 Marks

Course Objectives

1. To understand fundamental concepts of algorithm design, analysis, and asymptotic notations for evaluating performance.
2. To develop problem-solving skills using graph algorithms, dynamic programming, and backtracking techniques.
3. To analyze computationally hard problems including NP-Complete problems and apply suitable approximation methods.
4. To apply number-theoretic, string matching, and randomized algorithms to real-world computing applications.

Course Outcomes

After successful completion of this course, students will be able to:

1. Analyze algorithm efficiency using asymptotic analysis and recurrence solving techniques.
2. Design and implement graph, dynamic programming, and backtracking algorithms to solve optimization problems.
3. Identify NP-Complete problems and apply approximation techniques to obtain feasible solutions.
4. Implement number-theoretic, string matching, and randomized algorithms for practical applications.

SECTION-I

Unit 1 Foundation (6)

Algorithms, Performance of algorithms, Growth of Functions-Asymptotic notation, Amortized analysis, Solving recurrences- Substitution method, Master method

Unit 2 Graph Algorithms (7)

Minimum spanning tree -Prim's and Krushkal's Algorithm for, Single-Source Shortest Paths-The Bellman-Ford algorithm and Dijkstra's algorithm, The Ford-Fulkerson Algorithm,
Huffman codes.

Unit 3 Dynamic Programming and Backtracking (8)

Matrix-chain multiplication, longest common subsequences, All-Pairs Shortest Paths, optimal binary search tree, the general method, 8-queen problem, sum of subset, knapsack problem.

SECTION-II

Unit 4 Computational Geometry (8)

Prerequisites – Basic properties of line, intersection of line, line segment, polygon etc. Line segment properties, detaining segment intersection in time complexity, Convex full problem – formulation, solving by Graham scan algorithm, Jarvis march algorithm, closest pair of points

Unit 5 NP-Completeness and Approximation Algorithms (7)

NP-Completeness: NP-completeness and reducibility, NP-completeness proof, NP-complete problems, Approximation algorithms: The vertex-cover problem, the traveling-salesman problem, the set covering problem, The subset-sum problem

Unit 6 Applied Algorithms (7)

Number-Theoretic: Number Theoretic notion, Greatest common divisor, The Chinese remainder theorem, RSA. String Matching Algorithms: The Rabin-Karp algorithm, The Knuth-Morris-Pratt algorithm. Randomized Algorithms: Definition, Monte Corlo and Las Vegas algorithms

Internal Continuous Assessment (ICA):

Minimum 6 to 7 assignments based on above topics.

Textbooks:

1. Ellis Horowitz, Sartaj Sahni, - Fundamental of Computer Algoritms, Universities Press, II Edition
2. Bressard ,Bratley - Fundamental of Algorithms, PHI, 2nd Edition
3. Thomas H. Cormen and Chales E.L. Leiserson, Introduction to Algorithm, PHI, 2nd Edition

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Reference Books:

1. A.V.Aho and J.D.Ullman, Design and Analysis of Algorithms, Addition Wesley, 2nd Edition
2. Introduction to Design and Analysis of Algorithm, Goodman (McGrawhill)
3. Design and analysis of algorithms, Aho, Hopfcraft and Ullman (Addison wesley)
4. Design & Analysis of Algorithms, Sharma, Khanna Publishing House, N.Delhi
5. Design & Analysis of Algorithms, S. Sridhar, Oxford

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M. Tech (Computer Science & Engineering)

Semester-I

2. MTCSEPCC102 Theory of Computation

Teaching Scheme
Lectures–3 Hours/Week, 3 Credits
Tutorial- 1 Hour/Week, 1 Credit

Examination Scheme
ESE- 70 Marks
ISE- 30 Marks
ICA- 25 Marks

SECTION I

Unit 1: Introduction: (6)

Introduction To Finite Automata: Alphabets and languages - Deterministic Finite Automata – Non Deterministic Finite Automata - Equivalence of Deterministic and Non-Finite Automata Languages Accepted by Finite Automata - Finite Automata and Regular Expressions – Properties of Regular sets & Regular Languages and their applications. Context Free Language : Context - Free Grammar – Regular Languages and Context-Free Grammar –Pushdown Automata - Pushdown Automata and Context-Free Grammar – Properties of Context – Free Languages - Pushdown Automata and Equivalence and Context Free Grammar.

Unit 2: Turing machine: (5)

Turing machines, variants of TMs, programming techniques for TMs, TMs and computers.

Unit 3: Decidability: (5)

Decidable languages, decidable problems concerning Context-free languages. The halting problem – Diagonalization method, halting problem is undecidable, Semi-Decidable Problems, classification of decidability, Undecidability.

SECTION II

Unit 4: Reducibility: (6)

Undecidable problems from language theory, Regular expressions, Turing machines, Reduction, A simple undecidable problem (PCP), mapping reducibility and other undecidable problems, Rice theorem and problems on Undecidability with reducibility.

Unit 5 Computability: (6)

Primitive recursive functions, more examples, the recursion theorem, Computable and non-Computable problems, examples.

Unit 6 Computational Complexity: (6)

Tractable and Interactable problems, Growth rates of functions, Time complexity of TM, Tractable decision problems, Theory of Optimization, solvable v/s. Unsolvable Problems, Decidable v/s. Undecidable Problems, P v/s NP Problems, major problems in Computational Complexity.

Internal Continuous Assessment (ICA):

Assignments: Minimum 8 assignments based on above topics.

Text Books:

1. Introduction to Theory of Computation - Michael Sipser (Thomson Brools Cole)

2. Introduction to Automata Theory, Languages and Computation - J. E. Hoperoft, Rajeev Motawani and J.D. Ullman (Pearson Education Asia) 2nd Edition.

3. Theory of Computer Science – E. V. Krishnamoorthy

4. Introduction to languages & theory of computation -- John C. Martin (MGH)

References:

1. Theory of Computation- A Problem Solving Approach - Kavi Mahesh (Wiley India)

2. Theory of Computation - Dr. O.G.Kakde (University Science Press)

3. Formal Languages & Automata Theory - Basavraj S. Anami, Karibasappa K.G., Wiley Precise Textbook-Wiley India

4. Theory of Computation - Rajesh K Shukla (CENGAGE Learning)

पुण्यश्लोक अहिल्यादेवी होळकर
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Punyashlok Ahilyadevi Holkar Solapur University, Solapur

MTech (Computer Science & Engineering)

Semester-I

3. MTCSEPCC103 Research Methodology & IPR

Teaching Scheme	**Examination Scheme**
Lectures–3 Hours/week, 3 Credits	**ESE –70 Marks**
Tutorial- 1 Hour/Week, 1 Credit	**ISE – 30 Marks**
	ICA- 25 Marks

Course Objectives :

1. To introduce the fundamental concepts, principles, and methodologies of research and enable students to design appropriate research strategies for solving research problems.
2. To develop the ability to conduct effective literature surveys, and to understand and apply qualitative and quantitative data analysis techniques for research studies.
3. To familiarize students with the role of Computers and Information Technology tools in research, including data collection, analysis, documentation, and presentation of research work.
4. To create awareness about the concept, importance, and types of Intellectual Property Rights (IPR) and their role in protecting innovations and research outcomes.
5. To motivate students to understand IPR protection mechanisms such as patents, copyrights, trademarks, and to encourage innovation, creativity, and responsible research practices.

