



Shri Vaishnav Vidyapeeth Vishwavidyalaya, Indore

Shri Vaishnav Institute of Information Technology

Choice Based Credit System (CBCS) in the light of NEP-2020

B. Tech (CSE/ IT) - All Programs

SEMESTER-V (2024-28)

COURSE CODE	CATEGORY	COURSE NAME	TEACHING & EVALUATION SCHEME					L	T	P	CREDITS
			THEORY			PRACTICAL					
			END SEM University Exam	Two Term Exam	Teachers Assessment*	END SEM University Exam	Teachers Assessment*				
BTCS501N	DCC	Theory of Computation	60	20	20	-	-	3	1	-	4

Legends: L - Lecture; T - Tutorial/Teacher Guided Student Activity; P – Practical; C - Credit; *Teacher Assessment shall be based following components: Quiz/Assignment/ Project/Participation in Class, given that no component shall exceed more than 10 marks.

COURSE OBJECTIVES:

The student will have ability to:

1. Introduce concepts in automata theory and theory of computation.
2. Identify different formal language classes and their relationships.
3. Design grammar and recognizers for different formal languages.

COURSE OUTCOMES:

Upon completion of the subject, students will be able to:

1. Relate practical problems to languages, automata, and computability.
2. Demonstrate an increased level of mathematical sophistication.
3. Apply mathematical and formal techniques for solving problems.

SYLLABUS

UNIT I

10 HOURS

Introduction: Alphabets, Strings and Languages; Automata and Grammars, Deterministic finite Automata (DFA)- Formal Definition, Simplified notation: State transition graph, Transition table, Language of DFA, Nondeterministic finite Automata (NFA), NFA with epsilon transition, Language of NFA, Equivalence of NFA and DFA, Minimization of Finite Automata, Distinguishing one string from other, Myhill- Nerode Theorem.

UNIT II

8 HOURS

Regular Expression (RE): Definition, Operators of regular expression and their precedence, Algebraic laws for Regular expressions, Kleene's Theorem, Regular expression to FA, DFA to Regular expression, Arden's Theorem, Non Regular Languages, Pumping Lemma for regular Languages. Application of Pumping Lemma, Closure properties of Regular Languages, Decision properties of Regular Languages, FA with output: Moore and Mealy machine, Equivalence of Moore and Mealy Machine, Applications and Limitation of FA.

UNIT III

9 HOURS

Context Free Grammar (CFG) and Context Free Languages (CFL): Definition, Examples, Derivation, Derivation trees, Ambiguity in Grammar, Inherent ambiguity, Ambiguous to Unambiguous CFG, Useless symbols, Simplification



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of CFGs, Normal forms for CFGs: CNF and GNF, Closure properties of CFLs, Decision Properties of CFLs: Emptiness, Finiteness and Membership, Pumping lemma for CFLs.

UNIT IV

9 HOURS

Push Down Automata (PDA): Description and definition, Instantaneous Description, Language of PDA, Acceptance by Final state, Acceptance by empty stack, Deterministic PDA, Equivalence of PDA and CFG, CFG to PDA and PDA to CFG.

UNIT V

9 HOURS

Turing machines (TM): Basic model, definition and representation, Instantaneous Description, Language acceptance by TM, Variants of Turing Machine, TM as Computer of Integer functions, Universal TM, Church's Thesis, Recursive and recursively enumerable languages, Halting problem, Introduction to undecidability, undecidable problems about TM, NP hard and NP complete problem, Post correspondence problem (PCP), Modified PCP, Introduction to recursive function theory.

TEXTBOOKS:

1. J. E. Hopcraft, R. Motwani and J. D. Ullman, *Introduction to Automata Theory, Languages, and Computation*, 3rd Ed., Pearson, 2013.
2. P. Linz, S. H. Rodger, *An Introduction to Formal Languages and Automata*, 7th Ed., Jones & Bartlett Learning, 2023.

REFERENCE:

1. J. C. Martin, *Introduction to Languages and Theory of Computations*, 4th Ed., Tata McGraw Hill, 2010.
2. C. Papadimitriou, and C. L. Lewis, *Elements of the Theory of Computation*, PHI, 1997.
3. M. Sipser, *Introduction to Theory of Computation*, 3rd Ed., Cengage Learning, 2013.
4. https://onlinecourses.nptel.ac.in/noc26_cs85/preview
5. https://www.youtube.com/watch?v=_2w9UX17m_k&list=PLbRMhDVUMngcwWkzVTm_kFH6JW4JCtAUM (NPTEL)



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BTCSS502N	DCC	Introduction to Artificial Intelligence	60	20	20	30	20	3	0	2	4

Legends: L - Lecture; T - Tutorial/Teacher Guided Student Activity; P – Practical; C - Credit; *Teacher Assessment shall be based following components: Quiz/Assignment/ Project/Participation in Class, given that no component shall exceed more than 10 marks.

