



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.

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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 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.

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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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BTIBM703	DCC	Cloud Security	60	20	20	30	20	3	0	2	4

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COURSE OBJECTIVES:

The student will have ability:

1. To understand Cloud concepts, introduction to IBM cloud,
2. To understand ISO 27017-Cloud Security, PCI
3. To Understand DSS Controls

COURSE OUTCOMES:

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

1. Set Cloud computing security guidelines set forth by ISO, NIST, ENISA and Cloud Security Alliance.
2. Design Cloud security architectures that assure secure isolation of compute, network and storage infrastructures/
3. Comprehensive data protection, end-to-end identity and access management

SYLLABUS

UNIT I

8 HOURS

Cloud security model: Introduction of IBM cloud, Network parameters and cryptography

UNIT II

8 HOURS

FIPS: Management plan implementation, Forensic science, Gap analysis, Risk terminology, The CSA STAR component and supply chain.

UNIT III

9 HOURS

Key data function: Access process and share, Data depression in the cloud security, Threats to storage types: Gateway encryption key storage in cloud, Containerization data deidentification, Anonymization, DLP, DRM, SDN, Data protection risk.

UNIT IV

10 HOURS

Setup: Setup Key regulations for CSP Facilities, BIA, Phases and methodologies, Threat modeling, Software supply chain management.

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UNIT V

10 HOURS

Management: Scaling Federated identity management, WS federation, O Auth 2.0, Open id connect, Database activity monitor, Cloud secured development lifecycle, Open web aap security project, DRS performance monitoring

TEXTBOOKS:

1. R. K. Nichols and P. C. Lekkas, *Wireless Security: Models, Threats, and Solutions*. New York, NY, USA: McGraw-Hill, 2002.
2. T. Erl, Z. Mahmood, and R. Puttini, *Cloud Computing: Concepts, Technology & Architecture*. Upper Saddle River, NJ, USA: Prentice Hall, 2013.

REFERENCE:

1. R. A. Botha and J. H. P. Eloff, *Introduction to Digital Forensics*. Cape Town, South Africa: Oxford University Press, 2009.
2. T. Mather, S. Kumaraswamy, and S. Latif, *Cloud Security and Privacy: An Enterprise Perspective on Risks and Compliance*. Sebastopol, CA, USA: O'Reilly Media, 2009.
3. V. K. Pachghare, *Cryptography and Information Security*, 3rd ed. Delhi, India: PHI Learning, 2019.
4. D. Gollmann, *Computer Security*, 3rd ed. Hoboken, NJ, USA: Wiley, 2011.
5. J. Rhoton and R. Haukioja, *Cloud Computing Architected: Solution Design Handbook*. Recursive Press, 2013.

LIST OF PRACTICALS

1. Study Configuring IBM Cloud account and create an application using Cloud Foundry Service on IBM Cloud.
2. Deploying an application on IBM Cloud using CLI
3. Deploying an application on IBM Cloud using Git
4. Implementation of containerization using Docker
5. Create a text to speech service using Node Red
6. Create a Language Translator service using Node Red
7. How to create I'd in salesforce Developer
8. Deploying and Create Object in Salesforce
9. Securing a web application with single sign on

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10 Configuring Identity and Access management service on cloud environment.

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BTIBM504 N	DCC	Reactive Architecture	60	20	20	30	20	3	0	2	4

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COURSE OBJECTIVES:

The student will have ability to:

1. To learn the fundamentals of reactive architecture.
2. To understand where and why are reactive systems are applicable.
3. To gain knowledge about Akka ToolKit.

COURSE OUTCOMES:

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

1. To describe the detailed structure of reactive systems.
2. To describe reactive manifesto and reactive principles.
3. To understand Actor model, props in Akka tool kit.

SYLLABUS

UNIT I 10 HOURS

Introduction: What is the problem that Reactive Architecture is attempting to solve, Unresponsive software and its impacts, the goal of Reactive Architecture. Reactive Principles, An introduction to the Reactive Manifesto, An explanation of the Reactive Principles.

UNIT II 8 HOURS

Reactive Toolbox: Multi-Threading, The Reactor Pattern, The MultiReactor Pattern, Actor Model, Introduction to Akka Tool Kit, Akka Actor System, Props, Child Actor, Send Actor, Stop Actor, Reply Messages, Forward Messages.

UNIT III 9 HOURS

Reactive Systems vs Reactive Programming: Reactive Systems, Reactive Programming, Relation between Reactive Systems and Reactive Programming, The Actor Model and its relationship to Reactive Systems.

UNIT IV 9 HOURS

Putting Your Reactive Toolbox to Work: Going from Services to Systems: Being Message Driven, Distributed Infrastructure, Orchestrated Cloud Infrastructure, Reactive Meets Machine Learning.

