R23 B. Tech AI & ML COURSE STRUCTURE & SYLLABUS

B. Tech. – IV Year I Semester

S. No.	Category	Title	Subject Code	L	T	P	C
1	Professional Core	Generative AI	V231416131	3	0	0	3
2	Management Course- II	Human Resource & Project Management	V2314161M1	2	0	0	2
3	Professional Elective-IV	1. Quantum Computing 2. Robotic Process Automation 3. Explainable AI 4. Software Project Management 5. 12 week MOOC Swayam /NPTEL course recommended by the BoS	V231416141 V231416142 V231416143 V231416144 V231416145	3	0	0	3
4	Professional Elective-V	1. Agile Methodologies 2. High Performance Computing 3. Blockchain Technology 4. NoSQL databases 5. 12 week MOOC Swayam/NPTEL course recommended by the BoS	V231416146 V231416147 V231416148 V231416149 V23141614A	3	0	0	3
5	Open Elective-III	Object Oriented Programming Through Java	V231416151	3	0	0	3
6	Open Elective-IV	Computer Networks Software Engineering IOT Based Smart Systems	V231416152 V231416153 V231416154	3	0	0	3
7	Skill Enhancement Course	Prompt Engineering / SWAYAM Plus - Certificate program in Prompt Engineering and ChatGPT	V231416161 V231416162	0	1	2	2
8	Audit Course	Constitution of India	V2314161C1	2	0	0	-
9	Internship	Evaluation of Industry Internship / Mini Project	V231416181	-	-	-	2
		Total		**19**	**1**	**02**	**21**
MC	Student may select from the same minor's pool			3	0	0	3
HC	Student may select from the same honors pool			3	0	0	3
HC	Student may select from the same honors pool			3	0	0	3

B. Tech.– IV Year II Semester

S. No.	Category	Title	Subject Code	L	T	P	Credits
1	Internship / Project Work	Full Semester Internship & Project Work	V2314261A1	0	0	24	12

Note: Student need to do at least ONE MOOC Course (3 credits out of 160 credits) to meet the mandatory requirement (11th criteria, as per R23 Regulations)

Open Electives, offered to other department students:

Open Elective I: Operating Systems / Computer Organization and Architecture
Open Elective II: Database Management Systems
Open Elective III: Object Oriented Programming Through Java
Open Elective IV: Computer Networks / Software Engineering / IOT Based Smart Systems

Minor Engineering

Note:

1. *To obtain Minor Engineering, student needs to obtain 18 credits by successfully completing any of the following courses in the concern stream.*
2. *During Minor/Honors Course selection, there should not be any overlapping with Regular/Major/OPEN Electives*

Minor in AI&ML

1. Database Management Systems 3-0-3-4.5 (II-II)
2. Operating Systems 3-0-0-3 (III-I)
3. Data Visualization 3-0-3-4.5 (III-II)
4. Generative AI 3-0-0-3 (IV-I)

Any of the following 12 Week 3 credit NPTEL MOOC Courses

5. Artificial Intelligence: Knowledge Representation and Reasoning
6. Machine Learning and Deep Learning - Fundamentals and Applications
7. Fundamentals of Object Oriented Programming
8. Discrete Mathematics for CS
9. Computer Networks and Internet Protocol
10. Software Engineering
11. Natural Language Processing
12. Business Intelligence & Analytics

Suggested MOOC Courses for Honors Degree in AI&ML

Note: ***To obtain Honor's degree, student needs to obtain 18 credits by successfully completing any of the following courses in the concern stream (without duplication).***

Mandatory Course(s) (2)

1. Applied Linear Algebra in AI & ML 12 Week 3 Credit Course, MOOCS
2. Deep Learning for Natural Language Processing- 12 Week 3 Credit Course, MOOCS
3. Agentic AI
4. Adversarial Machine Learning

Any of the following for remaining 12 Credits (4)

5. High Performance Scientific Computing 12 Week 3 Credit Course, MOOCS
6. Computer Vision - 12 Week 3 Credit Course, MOOCS
7. Applied Time-Series Analysis 12 Week 3 Credit Course, MOOCS
8. Reinforcement Learning 12 Week 3 Credit Course, MOOCS
9. GPU Architecture and Programming 12 Week 3 Credit Course, MOOCS
10. Computational Complexity 12 Week 3 Credit Course, MOOCS
11. Quantum Algorithms and Cryptography 12 Week 3 Credit Course, MOOCS
12. Practical High-Performance Computing 12 Week 3 Credit Course, MOOCS
13. Cryptography and Network Security 12 Week 3 Credit Course, MOOCS

IV B. Tech I Semester	GENERATIVE AI (V231416131)	L	T	P	C
		3	0	0	3

Course Objectives:

- Understand the basics of Generative AI.
- Know the basics of Text Generation.
- Understand the process of generating videos.
- Know about GAN and its variants.