COURSE OBJECTIVES:

The student will have ability to:

1. Know how computer system adapts, evolves and learns
2. Gain expertise in one of fastest growing areas of Computer Science that covers topics related to human intelligence and its applications in industry, defense, healthcare, agriculture and many other areas.
3. Provides a rigorous, advanced and professional graduate-level foundation in Artificial Intelligence

COURSE OUTCOMES:

Upon completion of the subject, students will be able to:

1. Build intelligent agents for search and games
2. Solve AI problems through programming with Python
3. Learning optimization and inference algorithms for model learning
4. Design and develop programs for an agent to learn and act in a structured environment

SYLLABUS

UNIT I

9 HOURS

Introduction: Concept of AI, history, current status, scope, agents, environments, Problem Formulations, Review of tree and graph structures, State space representation, Search graph and Search tree.

UNIT II

9 HOURS

Search Algorithms: Random search, Search with closed and open list, Depth first and Breadth first search, Heuristic search, Best first search, A* algorithm, Game Search.

UNIT III

9 HOURS

Probabilistic Reasoning: Probability, conditional probability, Bayes Rule, Bayesian Networks- representation, construction and inference, temporal model, hidden Markov model.

UNIT IV

9 HOURS

Markov Decision Process: MDP formulation, utility theory, utility functions, value iteration, policy iteration and partially observable MDPs.

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UNIT V

9 HOURS

Reinforcement Learning: Passive reinforcement learning, direct utility estimation, adaptive dynamic programming, temporal difference learning, active reinforcement learning- Q learning.

TEXTBOOKS:

1. S. Russell and P. Norvig, *Artificial Intelligence: A Modern Approach*, 3rd ed. Upper Saddle River, NJ, USA: Prentice Hall, 2010.
2. E. Rich and K. Knight, *Artificial Intelligence*. New Delhi, India: Tata McGraw-Hill, 1991.

REFERENCE:

1. M. C. Trivedi, *A Classical Approach to Artificial Intelligence*. Delhi, India: Khanna Publishing House, 2010.
2. S. Kaushik, *Artificial Intelligence*. Delhi, India: Cengage Learning India, 2011.
3. D. Poole and A. Mackworth, *Artificial Intelligence: Foundations for Computational Agents*. Cambridge, U.K.: Cambridge University Press, 2010.
4. <https://nptel.ac.in/courses/106105077>
5. <https://nptel.ac.in/courses/106106126>
6. <https://aima.cs.berkeley.edu>
7. https://ai.berkeley.edu/project_overview.html

LIST OF PRACTICALS

1. Write a program to conduct uninformed and informed search.
2. Write a program to conduct game search.
3. Write a program to construct a Bayesian network from given data.
4. Write a program to infer from the Bayesian network.
5. Write a program to run value and policy iteration in a grid world.
6. Write a program to do reinforcement learning in a grid world.
7. Mini Project work.

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BTIT301N	DCC	Computer Networks	60	20	20	30	20	3	0	2	4

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COURSE OBJECTIVES:

The student will have ability to:

1. Understand the general overview of the concepts and fundamentals of computer networks.
2. Understand the various components required to build different networks.
3. Familiarize the students with the standard models for the layered approach to communication between machines in a network and the protocols of the various layers.

COURSE OUTCOMES:

Upon completion of the subject, students will be able to:

1. Understanding basic computer network technology.
2. Understand the functions of each layer in the OSI and TCP/IP reference model.
3. Obtain the skills of subnetting and routing mechanisms.
4. Familiarity with the essential protocols of computer networks, and how they can be applied in network design and implementation.

SYLLABUS

UNIT I

9 HOURS

Introduction: Importance of Computer Networks, Classifications & Types. Layered Architecture: Protocol hierarchy, Interfaces and Services, Connection Oriented & Connection less Services, ISO- OSI Reference Model, TCP/IP model overview, comparison of TCP/IP and ISO-OSI reference model.

