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/ CSE (ES/MA/AI/DS/MLCC/ICS/BDCE) /IT

SEMESTER-VII (2023-2027)

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*				
BTCS710	DCC	Deep Learning Foundations	60	20	20	30	20	3	1	2	5

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 understand the fundamental theoretical concepts of neural networks and deep learning.
2. To provide knowledge of various optimization algorithms used in training deep models.
3. To enable the design and implementation of CNNs and RNNs for real-world tasks.
4. To explore unsupervised learning frameworks like Auto encoders and Generative Models.
5. To develop skills in using modern deep learning frameworks for solving complex engineering and data-driven problems.

COURSE OUTCOMES:

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

1. Demonstrate fundamental knowledge of McCulloch-Pitts neurons, Perceptron, and the mathematical foundations of gradient descent.
2. Design and optimize Multi-Layer Perceptron using backpropagation and advanced regularization techniques.
3. Implement Convolutional Neural Networks for image recognition, denoising, and computer vision tasks.
4. Apply Recurrent Neural Networks and LSTMs for sequential data analysis and natural language processing.
5. Evaluate generative models and unsupervised learning architectures for data synthesis and dimensionality reduction.

SYLLABUS

UNIT I — 9 HOURS

Foundations of Neural Networks: - History of Deep Learning, McCulloch-Pitts Neuron, Perceptron's and Perceptron Learning Algorithm. Multilayer Perceptron's (MLPs), Representation Power of MLPs, Sigmoid Neurons, Feed Forward Neural Networks, Back propagation.

UNIT II — 9 HOURS

Optimization and Linear Algebra for DL: - Gradient Descent (GD), Momentum Based GD, Nesterov Accelerated GD, Stochastic GD, AdaGrad, RMSProp, Adam. Mathematical Foundations: Eigenvalue Decomposition, Singular Value Decomposition (SVD), Principal Component Analysis (PCA).

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UNIT III — 9 HOURS

Regularization and Effective Training: - Bias-Variance Tradeoff, L1 & L2 regularization, Early stopping, Dataset augmentation, Parameter sharing, Dropout, Batch Normalization, Instance and Group Normalization. Weight Initialization methods (Xavier/He), Greedy Layer wise pre-training.

UNIT IV — 9 HOURS

Convolutional Neural Networks (CNN): - Building blocks of CNN: Convolution, Pooling, and Stride. Architectures: LeNet, AlexNet, VGGNet, GoogLeNet, ResNet (Skip Connections). Applications: Image Denoising, Semantic Segmentation, Object Detection, Transfer Learning.

UNIT V — 9 HOURS

Sequence Models and Generative Modeling: - Recurrent Neural Networks (RNN), Backpropagation through time (BPTT), Vanishing/Exploding Gradients. GRU, LSTMs. Attention Mechanism and Encoder-Decoder Models. Introduction to Generative Modeling: Variational Autoencoders (VAE) and Generative Adversarial Networks (GAN).

TEXTBOOKS:

1. I. Good fellow, Y. Bengio, and A. Courville, *Deep Learning*. Cambridge, MA, USA: MIT Press, 2016.
2. E. Charniak, *Introduction to Deep Learning*. Cambridge, MA, USA: MIT Press, 2019.

REFERENCE:

1. F. Chollet, *Deep Learning with Python*. Shelter Island, NY, USA: Manning Publications, 2021.
2. S. Haykin, *Neural Networks and Learning Machines*, 3rd ed. Upper Saddle River, NJ, USA: Pearson, 2009.
3. A. Geron, *Hands-On Machine Learning with Scikit-Learn, Keras, and Tensor Flow*, 3rd ed. Sebastopol, CA, USA: O'Reilly Media, 2022.
4. https://onlinecourses.nptel.ac.in/noc26_cs66/preview
5. https://onlinecourses.nptel.ac.in/noc26_ee53/preview

LIST OF PRACTICALS

1. Implementation of a McCulloch-Pitts Neuron to simulate basic logic gates.
2. Implementation of the Perceptron Learning Algorithm for binary classification.
3. Design a Multi-Layer Perceptron (MLP) for the MNIST handwritten digit dataset using Back propagation.

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/ CSE (ES/MA/AI/DS/MLCC/ICS/BDCE) /IT

SEMESTER-VII (2023-2027)

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*				
BTCS710	**DCC**	**Deep Learning Foundations**	**60**	**20**	**20**	**30**	**20**	**3**	**1**	**2**	**5**

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.