Course Outcomes: **At the end of the Course student will be able to:**

CO1: Understand the fundamentals, architectures, and applications of Generative AI and Large Language Models.

CO2: Apply deep learning techniques to implement generative models for various data generation tasks.

CO3: Analyze and compare different Generative AI models, architectures, and techniques for specific applications.

CO4: Design and develop Generative AI applications using prompting, fine-tuning, RAG, and AI APIs.

CO5: Evaluate Generative AI systems considering performance, ethics, bias, privacy, security, and responsible AI practices.

UNIT I : Introduction To Gen Ai: Historical Overview of Generative modelling, Difference between Gen AI and Discriminative Modeling, Importance of generative models in AI and Machine Learning, Types of Generative models, GANs, VAEs, autoregressive models and Vector quantized Diffusion models, Understanding if probabilistic modeling and generative process, Challenges of Generative Modeling, Future of Gen AI, Ethical Aspects of AI, Responsible AI, Use Cases.

UNIT II: Generative Models For Text: Language Models Basics, Building blocks of Language models, Transformer Architecture, Encoder and Decoder, Attention mechanisms, Generation of Text, Models like BERT and GPT models, Generation of Text, Auto encoding, Regression Models, Exploring ChatGPT, Prompt Engineering: Designing Prompts, Revising Prompts using Reinforcement Learning from Human Feedback (RLHF), Retrieval Augmented Generation, Multimodal LLM, Issues of LLM like hallucination.

UNIT III: Generation of Images: Introduction to Generative Adversarial Networks, Adversarial Training Process, Nash Equilibrium, Variational Auto encoders, Encoder-Decoder Architectures, Stable Diffusion Models, Introduction to Transformer-based Image Generation, CLIP, Visual Transformers ViT- Dall-E2 and Dall-E3, GPT-4V, Issues of Image Generation models like Mode Collapse and Stability.

UNIT IV: Generation of Painting, Music, and Play: Variants of GAN, Types of GAN, Cyclic GAN, Using Cyclic GAN to Generate Paintings, Neural Style Transfer, Style Transfer, Music Generating RNN, MuseGAN, Autonomous agents, Deep Q Algorithm, Actor-critic Network.

UNIT V: Open Source Models And Programming Frameworks: Training and Fine tuning of Generative models, GPT 4 All, Transfer learning and Pretrained models, Training vision models, Google Copilot, Programming LLM, LangChain, Open Source Models, Llama, Programming for TimeSformer, Deployment, Hugging Face.

Text Books:

1. Denis Rothman, "Transformers for Natural Language Processing and Computer Vision", Third Edition , Packt Books, 2024

Reference Books:

1. David Foster," Generative Deep Learning", O'Reily Books, 2024.
2. Altaf Rehmani, "Generative AI for Everyone", BlueRose One, 2024.

IV B. Tech I Semester	HUMAN RESOURCE & PROJECT MANAGEMENT (V2314161M1)	L	T	P	C
		2	0	0	2

Course Objectives: The main objectives of the course are to

- Provide knowledge about HR planning, recruitment, selection, and job design.
- Develop skills in managing HR functions such as performance appraisal, compensation, and employee relations.
- Emphasize the importance of ethical practices and HR audits in maintaining organizational health.
- Understand the HRD framework and its impact on organizational success.
- **Improve group interaction and team dynamics** for better collaboration and performance.
- Understand the Fundamentals of Project Management and Project Networks
- Implement appropriate management strategies tailored to specific challenges in different project types.

Course Outcomes: At the end of the Course student will be able to:

1. **CO1:** Understand the fundamental concepts and functions of Human Resource and Project Management.
2. **CO2:** Apply HRM practices for recruitment, training, motivation, performance appraisal, and employee development.
3. **CO3:** Analyze human resource and project requirements for effective team formation and project execution.
4. **CO4:** Develop project plans involving scope, scheduling, resources, cost, quality, and risk management.
5. **CO5:** Evaluate project and team performance using appropriate leadership, monitoring, control, and conflict-management techniques.