Course Outcomes (COs)

At the end of the course, students will be able to:

1. **Design and differentiate** suitable research designs and methodologies for a given research problem.
2. **Acquire and apply skills** in conducting literature surveys, performing qualitative and quantitative data analysis, and effectively presenting research results.
3. **Explain the role of Computers and Information Technology** in research and emphasize the value of ideas, concepts, and creativity in the research process.
4. **Explain and evaluate the significance of Intellectual Property Rights (IPR)** in the development and progress of individuals and the nation.
5. **Demonstrate understanding of IPR protection mechanisms**, encouraging innovation and motivating inventors to undertake further research for developing improved and innovative products.

SECTION-I

UNIT 1. Research Fundamentals: (6)

Defining Research, Scientific Enquiry, Hypothesis, Scientific Method, Types of research and approaches- theoretical, applied and experimental, Research Process and steps in it. Research Proposals – Types, contents, sponsor agent's requirements, Ethical, Training, Cooperation and Legal aspects.

UNIT 2. Research Design: (6)

Meaning, Need, Concepts related to it, categories; Literature Survey and Review, Dimensions and issues of Research Design, Research Design Process – Selection of type of research, Measurement and measurement techniques ,Selection of Sample, Selection of Data Collection Procedures, Selection of Methods of Analysis, Errors in Research.

UNIT 3. Information communication & Research Problem: (8)

Report writing and presentation of results- Need, report structure, formulation, sections, protocols, graphs, tables, IEEE format, evaluation of report, writing abstract, writing technical paper. Information communication-e-research, indices, virtual lab, digital lab, ethical issues in research. Problem Solving – Types, Process and Approaches – Logical, Soft System and Creative; Creative problem solving process, Development of Creativity, Group Problem Solving Techniques for Idea Generation – Brain storming and Delphi Method.

SECTION-II

UNIT 4. Mathematical modelling and Simulation: (7)

Mathematical modelling: Need, techniques and classification, system models –types, static, dynamic, system simulation – why to simulate, technique of simulation, Monte Carlo simulation, continuous modelling, discrete model, Role of probability and statistics in simulation, statistical distributions.

UNIT 5. Nature of Intellectual Property: (7)

Patents, Designs, Trademarks and Copyright. Process of Patenting and Development: Technological research, Innovation, Patenting, Development. International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, Patenting under PCT.

UNIT 6. New Developments in IPR & Patent Rights: (6)

Administration of Patent System. New developments in IPR; IPR of Biological Systems, Computer Software etc. Traditional knowledge Case Studies, IPR Scope of Patent Rights. Licensing and transfer of technology. Patent

information and databases. Geographical Indications.

References:

1. Vinayak Bairagi, Mousami V. Munot, Vinayak Bairagi, Mousami V. Munot, Research Methodology, A Practical and Scientific Approach, Publisher: Chapman and Hall/CRC ,Year 2019, ISBN 9781351013253.Krishnaswamy, K.N., Sivakumar, AppaIyer & Mathirajan M., (2006) - Management Research Methodology: Integration of Principles, Methods & Techniques (New Delhi, Pearson Education)

2. Montgomery, Douglas C. (2004) – Design & Analysis of Experiments, (New York, John Wiley &Sons)

3. Kothari, C.K. (2004) – Research Methodology, Methods & Techniques, (New Delhi, New Age International Ltd. Publishers).

4. Prabuddha Ganguli, IPR: Unleashing the Knowledge Economy, published by Tata McGraw Hill2001.

5. John W Cresswell, (2009)-Research Design: Qualitative, Quantitative and Mixed Methods Approaches, (Sage Publications Pvt Ltd. 3rd Edition.)

6. Ranjit Kumar, 2nd Edition, “Research Methodology: A Step by Step Guide for beginners”

7. Halbert, “Resisting Intellectual Property”, Taylor & Francis Ltd, 2007.

8. Robert P. Merges, Peter S. Menell, Mark A. Lemley, “Intellectual Property in New Technological Age”, 2016.

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पुण्यश्लोक अहिल्यादेवी होळकर
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Punyashlok Ahilyadevi Holkar Solapur University, Solapur

MTech (Computer Science & Engineering)

Semester-I

4. MTCSEPCC104 Machine Learning

Teaching Scheme	Examination Scheme
Lectures–3 Hours/week, 3 Credits	ESE –70 Marks
Practical- 2 Hours/Week , 1 Credit	ISE – 30 Marks
	ICA- 25 Marks

SECTION-I

Unit I : Introduction **(6)**

Machine learning: what and why?, Supervised learning, Unsupervised learning, Some basic concepts in machine learning, Definition of learning systems. Goals and applications of machine learning. Aspects of developing a learning system: training data, concept representation, function approximation.

Unit II: Linear and Logistic Regression (7)

Linear regression: Introduction, Model specification, Maximum likelihood Robust linear regression, Ridge regression, Bayesian linear regression estimation (least squares), Logistic regression: Introduction, M del specification, Model fitting, Bayesian logistic regression, Online learning and stochastic optimization, Generative vs discriminative classifiers.

Unit III: Decision Tree Learning and Ensemble Methods (8)

Representing concepts as decision trees. Recursive induction of decision trees. Picking the best splitting attribute: entropy and information gain. Searching for simple trees and computational complexity. Occam's razor. Overfitting, noisy data, and pruning, Ensemble Methods: Bagging and Boosting

SECTION-II

Unit IV: Clustering (6)

Introduction, Dirichlet process mixture models, Affinity propagation, Spectral clustering, Hierarchical clustering, Clustering datapoints and features, Applications of Clustering.

Unit V: Sparse Kernel Machines (6)

Introduction to Support Vector Machines (SVM), Maximum Margin Classifiers, Machines. Applications of Support Vector Machines.

Unit VI: Neural Networks and Deep Learning (4)

Feed-forward Network Functions, Network Training, Error Backpropagation, Regularization in Neural Networks.

Unit VII: Key Ideas in Machine Learning (4)

Introduction, Key Perspectives on Machine Learning, Key Results, Future of Machine Learning.

Unit VIII: Applications of Machine Learning (4)

Applying Learning to Real Problems, Classifying Images, Scoring Opinions and Sentiments, Recommending Products and Movies, Using Machine Learning to Provide Solutions to Business Problems, Future of Machine Learning.

Internal Continuous Assessment (ICA) :

ICA shall be based upon minimum 6 laboratory experiment based upon above curriculum.

Text Books:

1. Machine Learning For Dummies, IBM Limited Edition by Judith Hurwitz, Daniel Kirsch (Published by Wiley, First edition).

2. Machine Learning For Dummies by John Paul Mueller, Luca Massaron (Published by For Dummies; First edition).

Reference Books:

Book 1: Machine Learning by Tom Mitchell, McGraw Hill (1st Edition) + New chapters from the upcoming second edition.