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UNIT V	9 HOURS
Apache Kafta in Reactive Architecture: Asynchronous messaging backbone, Message retention and data persistence, Decoupling, Backpressure, Backpressure in Kafka Consumers, Backpressure in Alpakka Kafka Connector, Backpressure in MicroProfile Reactive Messaging.	
TEXTBOOKS:	
1.	H. Wickham and G. Grolemund, <i>R for Data Science: Import, Tidy, Transform, Visualize, and Model Data</i> . Sebastopol, CA, USA: O'Reilly Media, 2017.
2.	G. James, D. Witten, T. Hastie, and R. Tibshirani, <i>An Introduction to Statistical Learning with Applications in R</i> , 2nd ed. New York, NY, USA: Springer, 2021.
REFERENCE:	
1.	B. Kabacoff, <i>R in Action: Data Analysis and Graphics with R</i> , 3rd ed. Shelter Island, NY, USA: Manning Publications, 2024.
2.	J. Han, M. Kamber, and J. Pei, <i>Data Mining: Concepts and Techniques</i> , 4th ed. Burlington, MA, USA: Morgan Kaufmann, 2022.
3.	R. I. Kabacoff, <i>Practical Statistics for Data Scientists: 50+ Essential Concepts Using R and Python</i> , 2nd ed. Sebastopol, CA, USA: O'Reilly Media, 2020.
4.	N. ZumeI and J. Mount, <i>Practical Data Science with R</i> , 2nd ed. Shelter Island, NY, USA: Manning Publications, 2019.
5.	R. S. Bivand, E. Pebesma, and V. Gómez-Rubio, <i>Applied Spatial Data Analysis with R</i> , 2nd ed. New York, NY, USA: Springer, 2013.
LIST OF PRACTICALS	
1.	Create a reactor pattern in node js.
2.	Create multireactor pattern in node js.
3.	Implement Actor model.
4.	Implementations of Akka tell method.
5.	Implementation of Akka Ask method.

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6.	Implementation of stopping top level actor in Akka using stop method.
7.	Implement of stopping child actor in Akka.
8.	Implementation of stopping Actor Sytem.
9.	Implement props in Akka using akka.actor.Props.
10	Write program using Akka toolkit to forward message from one actor to another.

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BTDSE511M	DSE	Image Processing	60	20	20	30	20	3	0	2	4

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COURSE OBJECTIVES:

The student will have ability to:

1. Understand the image processing system.
2. Analyze different transformation and segmentation techniques
3. Apply feature extractions from images.

COURSE OUTCOMES:

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

1. Define key concepts and terminologies related to image processing systems and their applications
2. Apply intensity transformations for image enhancement
3. Develop a comprehensive understanding of image processing theories and techniques
4. Demonstrate an understanding of transform and similarity measures

SYLLABUS

UNIT I

8 HOURS

Introduction: Image processing systems and its applications. Basic image file formats. **Image formation:** Geometric and photometric models; Digitization - sampling, quantization; Image definition and its representation, neighborhood metrics.

UNIT II

8 HOURS

Intensity transformations and spatial filtering: Enhancement, contrast stretching, histogram specification, local contrast enhancement; Smoothing, linear and order statistic filtering, sharpening, spatial convolution, Gaussian smoothing, DoG, LoG.

UNIT III

10 HOURS

Segmentation: Pixel classification; Grey level thresholding, global/local thresholding; Optimum thresholding - Bayes analysis, Otsu method; Derivative based edge detection operators, edge detection/linking, Canny edge detector; Region growing, split/merge techniques, line detection, Hough transform.

UNIT IV

10 HOURS

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Image/Object features extraction: Textural features - gray level co-occurrence matrix; Moments; Connected component analysis; Convex hull; Distance transform, medial axis transforms, skeletonization/ thinning, shape properties.

Registration: Mono-modal/multimodal image registration; Global/local registration; Transform and similarity measures for registration; Intensity/pixel interpolation.

UNIT V

9 HOURS

Colour image processing: Fundamentals of different colour models - RGB, CMY, HSI, YCbCr, Lab; False colour; Pseudocolour; Enhancement; Segmentation. **Morphological Filtering Basics:** Dilation and Erosion Operators, Top Hat Filters.

TEXTBOOKS:

1. R. C. Gonzalez and R. E. Woods, Digital Image Processing. Upper Saddle River, NJ, USA: Prentice Hall, 2008.

REFERENCE:

1. M. Petrou and P. Bosdogianni, *Image Processing: The Fundamentals*. Chichester, U.K.: John Wiley & Sons, Ltd., 1999.
2. K. R. Castleman, *Digital Image Processing*. Englewood Cliffs, NJ, USA: Prentice Hall, 1996.
3. A. Blake and A. Zisserman, *Visual Reconstruction*. Cambridge, MA, USA: MIT Press, 1987.
4. A. N. Netravali and B. G. Haskell, *Digital Pictures: Representation, Compression, and Standards*. New York, NY, USA: Plenum Press, 1995.
5. A. B. Watson, *Digital Images and Human Vision*. Cambridge, MA, USA: MIT Press, 1993.