UNIT II

9 HOURS

Data Link Layer & MAC Sublayer: Need, Services Provided, Design issues, Elementary data link protocols: simplex protocol, A simplex stop and wait protocol for an error-free channel, A simplex stop and wait protocol for noisy channel. Sliding Window protocols: A one-bit sliding window protocol, A protocol using Go-Back-N, A protocol using Selective Repeat, MAC Addressing, Binary Exponential Back-off (BEB) Algorithm, Distributed Random Access Schemes/Contention Schemes: for Data Services (ALOHA and Slotted- ALOHA), CSMA, CSMA/CA, CSMA/CD.

UNIT III

9 HOURS

Network Layer: Need, Services Provided, Design Issues, Routing Algorithms and types of Routing Algorithm,

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IPv4, IPv6, Classful and classless Addressing, Subnetting, Supernetting.

UNIT IV

10 HOURS

Transport Layer: Need, Design Issues, Multiplexing and Demultiplexing, transport layer services, UDP, UDP Header Format, Principles of reliable data transfer, TCP, Connection Management, TCP Flow Control, TCP Congestion Control, TCP Header Format, TCP Timer Management, SCTP.

UNIT V

8 HOURS

Session layer: Overview, Authentication, Session layer protocols.

Presentation layer: Overview, Data conversion, Encryption and Decryption, Presentation layer protocols (LPP, Telnet, X.25 packet Assembler/Disassembler).

Application Layer: Domain name system, SNMP, Electronic Mail; the World WEB, HTTP, FTP.

TEXTBOOKS:

1. Andrew S Tanenbaum, *Computer Networks*, 6thEd., Pearson Education, 2016.
2. Behrouz A. Forouzan, *TCP/IP-Protocol suite*, 4th Ed., McGraw-Hill, 2010.

REFERENCE:

1. William Stallings, *Data and Computer Communication*, 10th Ed., Pearson, 2014.
2. Comer, *Internet working with TCP/IP Volume one*, Addison-Wesley, 2015.
3. W. Richard Stevens, *TCP/IP Illustrated, Volume 1*, 2nd Ed., Addison-Wesley Professional Computing Series.

LIST OF PRACTICALS

1. Demonstrate Different Types of Network Equipment's.
2. Color coding standard of CAT 5, 6, 7 and crimping of cable in RJ-45.
3. LAN installations and Configurations.
4. Experiment with basic Network configuration commands.
5. Write a program for error detection and correction technique.
6. Write a program for framing.
7. Write a program for routing algorithm.
8. Socket Programming.

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9. Study about different network simulators.
10. Establish and simulate peer to peer network using packet tracer.
11. Simulate LAN using hub and switch and discuss pros and cons of hub.
12. Router configuration using packet tracer.

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B. Tech CSE (AIML-Microsoft)

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BTAIML510	DSE	Deep Learning	60	20	20	30	20	3	0	2	4

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COURSE OBJECTIVES:

The student will have ability to:

1. To provide understanding of deep learning concepts, neural networks, and model architectures for AI applications while building a strong foundation for advanced learning.
2. To train the students to design, develop, and train deep learning models using practical workflows with focus on real-world implementation using modern tools.
3. To introduce frameworks such as Py Torch and Tensor Flow to enable efficient model development, training, and evaluation.
4. To develop ability to solve real-world problems using deep learning in vision, text, and data domains through application-driven learning.
5. To prepare students for careers in AI, deep learning, and Generative AI by supporting industry readiness and research skills.

COURSE OUTCOMES:

Upon completion of the subject, students will be able to:

1. Explain basic concepts of deep learning and neural networks.
2. Build models for regression and classification tasks.
3. Apply CNN for image classification problems.
4. Use RNN, LSTM, and Seq2Seq for sequence tasks.
5. Build and use Transformer and BERT models for text tasks.

SYLLABUS

UNIT I

9 HOURS

Foundations of Deep Neural Networks: Introduction to Deep Learning, Why Deep Learning, Neural Networks overview, Architecture of Neural Networks, Building blocks of Deep Neural Networks, Forward propagation and Backward propagation, Activation functions, Loss functions, Gradient Descent (intuitive), Parameters vs Hyperparameters, Optimization techniques.