Draft content of chapter 14 of upcoming 2nd Edition of Book 1
http://www.cs.cmu.edu/~tom/mlbook/keyIdeas.pdf

Book 2: Machine Learning: a Probabilistic Perspective by Kevin Patrick Murphy

Book 3: Pattern Recognition and Machine Learning (Information Science and Statistics) by Christopher M. Bishop

Book 4: Introduction to Machine Learning (Second Edition) by Ethem Alpaydın (published by The MIT Press Cambridge, Massachusetts London, England

Punyashlok Ahilyadevi Holkar Solapur University, Solapur

M. Tech (Computer Science & Engineering)
Semester-I
Programming Elective Course-I
MTCSEPEC105A Advanced Cryptography

Teaching Scheme	Examination Scheme
Lectures–3 Hours/week, 3 Credits	ESE –70 Marks
	ISE – 30 Marks

Course Prerequisite:

A solid understanding of basic cryptography, discrete mathematics, and foundational cryptographic protocols. Prior knowledge of classical cryptographic algorithms, security models, and mathematical tools used in cryptography is essential.

Course Objectives:

1. To provide an in-depth understanding of advanced cryptographic theories, algorithms, and protocols.
2. To analyze modern cryptographic schemes and their mathematical foundations.
3. To explore current research trends, emerging technologies, and future directions in cryptography.
4. To develop skills for designing, analyzing, and evaluating secure cryptographic systems and protocols.

Course Outcomes:

After successful completion of the course, students will be able to:

1. Explain advanced mathematical concepts and security models underpinning modern cryptography.
2. Critically analyze the security and efficiency of symmetric and asymmetric cryptographic schemes.
3. Design and evaluate cryptographic protocols including zero-knowledge proofs, homomorphic encryption, and post-quantum schemes.
4. Assess emerging trends such as quantum-resistant cryptography, blockchain security, and formal methods in cryptography, applying them to research and practical applications.

SECTION-I

Unit 1 Mathematical Foundations and Security Models (6)

Revisiting advanced mathematical tools such as elliptic curves, pairings, finite fields, and Galois theory, understanding complexity assumptions and hardness proofs, studying formal security models like IND-CPA, IND-CCA, and UC security, emphasizing the theoretical basis for cryptographic security and provably secure schemes.

Unit 2 Advanced Symmetric Cryptography (6)

Exploring modern block cipher design principles, cryptanalysis techniques, modes of operation, lightweight ciphers, tweakable encipherments, pseudorandom functions, analyzing security and efficiency trade-offs in contemporary symmetric cryptography.

Unit 3 Modern Public-Key Cryptography and Post-Quantum Schemes (6)

Studying lattice-based cryptography, code-based cryptography, multivariate cryptosystems, elliptic curve cryptography, pairing-based cryptography, analyzing security assumptions, potential as post-quantum candidates, and recent research trends.

SECTION-II

Unit 4 Cryptographic Protocols and Zero-Knowledge Proofs (6)

Examining complex protocols such as secure multiparty computation, oblivious transfer, zero-knowledge proofs, focusing on protocol design, simulation techniques, privacy-preserving computations, and blockchain applications.

Unit 5 Homomorphic Encryption and Functional Encryption (6)

Introducing encryption schemes enabling computation over encrypted data, covering partially, somewhat, and fully homomorphic encryption, functional encryption, discussing their construction, security considerations, and real-world applications in cloud computing and data privacy.

Unit 6 Emerging Trends and Research Directions (6)

Covering cutting-edge topics like quantum-resistant cryptography, blockchain security, cryptanalysis of modern schemes, formal methods in cryptography, encouraging critical analysis of research papers, discussion of open problems, and future directions in cryptographic research.

Text books:

1. Shallit, J., 1999. Handbook of applied cryptography. by alfred j. menezes, paul c. van oorschot, and scott a. vanstone, the cryptographic imagination: Secret writing from edgar poe to the internet. by shawn james rosenheim. The American Mathematical Monthly, 106(1), pp.85-88.
2. Jajodia S, Samarati P, Yung M, editors. Encyclopedia of cryptography, security and privacy. Cham: Springer Nature Switzerland; 2025 Jan 10.

ReferenceBooks:

1. Albrecht, M., Chase, M., Chen, H., Ding, J., Goldwasser, S., Gorbunov, S., Halevi, S., Hoffstein, J., Laine, K., Lauter, K. and Lokam, S., 2022. Homomorphic encryption standard. In Protecting privacy through homomorphic encryption (pp. 31-62). Cham: Springer International Publishing.

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M. Tech (Computer Science & Engineering)
Semester-I
Programming Elective Course-I
MTCSEPEC105B Advanced Image Processing

Teaching Scheme
Lectures–3 Hours , 3 Credits

Examination Scheme
ESE –70 Marks
ISE – 30 Marks

COURSE OUTCOMES:
At the end of the course, students will be able to:

1. Apply advanced mathematical models for image analysis and processing.
2. Design and implement algorithms for image enhancement, restoration and segmentation.
3. Analyze and develop feature extraction and pattern recognition techniques.
4. Develop research-oriented solutions in medical, satellite and industrial image applications.

SECTION-I

Unit 1: Fundamentals of Digital Image Processing (06)

Digital image processing basics, Applications of digital image processing, Fundamental steps in image processing, Components of an image processing system, Image formation models; Image sampling and quantization; Image transforms (DFT, DCT, DWT); Color models; Image filtering in spatial and frequency domain.

Unit 2: Advanced Image Enhancement & Restoration (06)

Histogram equalization; Adaptive filtering; Noise models; Image degradation and restoration models; Wiener filtering; Blind deconvolution; Regularization techniques.

Unit 3: Image Segmentation & Feature Extraction (06)

Edge detection techniques; Thresholding; Region-based segmentation; Clustering-based segmentation; Texture analysis; Shape descriptors; Feature selection methods.

SECTION-II

Unit 4: Morphological and Structural Image Analysis (06)

Morphological operations; Skeletonization; Object representation; Boundary representation; Region representation; connected component analysis.

Unit 5: Image Compression and Pattern Recognition (06)

Lossy and lossless compression; JPEG and JPEG2000; Vector quantization; Introduction to statistical pattern recognition; Classification techniques for image analysis.

Unit 6: Advanced Applications of Image Processing (06)

Medical image processing; remote sensing and satellite image analysis; Biometric systems; deep learning for image processing (CNNs); Object detection and image classification.

Text Books:

1. Gonzalez, R.C. and Woods, R.E., "Digital Image Processing", 4th Edition, Pearson.

2. Jain, A.K., "Fundamentals of Digital Image Processing", PHI.

3. Sonka, Hlavac & Boyle, "Image Processing, Analysis and Machine Vision", Cengage Learning.

Reference Books:

1. Pratt, W.K., "Digital Image Processing", Wiley.

2. Bishop, C.M., "Pattern Recognition and Machine Learning", Springer.

3. Goodfellow, Bengio & Courville, "Deep Learning", MIT Press.

पुण्यश्लोक अहिल्यादेवी होळकर
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Punyashlok Ahilyadevi Holkar Solapur University, Solapur

M.Tech (Computer Science & Engineering)
Semester-I
Programming Elective Course-I
MTCSEPEC105C Natural Language Processing

Teaching Scheme
Lectures–3 Hours , 3 Credits

Examination Scheme
ESE –70 Marks
ISE – 30 Marks

COURSE OUTCOMES:

At the end of the course students will be able to

1. Demonstrate the fundamental mathematical models and algorithms in the field of NLP.
2. Apply these mathematical models and algorithms in applications of software design and implementation for NLP.
3. Use tools to analyze language resource annotation and apply to data for acquiring intended information.
4. Design and implement various NLP applications.