LIST OF PRACTICALS

1. Image File Format Comparison Load, display, and save images in different formats (JPEG, PNG, BMP) using a programming library. Analyze and compare the compression quality and file size.
2. Histogram Equalization Implement histogram equalization to enhance the contrast of a given image. Visualize the original and equalized histograms to show the effect of the transformation.
3. Spatial Filtering: Smoothing and Sharpening Apply various spatial filters (mean, median, Gaussian) for

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smoothing and different sharpen filters (Laplacian, Sobel) to an image. Compare and analyze the results.

- Image Segmentation Using Thresholding Implement global and adaptive thresholding to segment an image. Use Otsu's method to determine the optimal threshold and evaluate the effectiveness of the segmentation.
- Edge Detection Techniques Implement several edge detection operators (e.g., Sobel, Prewitt, Canny) on the same image. Compare their performance visually and quantitatively (e.g., using precision and recall).
- Texture Feature Extraction Use the gray level co-occurrence matrix to extract texture features from an image (contrast, correlation). Compare textures from different regions of the same image.
- Image Registration Perform mono-modal image registration by aligning two images of the same scene taken at different times. Implement a technique to measure similarity (SSD, correlation) using transformations.
- Color Space Conversion Convert a color image from RGB to different color spaces (HSV, YCbCr, Lab). Visualize the changes and select one space to perform color-based segmentation.
- Morphological Operations: Dilation and Erosion Apply morphological operations (dilation and erosion) on binary images. Analyze how these operations affect the structure of the objects in the images.
- Canny Edge Detector Implementation Implement the Canny edge detection algorithm from scratch. Break down the steps involved.

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			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.

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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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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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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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.

- 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

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

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			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

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

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

B. Tech – CSE (FSDB)

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*				
BTIT510	SEC	Multi-Disciplinary Research	0	0	0	0	50	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 to:

1. Train students to independently formulate multi-disciplinary research problems by intersecting core software engineering tracks with parallel technology domains.
2. Develop advanced literature review skills, allowing students to synthesize whitepapers, industrial documentation, and academic journals to build a comprehensive technical foundation.
3. Cultivate self-driven prototyping capabilities, teaching students to build, validate, and document cross-domain technical proofs-of-concept (PoC).

COURSE OUTCOMES:

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

1. Analyze and critique contemporary technical publications or industry whitepapers to map out cross-disciplinary technological dependencies.
2. Architect and deploy an integrated, non-trivial technical prototype that solves a multi-disciplinary domain challenge.
3. Author a structured, publication-grade research manuscript or comprehensive technical whitepaper outlining their independent findings.

GUIDELINES

1. **Cross-Domain Domain Selection**
Students select their primary technical domain and couple it with a secondary domain (e.g., Smart Agriculture, Fintech, Supply Chain, or Healthcare). A formal research synopsis must be submitted to the internal mentor for approval. Weeks 1-2
2. **Literature Matrix Compilation**
Students must independently review a minimum of 10 research papers or enterprise whitepapers. They will produce a systematic literature review matrix mapping existing solutions and technical gaps. Weeks 3-4
3. **Independent Prototyping & Lab Logs**
Students work on the core implementation of their project. They must maintain a weekly Weeks 5-10

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self-study digital log (or Git commit history) documenting the architectural design choices, software configuration arrays, API endpoints, or smart contract logic.

4. Manuscript Drafting & Peer Presentation

Students compile their technical architecture, data findings, and system performance evaluations into a structured 15-page research report or whitepaper. The course concludes with an expert panel defense. Weeks 11-12

CONTINUOUS ASSESSMENT FRAMEWORK			
Assessment Component	Evaluation Deliverable	Target Cognitive Metric	Weightage
Progressive Research Logs	Regular verification of research matrices and Git repositories.	Consistent Execution & Git Workflow	20%
System Architecture Design	Detailed system topology diagrams, API specs, or data schema layouts.	Analytical System Engineering	20%
Functional Implementation	Review of the operational code repository or running system proof-of-concept.	Applied Technical Skills	30%
Final Dissertation / Whitepaper	A 25-to-30-page structured technical report summarizing findings.	Academic Reporting & Synthesis	15%
Expert Panel Presentation	Formal presentation slide delivery followed by a technical Q&A defense.	Oral Communication & Concept Mastery	15%

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