4. Comparative study of different optimizers (SGD, RMSProp, Adam) on a deep neural network.
5. Implementing Dimensionality Reduction using Auto encoders and comparing it with PCA.
6. Applying Dropout and Batch Normalization to a deep network to analyze performance and over fitting.
7. Image Classification using a standard CNN architecture (e.g., LeNet or AlexNet).
8. Implementing Transfer Learning using a pre-trained model (VGG16 or ResNet) for a custom image dataset.
9. Time-series prediction (e.g., stock price or weather) using LSTMs.
10. Implementation of a basic Generative Adversarial Network (GAN) to generate synthetic images.
11. Capstone Project

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SEMESTER-VII (2023-2027)

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			THEORY			PRACTICAL					
			END SEM University Exam	Two Term Exam	Teachers Assessment*	END SEM University Exam	Teachers Assessment*				
BTCS711	DCC	Introduction to Quantum Computing	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:

1. To introduce the fundamental principles of quantum mechanics as applied to computing.
2. To develop proficiency in the linear algebraic representation of quantum states and operations.
3. To analyze and design quantum circuits and basic quantum algorithms.
4. To understand complex quantum algorithms like Shor's and Grover's and their implications for cryptography.
5. To explore quantum query complexity and the theoretical limits of quantum speedup.

COURSE OUTCOMES:

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

1. Explain the concepts of quantum "weirdness" and represent quantum states using Dirac notation and linear algebra.
2. Design and simulate quantum circuits using basic gates (Hadamard, CNOT, and Phase) and measurement principles.
3. Implement and analyze fundamental quantum algorithms such as Deutsch-Jozsa, Simon's, and Quantum Fourier Transform.
4. Evaluate the efficiency of Grover's Search and Quantum Walks compared to classical randomized computation.
5. Assess the impact of quantum computing on modern security (Shor's algorithm) and understand the limits of quantum query complexity.

SYLLABUS

UNIT I — 9 HOURS

Introduction and Mathematical Foundations: - Overview of Quantum Computing; Quantum Weirdness: Mach-Zehnder Interferometer; Linear Algebraic Formulation: Kat-Bra notation, deterministic vs. randomized vs. quantum states; Cubits and Composite Systems (Tensor products).

UNIT II — 9 HOURS

Quantum Operations and Circuits: - Operations in Quantum Computing: Unitary matrices and Semi definite matrices; Basic Gates: Pauli gates, Hadamard, Phase, and CNOT; Circuit representation; Projectors and

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BTCS711	DCC	Introduction to Quantum Computing	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.

Measurements; Principle of Deferred Measurement; Swap Circuits.

UNIT III 9 HOURS

Fundamental Quantum Algorithms: - Classical vs. Quantum Circuits; The Deutsch and Deutsch-Jozsa Algorithms; Simon's Algorithm; Quantum Fourier Transform (QFT): Mathematical derivation and circuit implementation.

UNIT IV 9 HOURS

Advanced Algorithms and Random Walks: - Applications of QFT: Phase Estimation and Shore's Algorithm (Period finding and Factoring); Grover's Search Algorithm: Amplitude amplification and optimality; Randomized computation; Discrete-time Quantum Walks.

UNIT V 9 HOURS

Query Complexity and Future Trends: - The Query Model: Classical vs. Quantum complexity; Approximate degree; Total functions: Polynomial separation; Partial functions: For relation problem; Aaronson-Amboina's conjecture; Introduction to Quantum Security and Post-Quantum Cryptography.

TEXTBOOKS:

1. M. A. Nielsen and I. L. Chuang, *Quantum Computation and Quantum Information: 10th Anniversary Edition*. Cambridge, UK: Cambridge University Press, 2010.
2. P. Kaye, R. Laflamme, and M. Mosca, *An Introduction to Quantum Computing*. Oxford, UK: Oxford University Press, 2007.

REFERENCE:

1. J. S. Desharnais, *Quantum Mechanics for Engineers*. New York, NY, USA: McGraw-Hill, 2013.
2. E. Rieffel and W. Polak, *Quantum Computing: A Gentle Introduction*. Cambridge, MA, USA: MIT Press, 2011.
3. https://onlinecourses.nptel.ac.in/noc26_cs06/preview

LIST OF PRACTICALS

1. **Qubit Visualization:** Representing single qubit states on the Bloch Sphere and performing rotations.

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SEMESTER-VII (2023-2027)

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BTCS711	DCC	Introduction to Quantum Computing	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.