SECTION-I

Unit 1 Introduction (06)

Definition and Scope of Natural Language Processing, Artificial Intelligence, Machine Learning and NLP, Biology of Speech Processing; Place and Manner of Articulation, Word Boundary Detection, Arg-Max Computation, Lexical Knowledge Networks.

Unit 2 Word-netTheory (06)

Semantic Roles, Knowledge Graphs and Semantic Networks, Word Sense Disambiguation (WSD): Word-Net, Word-net Application in Query Expansion, Wiktionary, semantic relatedness, Measures of Word-Net Similarity, Similarity Measures. Resnick's work on Word-Net Similarity, Indian Language Word-nets and Multilingual Dictionaries, Multi- linguality, Metaphors, Co-references.

Unit 3 Theories of Parsing (06)

Parsing Algorithms, Evidence for Deeper Structure, Top-Down Parsing Algorithms, Neural Network–Based Parsing, Noun Structure, Non-noun Structure and Parsing Algorithms, Robust and Scalable Parsing on Noisy Text in Web documents, Probabilistic parsing, Hybrid of Rule Based and Probablistic Parsing sequence labeling, Training issues, Arguments and Adjuncts, inside-outside probabilities, Scope Ambiguity and Attachment Ambiguity resolution.

SECTION-II

Unit 4 Speech (06)

Phonetics, HMM, Morphology, Morphology fundamentals; Morphological Diversity of Indian Languages; Morphology Paradigms; Finite State Machine Based Morphology; Automatic Morphology Learning ; Shallow Parsing; Named Entities; Maximum Entropy Models; Random Fields.

Unit 5 Semantic Relations (06)

UNL, Towards Dependency Parsing, Universal Networking Language, Semantic Role Extraction, Baum Welch Algorithm, HMM and Speech Recognition. HMM training, Baum Welch Algorithm,

Unit 6 NLP Applications (06)

Sentiment Analysis; Text Entailment; Robust and Scalable Machine Translation; Question Answering in Multilingual Setting; Cross Lingual Information Retrieval (CLIR), Conversational Systems and Chatbots, Healthcare, Finance and Social Media Applications of NLP.

Text Books:

1. Allen, James, "Natural Language Understanding", Second Edition, Benjamin/Cumming,1995.

2. Charniack, Eugene, "Statistical Language Learning", MIT Press,1993.

3. Jurafsky, Dan and Martin, James, Speech and Language Processing, Second Edition, Prentice Hall,2008.

4. Manning, Christopher and Heinrich, Schutze, Foundations of Statistical Natural Language Processing, MIT Press,1999.

Reference Books:

1. Jurafsky, D., and Martin, J.H. (2008). "Speech and Language Processing" (2nd Edition). Upper Saddle River, NJ: PrenticeHall

2. Bird, S., Klein, E., Loper, E. (2009). "Natural Language Processing with Python". Sebastopol.

Punyashlok Ahilyadevi Holkar Solapur University, Solapur

M.Tech (Computer Science & Engineering)
Semester-II
MTCSEPCC201 Internet of Things

Teaching Scheme	Examination Scheme
Lectures–3 Hours and 1 Tutorial/week, 3 Credits	ESE –70 Marks
Practical- 2 Hours/Week , 1 Credit	ISE – 30 Marks
	ICA- 25 Marks

Course Objectives

1. To understand architecture and design principles of IoT systems.
2. To develop skills for designing IoT based smart applications.
3. To analyze IoT communication technologies and protocols.
4. To build hands-on IoT systems using edge devices and cloud platforms.
5. To encourage project-based learning aligned with NEP experiential learning guidelines.

Section I

Unit 1: Overview of Internet of Things (6 Hours)
IoT Paradigm and Evolution, IoT Reference Architectures, IoT Technology Stack, Design principles for scalable IoT systems, Advanced embedded prototyping, Hardware–Software co-design, Wireless Sensor Networks, IoT data lifecycle, Application domains and emerging research trends.

Unit 2: IoT Architecture and Protocol Stack (6 Hours)
IoT node architecture, communication protocol stack for IoT, IPv6 based networking, IoT layered architectures (IoT-A, oneM2M), networking topologies, routing mechanisms, edge–fog–cloud architecture, interoperability frameworks and middleware platforms.

Unit 3: Wireless Technologies for IoT (7 Hours)
Wireless communication fundamentals, IEEE 802.11, Bluetooth Low Energy, ZigBee, LoRaWAN, NB-IoT, Sigfox, 6LoWPAN, RPL, Industrial wireless networks, 5G support for massive machine type communication (mMTC), performance comparison of IoT networks.

Section II

Unit 4: Edge Based IoT Development (6 Hours)
Edge device architecture using Raspberry Pi/ESP32, sensor interfacing, embedded Linux for IoT devices, containerized deployment, API development, cloud–edge integration and performance optimization.

Unit 5: IoT Data Management and Cloud Platforms (7 Hours)
IoT data characteristics, SQL vs NoSQL databases, time-series databases, cloud platforms such as AWS IoT, Azure IoT, Google Cloud IoT, data ingestion pipelines, stream processing frameworks, security and privacy issues in IoT data management.

Unit 6: IoT Applications and Case Studies (6 Hours)

Smart home systems, smart city infrastructure, smart agriculture, industrial IoT, environmental monitoring, electric vehicle charging networks, system architecture analysis and emerging IoT research trends.

Experiment List :

1. Interfacing sensors with Raspberry Pi / ESP32.
2. IoT data acquisition using temperature, humidity and motion sensors.
3. Communication using MQTT protocol.
4. Implementation of REST API for IoT devices.
5. IoT device communication using Bluetooth / Wi-Fi.
6. Implementing cloud connectivity using AWS IoT / Azure IoT.
7. Real-time data visualization dashboard.
8. LoRa / LPWAN communication simulation.
9. Edge analytics on Raspberry Pi.
10. IoT security experiment – device authentication.

Mini Project / Project Based Learning (PBL)

Students will develop an IoT-based prototype addressing real-world problems such as smart agriculture monitoring, smart energy management, smart health monitoring, industrial monitoring systems, or environmental monitoring. The project must include hardware interfacing, data transmission, cloud integration, and a visualization dashboard.

Expected Outcomes

Students will be able to design, develop, and deploy IoT systems integrating sensors, communication protocols, edge devices, and cloud platforms while addressing scalability, security, and real-world application challenges.