UNIT II

9 HOURS

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Deep Learning Frameworks: Computation graphs, Vectorization, Introduction to PyTorch, Introduction to TensorFlow, Model building using PyTorch, Training loop implementation, Regression task, Classification Task- Debugging training issues, Basic experiment tracking

UNIT III

9 HOURS

Convolutional Neural Networks and Representation Learning: Introduction to Convolutional Neural Networks, Convolution operation and filters, Feature maps and pooling, CNN architecture, Image classification using CNN, Transfer learning (pretrained models)- Autoencoders, Encoder–decoder architecture, Latent space representation, Reconstruction loss, Denoising autoencoders

UNIT IV

9 HOURS

Sequence Models: Need for sequence models, Recurrent Neural Networks (RNN), Limitations of RNN, Long Short-Term Memory (LSTM), Gated Recurrent Unit (GRU), Sequence to Sequence (Seq2Seq) modelling

UNIT V

9 HOURS

Transformers and Generative AI: Limitations of RNN and LSTM, Attention mechanism, Transformer architecture – Encoder, Decoder, Self-attention, Positional encoding, Pretrained Models – BERT – BERT Fine Tuning.

TEXTBOOKS:

1. I. Goodfellow, Y. Bengio, and A. Courville, *Deep Learning*. Cambridge, MA, USA: MIT Press, 2016.
2. A. Zhang, Z. C. Lipton, M. Li, and A. J. Smola, *Dive into Deep Learning*. Cambridge, U.K.: Cambridge University Press, 2023.

REFERENCE:

1. F. Chollet, *Deep Learning with Python*, 2nd ed. Shelter Island, NY, USA: Manning Publications, 2021.
2. A. Géron, *Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow*, 2nd ed. Sebastopol, CA, USA: O'Reilly Media, 2022.
3. S. Raschka, *Build a Large Language Model (From Scratch)*. Shelter Island, NY, USA: Manning Publications, 2024.

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4. D. Foster, *Generative Deep Learning: Teaching Machines to Paint, Write, Compose, and Play*. Sebastopol, CA, USA: O'Reilly Media, 2019.

LIST OF PRACTICALS

1. Predicting house prices using Regression with PyTorch
2. Classification using Artificial Neural Networks
3. Image classification using Convolutional Neural Networks
4. Object detection using Convolutional Neural Networks
5. Image denoising using Autoencoders
6. Sentiment analysis using RNN/LSTM
7. Sequence to sequence modelling for text generation
8. Text generation using Small Language Models
9. BERT Fine-tuning for Text Classification

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BTDSE512N	DSE	Software Testing and Quality Assurance	60	20	20	30	20	3	0	2	4

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COURSE OBJECTIVES:

The student will have ability to:

1. Develop a skill in developing good quality in the software product.
2. Develop methods and procedures for software development that can scale up large systems and that can be used to consistently produce high-quality software at low cost and with a small cycle time.
3. Learn systematic approach to the operation, maintenance, and retirement of software.
4. Learn how to use available resources to develop software, reduce cost of software and how to maintain quality of software.
5. Methods and tools of testing and maintenance of software.

COURSE OUTCOMES:

Upon completion of the subject, students will be able to:

1. Apply approach to Software Testing & QA concepts.
2. Apply modern software testing processes in relation to software development and project management.
3. Create test strategies and plans, design test cases prioritize and execute them.
4. Manage defects within a project.
5. Contribute to efficient delivery of software solutions and implement improvements in the software development processes.

SYLLABUS

UNIT I

10 HOURS

BASIC CONCEPTS: Basic Testing Vocabulary, Quality Assurance versus Quality Control, The Cost of Quality, Software Quality Factors, Software Defect, The Multiple Roles of the Software Tester(People Relationships), Scope of Testing, Testing Constraints, Various software development Life cycles (SDLC), Independent Testing, QA Process, Levels of Testing, The “V” Concept of Testing.

UNIT II

9 HOURS

WHITE BOX TESTING: White box testing techniques - Statement coverage - Branch Coverage - Condition coverage - Decision/Condition coverage - Multiple condition coverage - Dataflow coverage - Mutation testing - Automated code coverage analysis.

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UNIT III

8 HOURS

BLACK BOX TESTING: Black box testing techniques - Boundary value analysis - Robustness testing - Equivalence partitioning -Syntax testing - Finite state testing - Levels of testing – Unit testing- Integration Testing.

UNIT IV

9 HOURS

SYSTEM TESTING - Functional testing-non-Functional testing-acceptance testing-performance testing –Factors and Methodology for Performance testing, Regression testing-Methodology for Regression-testing. Five Views of Software Quality, McCall’s Quality Factors and Criteria, Quality Factors, Quality Criteria, Relationship between Quality Factors and Criteria, Quality Metrics, Quality Characteristics, Software Quality Standard.