2. **Entanglement:** Implementing the Bell States and verifying entanglement via measurement.
3. **Circuit Design:** Building a 3-qubit Adder circuit using basic quantum gates.
4. **Deutsch-Jozsa:** Implementation of the Deutsch-Jozsa algorithm to determine if a function is constant or balanced.
5. **Teleportation:** Implementing the Quantum Teleportation protocol.
6. **Bernstein-Vazirani:** Solving the "hidden bitstring" problem in a single query.
7. **Grover's Search:** Implementing a 2-qubit and 3-qubit search for a specific marked state.
8. **QFT & Phase Estimation:** Visualizing the effect of the Quantum Fourier Transform on different input states.
9. **Shore's Core:** Implementing the period-finding component of Shore's algorithm.
10. **Quantum Walks:** Simulating a discrete-time quantum walk on a 1D line.

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BTCS712	SEC	Cloud Competency Lab	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.

COURSE OBJECTIVES:

The student will have ability to:

1. Understand cloud development concepts and AWS architecture.
2. Develop applications using AWS services like S3, Lambda, and DynamoDB.
3. Implement secure, scalable, and event-driven cloud applications.
4. Analyze deployment strategies and CI/CD pipelines in cloud environments.

COURSE OUTCOMES:

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

1. Develop and deploy applications using AWS cloud services.
2. Implement REST APIs and serverless architectures.
3. Analyze cloud security, scalability, and performance issues.
4. Design distributed applications using messaging and workflow services.

SYLLABUS

UNIT I — 6 HOURS

Introduction to Cloud Developing on AWS: Overview of AWS Cloud and infrastructure, Roles in cloud computing, Introduction to development lifecycle in cloud, AWS SDKs and development tools (Cloud9, CloudShell), Basics of distributed systems and cloud architecture.

UNIT II — 6 HOURS

Storage and Security in AWS: Amazon S3: Buckets, objects, and storage management, Data protection and access control, AWS Identity and Access Management (IAM), Authentication and authorization mechanisms, Cross-account access and security best practices.

UNIT III — 6 HOURS

Database and API Development: AWS database services overview, Amazon DynamoDB concepts (RCU, WCU, indexing), Developing NoSQL solutions, REST API development using Amazon API Gateway, API deployment, monitoring, and optimization

UNIT IV — 6 HOURS

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*				
BTCS712	SEC	Cloud Competency Lab	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.

Serverless and Container-Based Development: Serverless computing concepts, AWS Lambda: Function creation and deployment, Event-driven architectures, Containerization using Docker, AWS container services and Elastic Beanstalk.

UNIT V 6 HOURS

Advanced Cloud Development & Deployment: Caching with Amazon ElastiCache and CloudFront, Messaging services: Amazon SQS, SNS, Kinesis, Workflow orchestration using AWS Step Functions, Security in cloud applications (Cognito, STS), CI/CD pipelines using AWS Code services and CloudFormation.

TEXTBOOKS:

1. Amazon Web Services, *AWS Training and Certification Material (AWS Academy Cloud Developing)*. [Online]. Available: https://aws.amazon.com/training/academy/
2. M. Wittig and A. Wittig, *Amazon Web Services in Action*. Shelter Island, NY, USA: Manning Publications, 2015.

REFERENCE:

1. J. P. Mueller, *AWS for Developers*. Hoboken, NJ, USA: Wiley, 2017.
2. B. Golden, *Amazon Web Services for Dummies*. Hoboken, NJ, USA: Wiley, 2013.
3. Amazon Web Services, *AWS Official Documentation.*

LIST OF PRACTICALS

1. Working with AWS Cloud9 and CloudShell
2. Creating and managing S3 buckets
3. Implementing IAM roles and policies
4. Developing applications using DynamoDB
5. Building REST APIs using API Gateway
6. Creating serverless applications using AWS Lambda
7. Containerizing applications using Docker
8. Implementing caching with CloudFront/ElastiCache
9. Developing messaging systems using SQS and SNS
10. Automating deployment using CI/CD pipelines

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SEMESTER-VII (2023-2027)

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BTIBM721	DCC	Introduction to Blockchain	60	20	20	30	20	3	0	2	4

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COURSE OBJECTIVES:	
The student will have ability to:	
1.	To introduce the core concepts, foundational global infrastructure, and standard service delivery models of Google Cloud Platform (GCP).
2.	To identify the structural configuration, networking, deployment, and scalability mechanics of cloud-based compute and storage engines.
3.	To design secure, automated microservice deployment architectures and serverless data workflows leveraging modern IT monitoring suites.

COURSE OUTCOMES:	
Upon completion of the subject, students will be able to:	
1.	Explain the core architecture of Google Cloud, including its physical regions, project resource hierarchy model, and IAM security controls.
2.	Deploy and run virtual machine instances, scalable managed container workloads, and cloud storage systems securely within an isolated virtual network environment.
3.	Examine microservice resource metrics using cloud operations tooling and apply policy frameworks to optimize operational availability and enterprise security compliance.