Text Books:

1. Adrian McEwen and Hakim Cassimally“ Designing the Internet of Things “Wiley,2014. (UNIT I &V)
2. Oliver Hersent , David Boswarthick and Omar Elloumi “ The Internet of Things”, Wiley,2016 (UNIT II, III & UNIT V)
3. Peter Waher, “Learning Internet of Things”, Packt Publishing, 2015(UNIT IV)
4. Iot-Enabled Applications Third Edition, by Gerardus Blokdyk(Author)

Reference Books:

1. Jean-Philippe Vasseur, Adam Dunkels, “Interconnecting Smart Objects with IP: TheNextInternet” Morgan Kuffmann Publishers, 2010

2. ArshdeepBahga and VijaiMadisetti :A Hands-on Approach“Internet of Things”,UniversitiesPress 2015.

3. Samuel Greengard,“ The Internet of Things”, The MIT press, 2015 4. OvidiuVermesan and Peter Friess (Editors), “Internet of hings: Converging Technologies for Smart Environments and Integrated Ecosystems”, River Publishers Series in Communication,2013 5. https://www.coursera.org/specializations/iot

पुण्यश्लोक अहिल्यादेवी होळकर
सोलापूर विद्यापीठ
।। विद्यया संपन्नता ।।

Punyashlok Ahilyadevi Holkar Solapur University, Solapur

MTech (Computer Science & Engineering)
Semester-II
MTCSEPCC202 Internet Routing Algorithm

Teaching Scheme	Examination Scheme
Lectures–2 Hours/week, 3 Credits	ESE –70 Marks
Practical- 2 Hours/Week , 1 Credit	ISE – 30 Marks
	ICA- 25 Marks

SECTION-I

Unit-I Network Basics **(7)**

OSI Model, Network Hardware, Transmission media, Bridge, Router , Gateways, Network Software Components, MAC, Data Link Protocols, Switching Techniques TCP/IP Protocol suite.

Unit II : Networking and Network Routing **(7)**

Addressing and Internet Service: An Overview, Network Routing, IP Addressing, Service Architecture, Protocol Stack Architecture, Router Architecture, Network, Topology, Architecture, Network Management Architecture, Public Switched Telephone Network

Unit III : Routing Algorithms **(6)**

Shortest Path and Widest Path: Bellman–Ford Algorithm and the Distance Vector Approach, Dijkstra's

Algorithm, Widest Path Algorithm, Dijkstra-Based Approach, Bellman–Ford Based Approach, k-Shortest Paths Algorithm. OSPF and Integrated IS-IS : OSPF: Protocol Features, OSPF Packet Format, Integrated ISIS, Key Features, comparison BGP : Features ,Operations, Configuration Initialization, phases, Message Format. IP Routing and Distance Vector Protocol Family :RIPv1 and RIPv2

SECTION-II

Unit IV : Routing Protocols **(6)**

Framework and Principles Routing Protocol, Routing Algorithm, and Routing Table, Routing Information Representation and Protocol Message Vector Routing, Protocol, Link Cost.

s, Distance Vector Routing Protocol, Link State Routing Protocol, Path

Unit V : Internet Routing and Router Architectures **(6)**

Architectural View of the Internet, allocation of IP Prefixes and AS Number, Policy-Based Routing, Point of Presence, Traffic Engineering Implications, Internet Routing Instability. Router Architectures: Functions,

Types, Elements of a Router, Packet Flow, Packet Processing: Fast Path versus Slow Path, Router Architectures

Unit VI : Analysis of Network Algorithms **(6)**

Network Bottleneck, Network Algorithmics, Strawman solutions, Thinking Algorithmically, Refining the Algorithm, Cleaning up, Characteristics of Network Algorithms. IP Address Lookup Algorithms : Impact, Address Aggregation, Longest Prefix Matching, Naïve Algorithms, Binary , Multibit and Compressing Multibit Tries, Search by Length Algorithms, Search by Value Approaches, Hardware Algorithms, Comparing Different Approaches IP Packet Filtering and Classification : Classification, Classification Algorithms, Naïve Solutions, Two-Dimensional Solutions, Approaches for d Dimensions

Internal Continuous Assessment (ICA):

1. Network Routing – An Introduction through Implementation a. To setup Intranet : Installation and Configuration of Peer to Peer and Client Server models, Web server, E-mail, Proxy, Firewall and DNS Configurations b. Conversion of a simple machine into a router.

2. Routing Algorithms a. Bellman–Ford Algorithm and the Distance Vector Approach b. Comparison of the Bellman–Ford Algorithm and Dijkstra,,s Algorithm c. Shortest and Widest Path Computations

3. Routing Protocols a. Distance Vector Routing b. Link State Routing

4. Routing in IP networks a. RIP b. OSPF c. BGP

5. Internet Architecture a. Address Assignment b. Traffic Engineering c. Policy-Based Routing

6. Router Architectures a. Routing Functions b. Packet Processing

7. IP Address Lookup Algorithms

8. IP Packet Filtering and Classification

9. Quality of Service Routing

Text Books:

1. Network Algorithmic: An Interdisciplinary Approach to Designing Fast Networked Devices George Varghese (Morgan Kaufmann Series in Networking)

Reference Book:

1. Network Routing: Algorithms, Protocols, and Architectures Deepankar Medhi and Karthikeyan Ramasamy (Morgan Kaufmann Series in Networking)

Punyashlok Ahilyadevi Holkar Solapur University, Solapur

M. Tech (Computer Science & Engineering)
Semester-II
MTCSEPCC203 Deep Learning

Teaching Scheme
Lectures–3 Hours/week, 3 Credits
Practical- 2 Hours/Week , 1 Credit

Examination Scheme
ESE –70 Marks
ISE – 30 Marks
ICA- 25 Marks

Course Prerequisite:

A solid understanding of linear algebra, calculus, probability, and basic machine learning concepts. Prior knowledge of programming (Python), data structures, and foundational neural network principles is essential to grasp advanced deep learning techniques and architectures.

Course Objectives:

5. To provide an in-depth understanding of modern deep learning theories, architectures, and training techniques.
6. To analyze state-of-the-art models and their mathematical and computational foundations.
7. To explore current research trends, emerging technologies, and future directions in deep learning.
8. To develop skills for designing, implementing, and evaluating advanced neural network-based systems for various applications.

Course Outcomes:

After successful completion of the course, students will be able to:

5. Explain advanced deep learning architectures such as CNNs, RNNs, Transformers, and Autoencoders.
6. Critically analyze the design choices, training strategies, and limitations of modern neural networks.
7. Implement and evaluate complex models for tasks including image processing, natural language processing, and generative modeling.
8. Assess emerging trends like self-supervised learning, foundation models, and multimodal AI, and apply them to research and practical problems.

SECTION-I

Unit 1 Foundations of Neural Networks and Deep Learning (6)

Revisiting biological neurons and traditional models like McCulloch-Pitts, perceptrons, multilayer perceptrons, and their training algorithms. Covering activation functions (ReLU, GELU, Swish), normalization techniques (Batch, Layer, Group Norm), and the evolution towards deep architectures. Emphasizing the theoretical basis, capacity, and limitations of neural networks.

Unit 2 Modern Training and Regularization Techniques (6)

Exploring gradient-based optimization algorithms including SGD, Adam, RAdam, Lookahead, and techniques

like learning rate scheduling, warm restarts, and Sharpness-Aware Minimization. Discussing regularization methods such as Dropout, Data Augmentation, Cutout, MixUp, and normalization strategies to improve generalization.

Unit 3 Advanced Architectures and Model Variants (6)

Studying convolutional neural networks (ResNet, DenseNet, EfficientNet), attention mechanisms, Vision Transformers (ViT), and hybrid models. Analyzing architectural innovations like depthwise separable convolutions, residual connections, and neural architecture search (NAS). Covering applications in image classification, detection, and segmentation.

SECTION-II

Unit 4 Sequence Models and Transformers (6)

Covering RNNs, LSTMs, GRUs, and their limitations. Introducing transformer architectures, self-attention mechanisms, BERT, GPT series, and their applications in NLP, vision, and multimodal learning. Discussing efficiency improvements like sparse attention and long-range modeling.