UNIT V

9 HOURS

ADVANCE SOFTWARE TESTING METHOD (OBJECT ORIENTED TESTING): Syntax testing - Finite State testing - Levels of testing - Unit, Integration and System Testing. Challenges - Differences from testing non-OO Software - Class testing strategies - State-based Testing Software quality Assurance: ISO 9000; CMM and Test Management Issues; Quality Assurance personnel Issues.

TEXTBOOKS:

1. K. Naik and P. Tripathy, *Software Testing and Quality Assurance: Theory and Practice*. Hoboken, NJ, USA: John Wiley & Sons, Inc., 2008.
2. D. Meiraj, *Software Testing and Quality Assurance: A Comprehensive Guide to Strategies, Techniques, and Best Practices*. Peacock Books, 2023.

REFERENCE:

1. M. P. Navale, S. S. Mane, and S. C. Sethi, *Software Testing and Quality Assurance (SPPU Curriculum Edition)*. Nirali Prakashan, 2022.
2. Mathur, *Foundations of Software Testing and Quality Assurance*. Springer, 2024.
3. R. Black, *Advanced Software Testing – Vol. 3: Guide to the ISTQB Advanced Certification as Test Manager*. Rocky Nook, 2025.
4. Springer Editors, *Software Quality Journal – Special Issues on AI-driven QA*. Springer Nature, 2025.

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Choice Based Credit System (CBCS) in the light of NEP-2020

B. Tech CSE/IT- All Programs

SEMESTER-V (2024-2028)

COURSE CODE	CATEGORY	COURSE NAME	TEACHING & EVALUATION SCHEME					L	T	P	CREDITS
			THEORY			PRACTICAL					
			END SEM University Exam	Two Term Exam	Teachers Assessment*	END SEM University Exam	Teachers Assessment*				
BTDSE512N	DSE	Software Testing and Quality Assurance	60	20	20	30	20	3	0	2	4

Legends: L - Lecture; T - Tutorial/Teacher Guided Student Activity; P – Practical; C - Credit; *Teacher Assessment shall be based following components: Quiz/Assignment/ Project/Participation in Class, given that no component shall exceed more than 10 marks.

LIST OF PRACTICALS

1. Design test cases using Boundary value analysis by taking quadratic equation problem.
2. Design test cases using Equivalence class partitioning taking triangle problem.
3. Design test cases using Decision table taking triangle problem.
4. Design independent paths by calculating cyclometer complexity using date problem.
5. Design independent paths by taking DD path using date problem.
6. Design the test cases for login page of AMIZONE.
7. Manual Testing for PAN card verification.
8. Generate test case for ATM machines.
9. Overview of Testing process using Rational Robot.
10. Write a script to record verification points using Rational Robot (For GUI testing of single click on Windows).
11. Write a script to record verification points for Clip Board and alphanumeric values using Rational Robot.

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			THEORY			PRACTICAL					
			END SEM University Exam	Two Term Exam	Teachers Assessment*	END SEM University Exam	Teachers Assessment*				
BTDSE513N	DSE	Next Generation Telecommunication Networks	60	20	20	30	20	3	0	2	4

Legends: L - Lecture; T - Tutorial/Teacher Guided Student Activity; P – Practical; C - Credit; *Teacher Assessment shall be based following components: Quiz/Assignment/ Project/Participation in Class, given that no component shall exceed more than 10 marks.

COURSE OBJECTIVES:

The student will have ability to:

1. Understand the importance of QoS and resource management in next generation wireless networks.
2. Describe and compare the network and protocol architectures of GPRS and EDGE and the two principle 3G cellular based wireless standards: UMTS and cdma2000.
3. List and provide a high-level discussion on the key enabling technologies for next generation wireless networks.
4. Identify the relationship between WiFi, WiMAX, and 3G cellular-based wireless networks. In addition, the student will be able to outline and discuss the potential impact of these technologies upon wireless network evolution.

COURSE OUTCOMES:

Upon completion of the subject, students will be able to:

1. Outline the main architectural elements of a Next Generation Network and explain the logic behind it.
2. Understand the concept of Voice over IP (VoIP) and explain how full featured telephony can be provisioned over an IP network.
3. Understand the portfolio of broadband access mechanisms in a fixed network and be able to explain the relative merits of each type.
4. Understand the principles of connection-orientated and connectionless packet switching and the protocols available to enable such networks.
5. Understand the principles of mobile networks and they relate to NGN.