SYLLABUS

UNIT I — **6 HOURS**

CLOUD INFRASTRUCTURE FUNDAMENTALS & ACCESS CONTROL:

Introduction to Cloud Computing: Shift from On-Premises IT to Elastic Cloud Architectures. Google Cloud Global Footprint: Regions, Zones, and Points of Presence (PoPs). GCP Project Resource Hierarchy: Organizations, Folders, Projects, and Resources. Interaction Interfaces: Cloud Console GUI, Google Cloud SDK (gcloud CLI), Cloud Shell interactive terminal. Identity and Access Management (IAM): Mapping Principals (Users, Groups, Service Accounts) to Roles (Primitive, Predefined, Custom) through secure validation policies.

UNIT II — **6 HOURS**

CLOUD COMPUTE PROCESSING ENGINES & CONTAINERIZATION:

Google Compute Engine (GCE): Virtual Machine (VM) instantiation, machine type families, custom images, persistent boot disks, and volume snapshots. Horizontal Scaling: Compute Engine Autoscaling and Managed Instance Groups (MIGs). Introduction to Containers vs. Hypervisor Virtualization. Google Kubernetes Engine (GKE): Cluster architecture, control planes, pods, declarative deployments, services, and multi-zone node pool configurations.

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B. Tech – CSE (AI/DS)

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BTIBM721	DCC	Introduction to Blockchain	60	20	20	30	20	3	0	2	4

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UNIT III	**6 HOURS**
VIRTUAL NETWORKING & SCALABLE STORAGE ARCHITECTURE: Google Virtual Private Cloud (VPC): Subnet isolation, global routing paths, and ingress/egress Firewall rulesets. Networking Topologies: Internal/External IP address schemes and cloud DNS. Traffic Distribution: Global and Regional HTTP(S) Cloud Load Balancing. Storage Topologies: Unstructured data management with Google Cloud Storage (GCS), bucket ACLs, and object lifecycle rules. Managed Relational Storage: Cloud SQL, globally distributed Cloud Spanner. NoSQL Databases: Firestore and Cloud Bigtable.	
UNIT IV	**7 HOURS**
SERVERLESS COMPUTE & ASYNCHRONOUS MICROSERVICE INTEGRATION: Monolithic vs. Microservice Application Patterns. Serverless Processing Runtimes: Google Cloud Run (stateless containerized execution) and Google Cloud Functions (event-driven micro-execution blocks). Decoupled Enterprise Workflows: Asynchronous message passing using Cloud Pub/Sub architecture (Topics, Pull/Push Subscriptions, and message ordering semantics). Continuous Automation: Building container deployment pipelines using Cloud Build blocks.	
UNIT V	**6 HOURS**
OPERATIONS MANAGEMENT, SECURITY COMPLIANCE, & BIG DATA ANALYTICS: Google Cloud Operations Workspace: Dynamic resource performance dashboards, threshold-based Alerting strategies, and log collection paths via unified Cloud Logging sinks. Cloud Security Baselines: Enforcing the Principle of Least Privilege and cryptographic envelope encryption using Cloud Key Management Service (KMS). Introduction to the Data Analytics Ecosystem: Serverless multi-terabyte analytical queries inside Google BigQuery, and pipeline orchestration using Cloud Dataflow.	
TEXTBOOKS:	
1.	D. Sullivan, *Official Google Cloud Certified Associate Cloud Engineer Study Guide*, 1st ed. Indianapolis, IN, USA: Sybex, 2019.
2.	J. Lipson and A. Singh, *Google Cloud Platform in Action*, 1st ed. West Point, NY, USA: Manning Publications, 2020.
REFERENCE:	
1.	S. P. T. Krishnan and L. Gonzalez, *Building Cloud Apps with Google Cloud Platform: Programming, Google App Engine, and Cloud Data Store*, 1st ed. Berkeley, CA, USA: Apress, 2015.

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

B. Tech – CSE (AI/DS)

SEMESTER-VII (2023-2027)

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BTIBM721	DCC	Introduction to Blockchain	60	20	20	30	20	3	0	2	4

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2	J. Muñiz and R. C. Das, *Google Cloud Platform Cookbook: Over 40 recipes to help you build, scale, and manage computing and storage solutions*, 1st ed. Birmingham, UK: Packt Publishing, 2018.