Unit 5 Generative Models and Autoencoders (6)

Exploring Autoencoders (Denoising, Variational Autoencoders), GANs (StyleGAN, BigGAN), diffusion models, and their applications in high-fidelity image synthesis, image editing, and data augmentation. Covering the principles of generative modeling and evaluation metrics.

Unit 6 Emerging Trends and Research Directions (6)

Discussing recent advancements such as self-supervised learning, foundation models (GPT, BERT, CLIP), multimodal models, quantum deep learning, and Federated Learning. Analyzing current challenges, open problems, and potential future research directions in deep learning.

Internal Continuous Assessment (ICA) :

Minimum 6 to 7 assignments based on above topics.

Text books:

3. Goodfellow I, Bengio Y, Courville A, Bengio Y. Deep learning. Cambridge: MIT press; 2016 Nov 18.
4. Aggarwal CC. Neural networks and deep learning. Cham: Springer; 2018 Sep.

ReferenceBooks:

Nielsen MA. Neural networks and deep learning. San Francisco, CA, USA: Determination press; 2015 Sep 25.

Punyashlok Ahilyadevi Holkar Solapur University, Solapur

M. Tech (Computer Science & Engineering)
Semester-II
Programming Elective Course-II
MTCSEPEC204A Blockchain Technology

Teaching Scheme	Examination Scheme
Lectures–3 Hours/week, 3 Credits	ESE –70 Marks
Practical- 2 Hours/Week , 1 Credit	ISE – 30 Marks
	ICA- 25 Marks

COURSE OUTCOMES: At the end of this course students will be able to –

1. Describe the basic concepts and technology used for blockchain.
2. Describe the primitives of the distributed computing and cryptography related to blockchain.
3. Illustrate the concepts of Bitcoin and their usage.
4. Implement Ethereum block chain contract.
5. Apply security features in blockchain technologies.
6. Use smart contract in real world applications.

SECTION-I

Unit I: Basics **(8)**

Distributed Database, Two General Problem, Byzantine General problem and Fault Tolerance, Hadoop Distributed File System, Distributed Hash Table, ASIC resistance, Turing Complete. • Cryptography: Hash function, Digital Signature - ECDSA, Memory Hard Algorithm, Zero Knowledge Proof.

Unit II: Blockchain **(7)**

Introduction, Advantage over conventional distributed database, Blockchain Network, Mining Mechanism, Distributed Consensus, Merkle Patricia Tree, Gas Limit, Transactions and Fee, Anonymity, Reward, Chain Policy, Life of Blockchain application, Soft & Hard Fork, Private and Public blockchain.

Unit III: Distributed Consensus **(7)**

Nakamoto consensus, Proof of Work, Proof of Stake, Proof of Burn, Difficulty Level, Sybil Attack, Energy utilization and alternate.

SECTION-II

Unit IV: Cryptocurrency: **(8)**

History, Distributed Ledger, Bitcoin protocols - Mining strategy and rewards, Ethereum - Construction, DAO, Smart Contract, GHOST, Vulnerability, Attacks, Sidechain, Namecoin

Unit V: Cryptocurrency Regulation: **(8)**

Stakeholders, Roots of Bit coin, Legal Aspects-Crypto currency Exchange, Black Market and Global Economy.

Unit VI : Applications **(7)**

Internet of Things, Medical Record Management System, Domain Name Service and future of Walchand Institute of Technology M.Tech.(CSE) syllabus wef 2023-24 Page 28 Blockchain.

Internal Continuous Assessment (ICA) : Assignments: Minimum 5 to 6 assignments based on above topics.

Text Book

1. Arvind Narayanan, Joseph Bonneau, Edward Felten, Andrew Miller and Steven Goldfeder, Bitcoin and Cryptocurrency Technologies: A Comprehensive Introduction, Princeton UniversityPress (July 19, 2016). -

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Reference Books:

1. Antonopoulos, Mastering Bitcoin: Unlocking Digital Cryptocurrencies
2. Satoshi Nakamoto, Bitcoin: A Peer-to-Peer Electronic Cash System
3. DR. Gavin Wood, “ETHEREUM: A Secure Decentralized Transaction Ledger,”Yellowpaper.2014.
4. Nicola Atzei, Massimo Bartoletti, and Tiziana Cimoli, A survey of attacks on Ethereum smart contracts

पुण्यश्लोक अहिल्यादेवी होळकर
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Punyashlok Ahilyadevi Holkar Solapur University, Solapur

M. Tech (Computer Science & Engineering)
Semester-II
Programming Elective Course-II
MTCSEPEC204B Computer Vision

Teaching Scheme
Lectures–3 Hours/week, 3 Credits
Practical- 2 Hours/Week , 1 Credit

Examination Scheme
ESE –70 Marks
ISE – 30 Marks
ICA- 25 Marks

SECTION-I

Unit 1 (8)

Overview, computer imaging systems, lenses, Image formation and sensing, Image analysis, pre-processing and Binary image analysis

Unit 2 (8)

Edge detection, Edge detection performance, Hough transform, corner detection

Unit 3 (8)

Segmentation, Morphological filtering, Fourier transform

SECTION-II

Unit 4 (8)

Feature extraction, shape, histogra , color, spectral, texture, using CVIPtools, Feature analysis, feature vectors, distance /similarity measures, data preprocessing

Unit 5 (9)

Pattern Analysis: Clustering: K-Mea s, K-Medoids, Mixture of Gaussians Classification: Discriminant Function, Supervised, Un-supervised, Semisupervised Classifiers: Bayes, KNN, ANN models; Dimensionality Reduction: PCA, LDA, ICA, and Non-parametric methods.

Unit 6 (4)

Recent trends in Activity Recognitio , computational photography, Biometrics.

Internal Continuous Assessment (ICA):

ICA shall be based upon minimum 6 assignments based upon above curriculum

Reference Books:

1. Computer Vision: Algorithms and Applications by Richard Szeliski.

2. Deep Learning, by Goodfellow, B ngio, and Courville. 3. Dictionary of Computer Vision and Image Processing, by Fisher et al.

Punyashlok Ahilyadevi Holkar Solapur University, Solapur

M. Tech (Computer Science & Engineering)
Semester-II
Programming Elective Course-II
MTCSEPEC204C High Performance Computing

Teaching Scheme
Lectures–3 Hours/week, 3 Credits
Practical- 2 Hours/Week , 1 Credit

Examination Scheme
ESE –70 Marks
ISE – 30 Marks
ICA- 25 Marks

SECTION-I

Unit 1: Introduction to Parallel Processing (7)

Levels of Parallelism (instruction, transaction, task, thread, memory, and function), Models (SIMD, MIMD, SIMT, SPMD, Data Flow Models, Demand-driven Computation). HPC Platforms: Message-passing interface (MPI), Shared-memory thread-based OpenMP programs, hybrid (MPI/Open MP) programs, Grid Computing, Cloud Computing, Multi-Core Processors, accelerators, GPGPUs.

Unit 2: Parallel Programs (8)

The Parallelization Process: Steps in the process, Parallelizing computation versus data, Goals of the

Parallelization Process, Parallelization of an Example Program: The equation solver kernel, Decomposition, Assignment, Orchestration: under the data parallel model, under the shared address space model and under the message passing model.