SYLLABUS

UNIT I

10 HOURS

Introduction: Basic history of Mobile Computing Architecture for mobile computing, Three tier architecture, design considerations for mobile computing, mobile computing through internet, Wireless network architecture, Applications, Security, Concerns and Standards, Benefits, Future. Evolution of mobile computing.

UNIT II

9 HOURS

Next Generation Networks (NGN): Principles and definition of an NGN, The NGN architecture, Outline of

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technology choices, Network and implementation issues with NGN, Numbering & Addressing.

UNIT III

8 HOURS

Wireless Networks and Technologies: Introduction, Different generations. Introduction to 1G, 2G, 3G and 4G, Bluetooth, Radio frequency identification(Rfid),Wireless Broadband, Mobile IP: Introduction, Advertisement, Registration, TCP connections, two level addressing, abstract mobility management model, performance issue, routing in mobile host, Adhoc networks, Mobile transport layer: Indirect TCP, Snooping TCP, Mobile TCP, Time out freezing, Selective retransmission, transaction oriented TCP, IPv6.

UNIT IV

9 HOURS

Next Generation Core Network: The role of the core network, Enabling Control and Reconfigurability, Packet Switching (ATM, IP, MPLS, Ethernet), IP Multi-Media System (IMS), Principles of control for IP networks, Concept of IMS.

UNIT V

9 HOURS

NGN Service Aspects: Services on an NGN, Service compatibility with PSTN and IN, Use of APIs and service provider interfaces, Brief review of the principles of mobile networks, Relationship of mobile developments to NGN.

TEXTBOOKS:

1. R. Valdar, *Understanding Telecommunications Networks*. London, U.K.: IET Telecommunications Series 52, 2006.
2. J. Bannister, P. Mather, and S. Coope, *Convergence Technologies for 3G Networks: IP, UMTS, EGPRS and ATM*. Chichester, U.K.: John Wiley & Sons, Ltd., 2004.

REFERENCE:

1. K. Telukder and R. R. Yavagal, *Mobile Computing*. New Delhi, India: Tata McGraw-Hill, 2005.
2. T. SahaMisra, *Wireless Communications and Networks: 3G and Beyond*. New Delhi, India: Tata McGraw-Hill, 2009.
3. M. Carugi, "Introduction to the ITU-T NGN focus group release 1: target environment, services, and capabilities," *IEEE Communications Magazine*, vol. 43, no. 10, pp. 42–48, Oct. 2005.

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4. C.-S. Lee and D. Knight, "Realization of the next-generation networks," *IEEE Communications Magazine*, vol. 43, no. 10, pp. 34–41, Oct. 2005.

LIST OF PRACTICALS

1. Selection and study of various PN code (MLS, GOLD, BARKER).
2. Generate (spreading) DS-SS modulated signal.
3. To demodulate (dispreading) DS-SS modulated signal.
4. Selection & comparative study of various code modulation techniques: BPSK/QPSK/OQPSK.
5. Modulation and Demodulation using internal generation of 2047 bit PN sequence as modulator Input and Unpopulated carrier.
6. Spreading and Dispreading using Additive white Gaussian Noise Generator and frequency offset.
7. Voice communication using DSSS.

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COURSE CODE	CATEGORY	COURSE NAME	TEACHING & EVALUATION SCHEME					L	T	P	CREDITS
			THEORY			PRACTICAL					
			END SEM University Exam	Two Term Exam	Teachers Assessment*	END SEM University Exam	Teachers Assessment*				
BTAIML511	SEC	Python Full Stack	0	0	0	60	40	0	0	4	2

Legends: L - Lecture; T - Tutorial/Teacher Guided Student Activity; P – Practical; C - Credit; *Teacher Assessment shall be based following components: Quiz/Assignment/ Project/Participation in Class, given that no component shall exceed more than 10 marks.

COURSE OBJECTIVES:

The student will have ability:

1. To introduce the architectural fundamentals of REST APIs, HTTP protocols, and the core ecosystem of the FastAPI framework.
2. To train students in enforcing robust server-side data validation using Pydantic, executing dependency injection, and integrating object-relational mapping (ORM) databases.
3. To cultivate advanced backend engineering skills, including JWT authentication, password hashing, automated unit testing, containerization, and cloud deployment pipelines.