LIST OF PRACTICALS

1.	Workspace Configuration: Interacting with the Google Cloud Console GUI, authenticating environment states via gcloud CLI commands, and initializing project environments using Google Cloud Shell
2.	Custom Networking Topology: Creating a multi-tier Virtual Private Cloud (VPC) network with public/private isolated subnets and constructing granular ingress/egress Firewall barriers.
3.	Server Infrastructure Management: Spanning, configuring, and executing remote SSH bindings to a Linux Compute Engine instance, extending its root block persistent volume, and mapping static external network IPs.
4.	Object Storage Implementation: Orchestrating structural spaces inside Cloud Storage, modifying objects across the multi-tier lifestyle engine (Standard, Nearline, Coldline, Archive), and assigning explicit IAM service policies.
5.	Managed Relational Databases: Initializing a highly-available Cloud SQL database instance, setting up data transactional tables, and establishing secure proxy tunnels from a client VM.
6.	Containerized Cluster Deployment: Constructing Docker container images, publishing builds to the Artifact Registry, and standing up application services inside a managed Google Kubernetes Engine (GKE) cluster.
7.	Event-Driven System Logic: Scripting and deploying an event-triggered Cloud Function that executes microservice processing automatically when new data documents arrive in a targeted Cloud Storage bucket.
8.	Auto-Scaling Microservices: Deploying a web service container onto Google Cloud Run and integrating it with an external HTTP(S) Load Balancer to mitigate simulated user traffic surges.
9.	Auditing and Observability Monitoring: Standing up custom metric monitoring alerts, assembling active environment dashboards, and routing operational data using Google Cloud Operations Workspace.
10	Large-Scale Data Warehousing: Importing multi-gigabyte open-source datasets into a Google BigQuery environment and writing highly optimized serverless analytical SQL queries.

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Shri Vaishnav Institute of Information Technology

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

B.Tech./ B.Tech + M.Tech / B.Tech + MBA (CSE/ IT/CSBS) - All Programs

SEMESTER-VIII (2023-2027)

COURSE CODE	CATEGORY	COURSE NAME	TEACHING & EVALUATION SCHEME					L	T	P	CREDITS
			THEORY			PRACTICAL					
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BTCS705N	SEC	Industrial Training	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. To expose students to authentic engineering environments, corporate operations, and professional workflows, bridging the gap between classroom theory and industry practice.
2. To train students in systematic problem identification, data collection, and analytical troubleshooting by tackling real-world engineering issues or software deployment constraints.
3. To cultivate essential workplace competencies, including professional ethics, time management, collaborative teamwork, and structured technical reporting.

COURSE OUTCOMES:

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

1. Analyze the operational architecture, infrastructure, and technical tools utilized by a modern engineering enterprise or research institution.
2. Formulate, evaluate, and propose optimal engineering or software-driven solutions for a minimum of three distinct real-world technical problems observed during the training period.
3. Compile an industry-grade technical training report and professionally defend their observations, technical skills, and project outcomes before an expert evaluation committee.

Guidelines for Students Undergoing Industrial Training

1. Overview & Institutional Scope

Students need to complete a mandatory **minimum 2-week industrial training** program during the summer vacation of after third year.

- **Prerequisite:** Before starting your training, students must obtain clear instructions and official approval from the designated Faculty In-Charge and then by Head of Department (HOD).
- **Alternative Attachments:** In place of a traditional corporate internship, students are permitted to complete an academic attachment of equal duration at a recognized national institution (such as an IIT, NIT, or IIIT) or an accredited university abroad.

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BTCS705N	SEC	Industrial Training	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.

- **Professional Value:** This training serves as initial transition into corporate engineering. It is designed to cultivate practical engineering skills, build industry networks, enhance employability, and establish a foundational awareness of workplace behavior, interpersonal dynamics, and professional ethics.

2. Operational Phasing & Responsibilities

Students are completely responsible for ensuring their conduct throughout the placement cycle is ethical, conscientious, and professional.

1. **Application & Approval:** Pre-Training.

   Apply for a suitable training slot through the Training and Placement (T&P) Officer at least one semester in advance. Once an offer is secured, submit a copy of the official offer letter to your HOD or Faculty Coordinator. You are strictly prohibited from changing your company choice once it has been officially approved.

2. **Verify Company Eligibility:** Conflict of Interest Check.

   To prevent a conflict of interest, students are strictly prohibited from completing training at a family-owned business or an enterprise where close relatives hold direct management authority.

3. **Immediate Joining Notification:** Day 1 of Training.

   Upon arriving at training site, students must immediately contact to Faculty Coordinator. Provide your exact start date, company name, your active contact details, and the contact information of your designated industry supervisor.

4. **Problem Formulation & Study:** During Training.

   Actively engage with the industry's technical tasks. Students must identify and document 3 to 4 practical problems currently faced by the facility or software engineering team

5. **Professional Conduct & Confidentiality:** Daily Operations.