Unit 3: Parallel Models, Languages and Compiler (8) Parallel Programming Models: Shared Variable Model, Message Passing Model, Data Parallel Model, Object Oriented Model and Functional and Logic Models. Parallel Languages and Compilers: Language Features for Parallelism, Parallel Language Constructs, Optimizing Compilers for Parallelism. Loop Parallelism and Pipelining: Loop transaction theory, Parallelization and wavefronting, Tiling and Localization and Software Pipelining.

SECTION-II

Unit 4: Parallel Program Development and Environment **(**7)

Parallel Programming Environments: Software tools and environments, Y-MP, Paragon and CM-5

Environment, Visualization and Performance Tuning. Synchronization and Multiprocessing Models: Principles of Synchronization, Multiprocessor Execution Models, Multitasking on Cray Multiprocessors. Shared Variable Program Structures: Lock for protected access, Semaphores and Applications, Monitors and Applications.

Unit 5: Shared Memory Multiprocessor (8)

Cache Coherence: The Cache Coherence Problem, Cache Coherence through Bus Snooping. Memory Consistency: Sequential Consistency, Sufficient Conditions for Preserving Sequential Consistency. Synchronization: Components of a Synchronization event, Role of the user and Program, Mutual

exclusion, Point to Point Event Synchronization, Global(Barrier) Event Synchronization.

Unit 6: Interconnection Network Design (7)

Basic Communication Performance: Latency, Bandwidth. Organizational Structure: Links, Switches and Network Interface. Interconnection Topology: Fully connected network, Linear array and rings, Multidimensional Meshes and Tori, Trees, Butterflies and Hypercube. Routing: Routing Mechanisms, Deterministic Routing, Turn-Model Routing and Adaptive Routing.

Internal Continuous Assessment (ICA):

Minimum 6 assignments based on above topics.

Text books:

1. Ananth Grama, Anshul Gupta, George Karypis, Vipin Kumar, “Introduction to Parallel Computing”, Pearson Education, Second Edition, 2007.
2. Kai Hwang, Naresh Jotwani, “Advanced Computer Architecture: Parallelism, Scalability, Programmability”, McGraw Hill, Second Edition, 2010.
3. David Culler Jaswinder Pal Singh, "Parallel Computer Architecture: A hardware/Software Approach", Morgan Kaufmann,1999.

Reference Books:

1. Kai Hwang, "Scalable Parallel Computing", McGraw Hill 1998.
2. George S. Almasi and Alan Gottlieb, "Highly Parallel Computing", The Benjamin and Cummings Pub. Co., Inc
3. Georg Hager, Gerhard Wellein, “Introduction to High Performance Computing for Scientists and Engineers", Chapman & Hall / CRC Computational Science series, 2011.

Michael J. Quinn, “Parallel Programming in C with MPI and OpenMP”, McGraw-Hill International Editions, Computer Science Series, 2008.

सोलापूर विद्यापीठ

Punyashlok Ahilyadevi Holkar Solapur University, Solapur

M. Tech (Computer Science & Engineering)
Semester-II
Programming Elective Course-III
MTCSEPEC205A Data Science

Teaching Scheme	Examination Scheme
Lectures–3 Hours/week, 3 Credits	ESE –70 Marks
Tutorial-1 Hours/week	ISE – 30 Marks
	ICA- 25 Marks

COURSE OUTCOMES: At the end of the course the student will be able to:

1. Define data science and its fundamentals
2. Demonstrate the process in data science
3. Explain machine learning algorithms necessary for data sciences
4. Illustratetheprocessoffeatureselectionandanalysisofdataanalysisalgorithms
5. Visualize the data and follow of ethics

SECTION - I

Unit 1 - Introduction **(7)**

Introduction: What is Data Science? Big Data and Data Science hype – and getting past the hype, Why now? – Data fication, Current landscape of perspectives, Skill sets. Needed Statistical Inference: Populations and samples, Statistical modeling, probability distributions, fitting a model, -Introduction to R

Unit 2 – Exploratory Data Analysis **(7)**

Exploratory Data Analysis and the Data Science Process: Basic tools (plots, graphs and summary statistics) of EDA, Philosophy of EDA. The Data Science Process, Case Study: Real Direct (on line real estate firm). Three Basic Machine Learning Algorithms: Linear Regression, k-Nearest Neighbors (k-NN), k-means

Unit 3 – Machine Learning Algorithms **(7)**

One More Machine Learning Algorithm and Usage in Applications: Motivating application: Filtering Spam, Why Linear Regression and k-N Narepoor choices for Filtering Spam, Naïve Bayes and why it works for Filtering Spam, Data Wrangling:APIs and other tools for scrapping the Web

SECTION – II

Unit 4 – Feature Generation **(8)**

Feature Generation and Feature Selection (Extracting Meaning from Data): Motivating application: user (customer) retention. Feature Generation (brainstorming, role of domain expertise, and place for imagination), Feature Selection algorithms. Filters; Wrappers; Decision Trees; Random Forests.

Unit 5 - Recommendation Systems **(6)**

Recommendation Systems: Building a User-Facing Data Product, Algorithmic ingredients of a Recommendation Engine, Dimensionality Reduction, Singular Value Decomposition, Principal Component Analysis, Exercise: build your own recommendation system

Unit 6 – Data Visualization **(9)**

Mining Social-Network Graphs: Social networks as graphs, Clustering of graphs, Direct discovery of communities in graphs, Partitioning of graphs, Neighbourhood properties in graphs, Data Visualization: Basic principles, ideas and tools for data visualization. Data Scienceand Ethical Issues, Discussions on privacy, security, ethics, Next-generation data scientists

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Internal Continuous Assessment (ICA) ICA shall be based upon minimum 5-6 assignments based upon above curriculum.

Textbooks

1. Doing Data Science, Cathy O"Neil and Rachel Schutt, Straight Talk from The, Frontline.O"Reilly, 2014
2. Mining of Massive Datasets. V2.1 Jure Leskovek, AnandRajaraman and Jeffrey Ullman,Cambridge University Press, 2014

Reference Books

1. Data Mining : Concepts and Techniques Jiawei Han, Micheline Kamber and Jian Pei, Third Edition, 2012.
2. Machine Learning: A Probabilistic Perspective, Kevin P. Murphy, 2013

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Punyashlok Ahilyadevi Holkar Solapur University, Solapur

M. Tech (Computer Science & Engineering)
Semester-II
Programming Elective Course-III
MTCSEPEC205B Advanced Cloud Computing

Teaching Scheme	Examination Scheme
Lectures–3 Hours/week, 3 Credits	ESE –70 Marks
Tutorial- 1hours/week	ISE – 30 Marks
	ICA- 25 Marks

SECTION I

Unit 1 Computing Paradigms & Strategic Evolution (5)

Evolution from Distributed Systems to Cluster, Grid, Utility and Cloud Computing, Cloud as an Economic Utility Model, Business Drivers: CAPEX vs OPEX, Cost Modeling and ROI, Sustainability and Green Cloud Computing (Energy efficiency and carbon footprint of data centers), NIST Cloud Model: Critical analysis of 5 characteristics, 3 service models, 4 deployment models, Vendor Lock-in Mitigation Strategies