COURSE OUTCOMES:

Upon completion of the subject, students will be able to:

1. Design and implement well-structured RESTful API endpoints utilizing path parameters, query parameters, and appropriate HTTP response status codes.
2. Construct type-safe request bodies, custom exception handlers, and database connection pools using Pydantic schemas and SQLAlchemy ORM models.
3. Implement secure state management, role-based access control (RBAC), and stateless token pipelines utilizing OAuth2 frameworks and JSON Web Tokens (JWT).
4. Evaluate backend application stability and metrics through structured logging formats, automated API route testing, and execution of local unit testing suites.
5. Package, optimize, and deploy a complete production-ready relational backend application infrastructure to cloud platforms.

SYLLABUS

UNIT I

12 HOURS

Foundations of APIs & FastAPI Basics: What is an API? REST architecture principles, HTTP methods: GET, POST, PUT, DELETE & status codes, Introduction to FastAPI, installing environment: Python, pip, virtualenv, Creating first FastAPI app, Path parameters & query parameters, Interactive API docs: Swagger UI & ReDoc,

UNIT II

12 HOURS

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BTAIML511	SEC	Python Full Stack	0	0	0	60	40	0	0	4	2

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Data Validation & Request Handling: Pydantic models, Request body & response models, Server side rendering, Data validation and type hints, Handling forms & file uploads, Dependency Injection in FastAPI, Error handling & custom exceptions.

UNIT III

12 HOURS

Database Integration: Intro to databases: SQL vs NoSQL, Using SQLite / MySQL, ORM concepts, Using SQLAlchemy with FastAPI, CRUD operations with database, Migrations - basic introduction.

UNIT IV

12HOURS

Authentication, Security & Advanced Features: Sessions and Cookies management, Authentication basics, JWT authentication, Password hashing, OAuth2 in FastAPI, Role-based access control, Middleware, CORS handling, Background tasks.

UNIT V

12 HOURS

Deployment, Testing & Project: API testing using Postman, Unit testing basics, Debugging & logging, Docker basics - optional but valuable, Deployment: Render / Railway, Performance basics.

TEXTBOOKS:

1. M. Herman, *Building Data Science Applications with FastAPI: Develop, test, and deploy powerful asynchronous web apps with Python*, 2nd ed. Birmingham, UK: Packt Publishing, 2024.
2. B. Ramirez, *Robust Python: Write Clean, Flexible, and Maintainable Code*, 1st ed. Sebastopol, CA, USA: O'Reilly Media, 2022.

REFERENCE:

1. L. Richardson and S. Ruby, *RESTful Web Services: Designing Web APIs that Work*, 2nd ed. Boston, MA, USA: O'Reilly Media, 2023.
2. C. Garofolo, *Architecting Python Apps with Web Frameworks: In-Depth FastAPI and Data Engineering Structures*, 1st ed. New York, NY, USA: McGraw-Hill, 2025.
3. A. Percival and S. Shaw, *Enterprise Software Architecture with Python: Dependency Injection, Testing, and TDD Patterns*, 2nd ed. San Francisco, CA, USA: O'Reilly Media, 2024.

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SEMESTER-V (2024-28)

COURSE CODE	CATEGORY	COURSE NAME	TEACHING & EVALUATION SCHEME					L	T	P	CREDITS
			THEORY			PRACTICAL					
			END SEM University Exam	Two Term Exam	Teachers Assessment*	END SEM University Exam	Teachers Assessment*				
BTAIML511	SEC	Python Full Stack	0	0	0	60	40	0	0	4	2

Legends: L - Lecture; T - Tutorial/Teacher Guided Student Activity; P – Practical; C - Credit; *Teacher Assessment shall be based following components: Quiz/Assignment/ Project/Participation in Class, given that no component shall exceed more than 10 marks.