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BTCS705N	SEC	Industrial Training	0	0	0	0	50	0	0	4	2

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Maintain 100% attendance and strictly follow all rules, safety protocols, and regulations enforced by the host organization. Protect the company's intellectual property; students are legally and ethically bound to maintain absolute confidentiality and must not share proprietary company data with third parties.

3. Industrial Training Report Guidelines

Students must compile a comprehensive technical report of **at least 25 to 30 pages** documenting their work. If multiple students are trained at the same organization, each student must author and submit an entirely independent, unique report.

Core Content Requirements

The technical manuscript must thoroughly document the following areas:

- **Enterprise Profile:** Essential history, market domain, infrastructure, and corporate introduction of the company.
- **Operational Workflows:** The sequence of manufacturing operations, production systems, or software development lifecycles (SDLC) deployed at the site.
- **Physical or Logical Layout:** A clear description of the facility floors, laboratories, workshops, or administrative networks.
- **Technical Configurations:** The major industrial equipment used, or the complete computer/server architecture and development environments required for running specialized enterprise software.
- **Logistics (Where Applicable):** The physical movement of raw, semi-finished, and finished materials (exempt for pure software engineering tracks).
- **Technical Case Studies:** Detailed formulation of your 3 to 4 technical problems, including the underlying data gathered, analysis steps, precise software commands or engineering math used, and your final data-driven recommendations.

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- **Industrial Validation:** A formal certificate of completion issued, signed, and stamped by your industry supervisor covering the exact duration of your training.

Document Structure Checklist

The final report must be organized in the following order:

1. Preface & Acknowledgements
2. Official Training Certificate (featuring the signature and seal of the authorized industry representative)
3. Table of Contents
4. Introduction to the Organization
5. Training Schedule & Timeline
6. Daily Work Logs & Technical Observations
7. Specific Assignment / Handled Project Details
8. Post-Training Learning Outcomes & Personal Reflections
9. Executive Summary & Bibliography (properly referencing all text citations, books, technical papers, or engineering standards used)

4. Assessment Framework & Evaluation

Evaluation is continuous and designed to measure the quality of your insights relative to graduate-level engineering attributes. A copy of your finalized report must be distributed to your industry employer, your internal department advisor, and your personal archive.

Evaluation Mechanism

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The overall grade will be determined by the Faculty Coordinator and an appointed departmental expert committee via a formal **Seminar Presentation and Viva-Voce**.

Assessment Component	Evaluation Focus Criteria	Expected Graduate Attributes Tested
Technical Report	• Analytical depth of the case studies • Technical accuracy of data and logs • Structure and formatting compliance	• Engineering Knowledge • Problem Analysis • Investigation of Complex Problems
Seminar Presentation	• Clarity and quality of visual slides • Professional delivery and communication flow • Depth of technical knowledge during Q&A	• Modern Tool Usage • Design/Development of Solutions • Executive Presence

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BTCS706N	SEC	Project	0	0	0	120	80	0	0	8	4

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COURSE OBJECTIVES:

The student will have ability to:

1. Enable students to identify real-world, complex engineering problems and apply systematic research methodologies to formulate viable technical solutions.
2. Train students in designing, engineering, testing, and validating a complete product, system module, or computing architecture using modern engineering tools and industry-standard practices.
3. Foster collaborative engineering management skills, technical report writing, and the professional defense of engineered solutions before an evaluation panel.

COURSE OUTCOMES:

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

1. Formulate a well-defined problem statement by critically reviewing contemporary research literature, identifying technical gaps, and establishing clear engineering requirements.
2. Design and develop an architectural framework, hardware prototype, or software system by incorporating sustainable design methodologies, algorithm design, and resource optimization.
3. Implement and deploy the proposed system using modern development environments, programming paradigms, cloud infrastructure, or advanced technical tools.
4. Evaluate the performance, scalability, and security parameters of the developed system against standard benchmark metrics, interpreting the results through rigorous testing.
5. Compile comprehensive, industry-grade technical project reports and documentation compliant with standard engineering formats, defending the work effectively through oral presentations.

Project Timeline

Phases

Phase 1: Planning & Requirement Analysis (Weeks 1–2)

Focus: Defining the scope, setting up infrastructure, and identifying functional requirements.

- **Week 1: Project Initiation**
  - Form teams and define the problem statement.
  - **Tooling:** Set up **Jira** boards (Scrum or Kanban), create Backlog, and initialize **Git** repositories.
  - **Deliverable:** Project Vision document and initial Product Backlog.

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- **Week 2: Functional Modeling**
  - Identify Actors and Use Cases.
  - **UML Deliverables: * Use Case Diagram:** To define system boundaries.
    - **Use Case Descriptions:** Detailed text for each primary flow.
  - **Tooling:** Map Use Cases to Jira User Stories.