Unit-II Cloud-Native Architecture & Micro services **(6)**

Architectural evolution: From Monolithic and Client-Server architectures to Service-Oriented Architecture (SOA) and Cloud-Native Micro services, Cloud Computing Stack: Layered abstraction and hierarchical interaction among IaaS, PaaS, and SaaS, Role of Web Services: RESTful APIs, API Gateways in cloud workload orchestration, Cloud Infrastructure Internals: Virtual Networking (VPC), Subnets, Route Tables, and Global Edge Locations

Unit-III Infrastructure as a Service (IaaS) & Modern Virtualization **(7)**

Advanced Virtualization: Type-1 and Type-2 hypervisors, hardware-assisted and nested virtualization, Containerization Paradigm: Docker fundamentals; Container images vs Machine images (AMI) Container Orchestration: Kubernetes architecture (Control Plane and Worker Nodes), Pods, Services, Deployments, Public Cloud Implementations: Amazon EC2 (Compute Units, Spot/Reserved instances), Azure Virtual Machines, Google Compute Engine

SECTION II

Unit 4 Platform as a Service (PaaS) & Serverless Computing **(7)**

Advanced PaaS: Application runtimes, middleware architectures, and managed development environments (Force.com, Azure App Service), Serverless Computing (FaaS): Event-driven architectures; deep dive into AWS Lambda, Azure Functions, and Google Cloud Functions, Cloud Storage Architectures: Object storage, Block storage, and File storage as a Service

Unit 5 Cloud Operations, FinOps & Performance **(6)**

Economics of Scale: FinOps principles, cost optimization strategies, tagging and resource governance, Service Level Management: SLAs, SLOs, SLIs; billing, metering, and chargeback models, Observability and AIOps: Metrics, logs, traces; AI-driven automation of cloud operations, Large-Scale Data Processing: Cloud-native MapReduce, Apache Spark on cloud platforms, Large-Scale Data Processing: Cloud-native MapReduce, Apache Spark on cloud platforms

Unit 6 Cloud Security & Governance **(7)**

Zero Trust Architecture: Identity-centric security models, IAM policies, least privilege, RBAC and ABAC, Shared Responsibility Model: Security "of" the cloud vs. security "in" the cloud, Data Protection: Encryption at rest and in transit; Key Management Systems (KMS); Hardware Security Modules (HSM), Governance & Compliance: Cloud Security Posture Management (CSPM); GDPR, HIPAA, and India's DPDP Act Emerging Frontiers: Security challenges in Edge/Fog Computing; Introduction to Quantum Cloud Computing

Internal Continuous Assessment (ICA):

Minimum 6 to 7 assignments based on above topics.

Text books:

1. "Cloud Computing: Concepts, Tech & Architecture" by Thomas Erl (Updated for Cloud-Native).
2. "Kubernetes: Up and Running" by Brendan Burns.
3. "Cloud FinOps" by J.R. Storment and Mike Fuller.

ReferenceBooks:

1. Cloud Computing: Concepts, Technology, Security & Architecture (2nd Edition, 2024) * Authors: Thomas Erl, Eric Barcelo.

पुण्यश्लोक अहिल्यादेवी होळकर
सोलापूर विद्यापीठ
।। विद्या संपन्नता ।।

Punyashlok Ahilyadevi Holkar Solapur University, Solapur

M. Tech (Computer Science & Engineering)
Semester-II
Programming Elective Course-III
MTCSEPEC205C Wireless Sensor Network

Teaching Scheme	Examination Scheme
Lectures–3 Hours/week, 3 Credits	ESE –70 Marks
Tutorial-1 Hours/week	ISE – 30 Marks
	ICA- 25 Marks

SECTION-I

Unit 1: Introduction to WSN **(8)**

Introduction to WSN, Basic Overview of the Technology, Basic Sensor Network Architectural Elements, Brief Historical Survey of Sensor Networks, Challenges and Hurdles, Applications of Wireless Sensor Networks, Range of Applications and Category 1 WSN Applications: Sensor and Robots, Reconfigurable Sensor Networks, Highway Monitoring, Wildfire Instrumentation, Nanoscopic Sensor Applications, Habitat Monitoring, Category 2 WSN Applications: Home Control, Building Automation, Industrial Automation, Medical Applications, Smart City Monitoring.

Unit 2: Basic Wireless Sensor Technology **(8)**

Introduction, Sensor Node Technology, Hardware and Software, Sensor Taxonomy, WN Operating Environment, WN Trends, Introduction to Wireless Transmission Technology and Systems, Radio Technology Primer, Propagation and Propagation Impairments, Modulation, Available Wireless Technologies, Campus Applications, MAN/WAN Applications.

Unit 3: Factors Influencing WSN design **(4)**

Hardware Constraints, Fault Tolerance, Scalability, Production Costs, WSN Topology: Pre- deployment and Deployment Phase, Post-deployment Phase, Re-deployment Phase of Additional Nodes, Transmission Media, Power Consumption, Sensing, Data Processing, Communication.

SECTION-II

Unit 4: Physical layer **(6)**

Introduction to Wireless channel and communication fundamentals: Frequency allocation, Modulation and demodulation, Wave propagation effects and noise, Channel models, Spread- Spectrum communications, Packet transmission and synchronization, Quality of wireless channels and measures for improvement, Physical layer and transceiver design considerations in WSNs: Energy usage profile, Choice of modulation scheme, Dynamic modulation scaling, Antenna considerations, Green communication techniques.

Unit 5: MAC protocols and Link-layer protocols **(4)**

Fundamentals of (wireless) MAC protocols, Low duty cycle protocols and wakeup concepts, Contention based protocols, Schedule-based protocols, The IEEE 802.15.4 MAC protocol, Link- layer protocols: Fundamentals tasks and requirements, Error control, Framing, Link management, Security at MAC layer, Time synchronization in MAC.

Unit 6: Network Layer and Transport Layer **(8)**

Challenges for Routing, Data-centric and Flat-Architecture Protocols, Hierarchical Protocols, Geographical Routing Protocols, QoS-Based Protocols Transport Layer, Challenges for Transport Layer, Reliable Multi-Segment Transport (RMST) Protocol, Pump Slowly, Fetch Quickly (PSFQ) Protocol, Congestion Detection and Avoidance (CODA) Protocol, Event-to-Sink Reliable Transport (ESRT) Protocol, GARUDA, Real-Time and Reliable Transport Protocol.

Internal Continuous Assessment (ICA):

Minimum 5-6 assignments on above mentioned syllabus.

Text books:

1. Protocols & Architectures for Wireless Sensor Networks by Holger Karl, Andreas Willig, Wiley, 2005
2. Wireless Sensor Networks: Technology, Protocols, and Applications by Kazem Sohraby, Daniel Minoli, Taieb Znati
3. Wireless Sensor Networks by Ian F. Akyildiz, Mehmet Can Vuran, A John Wiley and Sons, Ltd, Publication

Reference Books:

1. Wireless sensor networks Edited by C. S. Raghavendra Pub: Springer
2. Carlos de Morais Cordeiro and Dharma Prakash Agrawal, “Ad Hoc and Sensor Networks: Theory and Applications”, Second Edition, World Scientific Publishers, 2011
Jagannathan Sarangapani, Wireless Ad hoc and Sensor Networks: Protocols, Performance, and Control, CRC Press, 2007