LIST OF PRACTICALS

1. Installation of Python, pip, and virtualenv to configure an isolated environment and execute a minimal "Hello World" FastAPI application.
2. Implementation of a Student Management CRUD API utilizing in-memory structures, path parameters, and query parameters evaluated via Swagger UI.
3. Development of a User Registration System enforcing data validation, data type hints, and request/response filtering using Pydantic models.
4. Engineering advanced endpoints to securely handle standard form fields, multi-part file uploads, custom exceptions, and structured HTTP error responses.
5. Configuration of an SQLAlchemy relational Object-Relational Mapping (ORM) pipeline connected to an isolated SQLite or MySQL database instance.
6. Building a persistent database-backed blogging or e-commerce API backend to perform automated transactional CRUD operations.
7. Implementing secure state management workflows utilizing server-side sessions, browser cookies, and encrypted password hashing configurations.
8. Constructing an enterprise-grade OAuth2 authentication pipeline generating stateless, time-restricted JSON Web Tokens (JWT) for role-based access control.
9. Designing automated endpoint validation testing suites using Postman collections alongside foundational Python mock unit testing scripts.
10. Packaging the full backend service into a Docker container image and deploying the system to live cloud infrastructure on Render or Railway.
11. Capstone Project

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SEMESTER-V (2024-2028)

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			THEORY			PRACTICAL					
			END SEM University Exam	Two Term Exam	Teachers Assessment*	END SEM University Exam	Teachers Assessment*				
BTIT508M	SEC	No SQL and MongDB	0	0	0	30	20	0	0	2	1

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COURSE OBJECTIVES:

The student will have ability to:

1. Understand NoSQL
2. Analyze the MongoDB Architecture
3. Understand the working of Atlas Search

COURSE OUTCOMES:

Upon completion of the subject, students will be able to:

1. Understanding NoSQL Database Concepts
2. Demonstrate Proficiency in MongoDB Operations
3. Investigate Advanced MongoDB Features
4. Design Database and Data Modelling Skills
5. Apply NoSQL development tools on Real-World Scenarios

SYLLABUS

UNIT I

6 HOURS

NoSQL Database: Types of NoSQL Database, Brief History of NoSQL Databases, NoSQL Database Features, Relational database vs NoSQL database example, Differences between RDBMS and NoSQL databases, NoSQL use cases, NoSQL Database Misconceptions.

UNIT II

6 HOURS

Introduction to MongoDB: MongoDB Atlas, MongoDB and Document Object Model, CRUD Operation, MongoDB Aggregation, Using \$match and \$group Stages in a MongoDB Aggregation Pipeline, Using \$sort and \$limit Stages in a MongoDB Aggregation Pipeline, Using \$project, \$count, and \$set Stages in a MongoDB Aggregation Pipeline, Using \$out Stage in a MongoDB Aggregation Pipeline.

UNIT III

6 HOURS

MongoDB Indexes: Using MongoDB Indexes in Collections, Creating a Single Field Index in MongoDB, Creating a Multikey Index in MongoDB, Working with Compound Indexes in MongoDB, Deleting MongoDB Indexes.

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BTIT508M	SEC	No SQL and MongDB	0	0	0	30	20	0	0	2	1

Legends: L - Lecture; T - Tutorial/Teacher Guided Student Activity; P – Practical; C - Credit; *Teacher Assessment shall be based following components: Quiz/Assignment/ Project/Participation in Class, given that no component shall exceed more than 10 marks.

UNIT IV

6 HOURS

Atlas Search: Using Relevance-Based Search and Search Indexes, creating a Search Index with Dynamic Field Mapping, Creating a Search Index with Static Field Mapping, Using \$search and Compound Operators, Grouping Search Results by Using Facets.

UNIT V

6 HOURS

MongoDB Data Modeling: Types of data relationships, modelling, embedding data in documents, referencing data in documents, scaling data model, Using Atlas Tools for Schema Help, MongoDB transactions.

List of Mini Projects

- Build a Mini-Application:** Create a sample application (e.g., a task manager, blog platform, or e-commerce site) using MongoDB as the database backend. Implement all CRUD functionalities and data modeling techniques learned in class.
- Performance Benchmarking:** Conduct performance tests comparing the execution time of queries on indexed versus non-indexed collections to understand the importance of indexing in MongoDB

TEXTBOOKS:

- M. Aleksendric, A. Borucki, and L. Domingues, *Mastering MongoDB 7.0 – Fourth Edition: Achieve Data Excellence by Unlocking the Full Potential of MongoDB*, 4th ed. New York, NY, USA: MongoDB Press, 2024.
- R. Palmer, B. Perlmutter, A. Gangadhar, N. Larew, S. Narváez, T. Rueckstiehs, H. Weller, R. Alake, and S. Ranjan, *Building AI-Intensive Python Applications: Create Intelligent Apps with LLMs and Vector Databases*, 1st ed. New York, NY, USA: MongoDB Press, 2025.

REFERENCE:

- MongoDB University, <https://learn.mongodb.com/>

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