Phase 2: Object-Oriented Analysis (Weeks 3–4)
Focus: Understanding the "What" of the system without focusing on implementation.

- **Week 3: Static Analysis**
  - Identify domain entities and their relationships.
  - **UML Deliverables:**
    - **Object Diagram:** To model specific instances and data snapshots.
    - **Initial Class Diagram (Domain Model):** Focus on attributes and relationships (1:1, 1:N, M:N) without methods.

- **Week 4: Dynamic Analysis**
  - Model how the system reacts to events.
  - **UML Deliverable: Activity Diagram:** To model complex business logic and parallel workflows.

Phase 3: Object-Oriented Design (Weeks 5–7)
Focus: Defining the "How" – architecture, patterns, and component interactions.

- **Week 5: Interaction Modeling**
  - **UML Deliverable: * Sequence Diagram:** Detailed logic showing how objects communicate over time to fulfill a use case.

- **Week 6: Detailed Class Design & Packaging**
  - Apply SOLID principles and Design Patterns.
  - **UML Deliverables:**
    - **Detailed Class Diagram:** Including methods, visibility, and interfaces.
    - **Package Diagram:** Organizing classes into logical modules/subsystems.

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- **Week 7: System Architecture**
  - **UML Deliverables:**
    - **Component Diagram:** Visualizing physical modules (API, Database, UI).
    - **Deployment Diagram:** Mapping software components to hardware/nodes (Cloud, Servers).

Phase 4: Implementation & CI/CD Integration (Weeks 8–10)
Focus: Coding, version control, and automated pipelines.

- **Week 8: Sprint 1 - Core Features**
  - Develop core logic based on the Class and Sequence diagrams.
  - **Git Strategy:** Use branching (Feature branches → Develop → Main).

- **Week 9: CI/CD Pipeline Setup**
  - Configure **GitHub Actions** or **GitLab CI**.
  - Automate build triggers on every git push.

- **Week 10: Sprint 2 - Integration**
  - Develop UI and connect to the database.
  - **Jira:** Move stories to "In Progress" and "Testing."

Phase 5: Testing & Deployment (Weeks 11–12)
Focus: Quality assurance and final delivery.

- **Week 11: Testing Phase**
  - **Unit Testing:** (JUnit, PyTest) ensuring methods work as intended.
  - **Integration Testing:** Testing the flow between components.
  - **Tooling:** Integrate test reports into the CI/CD pipeline.

- **Week 12: Deployment & Final Review**
  - Finalize the **Deployment Diagram** to match the production environment.
  - Deploy to a staging/production environment (Heroku, AWS, or Azure).
  - Project Demo and handover.

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Jira Backlog and a **Git Branching Strategy**

1. Jira Backlog & Sprint Structure

The project is divided into **six 2-week Sprints**. **Sample Jira Epic & Story Structure:**

Epic	Sample User Stories (Tasks)	Status
Requirements & Design	Create Use Case Diagrams; Draft System Architecture; Set up Jira Board.	Done/Sprint 1
Infrastructure	Initialize Git Repo; Configure CI/CD Pipeline; Setup Database.	Sprint 2
User Management	Design User Class; Implement Login/Auth; Sequence Diagram for Auth.	Sprint 3
Core Features	[Project Specific Logic]; Unit Tests for Core Logic.	Sprint 4-5
Deployment	Final Deployment Diagram; Production Hosting; Documentation.	Sprint 6

2. Git Branching Strategy

Students should avoid pushing directly to the main branch. A **Feature Branch Workflow** is best for academic teams to prevent code conflicts.

- **main branch:** Contains stable, production-ready code.
- **develop branch:** The integration branch where all features are merged before going to main.
- **feature/feature-name branches:** Created for every individual Jira task (e.g., feature/user-login).

3. Testing & CI/CD Pipeline

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To meet your requirement for testing software and CI/CD, the students should implement a pipeline that triggers on every **Pull Request** to the develop branch.

The Pipeline Flow:

1. **Build:** Compile the code to ensure there are no syntax errors.
2. **Unit Test:** Automatically run tests (e.g., JUnit, PyTest, or Jest). If tests fail, the merge is blocked.
3. **Static Analysis:** Use tools like SonarQube or ESLint to check for code "smells."
4. **Deploy:** Automatically deploy to a staging environment (like Vercel, Netlify, or AWS).

4. UML to Code Mapping (Object-Oriented Focus)

Students must ensure that their diagrams are not just "drawings" but blueprints:

- **Class Diagram** → Directly maps to the Classes and Attributes in their code.
- **Sequence Diagram** → Maps to the logic inside their methods (which object calls which method).
- **Package Diagram** → Maps to the Folder Structure of their project.

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Project Grading Rubric (Total 100%)

1. Analysis & Design (30%)

- **UML Consistency:** Do the diagrams match the actual code implementation?
    - *Check:* Does the **Class Diagram** reflect the actual inheritance and associations in the source code?
- **Behavioral Accuracy:** Do **Sequence Diagrams** correctly identify method calls between objects?
- **Architectural Soundness:** Does the **Deployment Diagram** accurately map to the cloud/server infrastructure used?

2. Object-Oriented Implementation (25%)

- **Encapsulation:** Are attributes private? Are getters/setters used appropriately?
- **Inheritance/Polymorphism:** Are these used to reduce code redundancy?
- **Solid Principles:** Is the code modular? (e.g., Single Responsibility Principle).
- **Design Patterns:** Did the team implement at least one recognizable pattern (e.g., Singleton, Factory, or Observer)?

3. DevOps & Tooling (20%)

- **Jira Management:** Is the backlog updated? Are stories assigned to specific members?
    - *Check:* Do commit messages reference Jira ticket IDs?
- **Git Workflow:** Is there evidence of Pull Requests and Code Reviews?
    - *Check:* Avoid "Mega-commits" (one giant commit at the end of the week).
- **CI/CD Pipeline:** Does the pipeline automatically trigger on pushes? Is the build status visible (Green/Red)?

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4. Testing & Quality (15%)

- **Unit Testing:** Is there a significant percentage of code coverage?
- **Integration Testing:** Are API endpoints or database connections tested?
- **Documentation:** Is the README.md clear, including setup instructions and a system overview?

5. Final Deployment (10%)

- **Accessibility:** Is the project hosted on a live URL?
- **Stability:** Does the system handle basic "unhappy path" errors without crashing?

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Definition of Done (DoD) Checklist

A Jira ticket is only considered **Done** when it meets the following criteria:

1. Design & Modeling

- **UML Alignment:** Any changes to the code structure are reflected in the **Class Diagram**.
- **Logic Validation:** For complex logic, a **Sequence Diagram** has been updated or created.
- **Documentation:** Public methods and classes are documented using standard docstrings (e.g., Javadoc, Docstring).

2. Code Quality & Standards

- **OO Principles:** Code follows Encapsulation and avoids "God Classes" (Single Responsibility Principle).
- **No Hardcoding:** Configuration values (like API keys or DB URLs) are in environment variables.
- **Peer Review:** At least one other team member has reviewed the **Pull Request (PR)** on Git.

3. Testing & CI/CD

- **Unit Tests:** New logic has corresponding unit tests.
- **CI Pipeline:** The CI/CD build is **Green** (passing) on the feature branch.
- **Zero Regressions:** Existing functionality still works as expected.

4. Integration

- **Git Merge:** The feature branch has been merged into the develop branch.
- **Jira Update:** The ticket is moved to the "Done" column and the "Actual Time Spent" is logged.

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Evaluation Schedule

Phase	Milestone	Expected Artifacts
Month 1	**Foundation**	Use Case, Activity, and Object Diagrams. Jira Backlog setup.
Month 2	**Design**	Sequence, Class, and Package Diagrams. Git Feature branches active.
Month 3	**Execution**	Component and Deployment Diagrams. Working CI/CD pipeline and Unit Tests.

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Weekly Progress Report Template

Project Title: [Project Name]

Team ID: [ID]

Date: [Date Range]

1. Executive Summary

- **Current Sprint:** [Sprint # of 6]
- **Sprint Goal:** (e.g., Finalize Sequence Diagrams and setup Database connection)
- **Status:** On Track | At Risk | Delayed

2. UML & OOAD Progress

- **Diagrams Completed this week:** (e.g., Package Diagram, Component Diagram)
- **Diagrams Revised:** (List any changes made based on implementation feedback)
- **OO Concept Applied:** (e.g., "Implemented Interface Inheritance for the Payment module")

3. Technical Execution (DevOps & Git)

- **Jira Tasks Completed:** [Link to Jira tickets]
- **Git Activity:**
  - Active Branches: [List branch names]
  - Merged Pull Requests: [List PR IDs]
- **CI/CD Status:** [e.g., Build Passing / 85% Code Coverage]

4. Testing Summary

- **Total Unit Tests:** [Number]

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- **Pass Rate:** [Percentage]%
- **Key Bug Identified:** [Brief description of one technical challenge overcome]

5. Goals for Next Week

- [Goal A]
- [Goal B]

Project Guide Signature

Project In-charge Signature