UNIT –I: HRM: Nature, Scope, Concept of HRM, Functions of HRM, Role of HR manager, emerging trends in HRM, E-HRM, HR audit models, ethical aspects of HRM. HR Planning, Demand and Supply forecasting of HR, Job Design, Recruitment, Sources of recruitment, Selection- Selection Procedure.

UNIT –II: HRD, HR accounting, Models, Concept of Training and Development, Methods of Training. Performance Appraisal: Importance Methods of performance appraisal, Career Development and Counseling, group interaction.

UNIT –III: Basics of Project Management, Concept, resource management, Project environment, Types of Projects, project networks-DPR, Project life cycle, Project proposals, Monitoring project progress, Project appraisal and Project selection, 80-20 rules, production technology, communication matrix

UNIT-IV: Identify various project types and their unique management challenges and apply appropriate management strategies for each.

UNIT-V: Project Implementation and Review: Forms of project organization, project planning, project control, human aspects of project management, prerequisites for successful project implementation, project review, performance evaluation, abandonment analysis

Text Books:

1. Robert L. Mathis, John H. Jackson, Manas Ranjan Tripathy, Human Resource Management, Cengage Learning 2016.
2. Sharon Pande and Swapnalekha Basak, Human Resource Management, Text and Cases, Vikas Publishing, 2e, 2016.
3. Stewart R. Clegg, Torgeir Skyttermoen, Anne Live Vaagaasar, Project Management, Sage Publications, 1e, 2021.
4. Nagarajan, Project Management, New Age International Publishers, 8e, 2017.

Reference Books :

1. Subba Rao P, "Personnel and Human Resource Management-Text and Cases", Himalaya Publications, Mumbai, 2013.
2. K Aswathappa, "Human Resource and Personnel Management", Tata McGraw Hill, New Delhi, 2013.
3. Prasanna Chandra, "Projects, Planning, Analysis, Selection, Financing, Implementation and Review", Tata McGraw Hill Company Pvt. Ltd., New Delhi, 1998.
4. Vasanth Desai, "Project Management", 4th edition, Himalaya Publications, 2018.
5. Lalitha Balakrishnan, Gowri, "Project Management", Himalaya publishing house, New Delhi, 2022.

IV B. Tech I Semester	QUANTUM COMPUTING (V231416141)	L	T	P	C
		3	0	0	3

Course Objectives:

- To introduce the fundamentals of quantum computing, the problem-solving approach using finite dimensional mathematics

Course Outcomes: At the end of the Course student will be able to:

CO1: Understand the fundamental principles of quantum mechanics and quantum computing.

CO2: Apply quantum gates, circuits, and linear algebra concepts to perform basic quantum computations.

CO3: Analyze important quantum algorithms and their computational advantages over classical approaches.

CO4: Design and implement quantum circuits using quantum programming tools and simulators.

CO5: Evaluate quantum computing performance, limitations, noise, error correction, and practical applications.

UNIT – I: History of Quantum Computing: Importance of Mathematics, Physics and Biology. Introduction to Quantum Computing: Bits Vs Qubits, Classical Vs Quantum logical operations

UNIT – II: Background Mathematics: Basics of Linear Algebra, Hilbert space, Probabilities and measurements.
Background Physics: Paul's exclusion Principle, Superposition, Entanglement and super-symmetry, density operators and correlation, basics of quantum mechanics, Measurements in bases other than computational basis. Background Biology: Basic concepts of Genomics and Proteomics (Central Dogma)

UNIT – III: Qubit: Physical implementations of Qubit. Qubit as a quantum unit of information. The Bloch sphere Quantum Circuits: single qubit gates, multiple qubit gates, designing the quantum circuits. Bell states.

UNIT – IV: Quantum Algorithms: Classical computation on quantum computers. Relationship between quantum and classical complexity classes. Deutsch's algorithm, Deutsch's-Jozsa algorithm, Shor's factorization algorithm, Grover's search algorithm.

UNIT – V: Noise and error correction: Graph states and codes, Quantum error correction, fault-tolerant computation. Quantum Information and Cryptography: Comparison between classical and quantum information theory. Quantum Cryptography, Quantum teleportation

Text Books:

1. Nielsen M. A., Quantum Computation and Quantum Information, Cambridge

Reference Books:

1. Quantum Computing for Computer Scientists by Noson S. Yanofsky and Mirco A. Mannucci
2. Benenti G., Casati G. and Strini G., Principles of Quantum Computation and Information, Vol.I: Basic Concepts, Vol II
3. Basic Tools and Special Topics, World Scientific. Pittenger A. O., An Introduction to Quantum Computing Algorithms

IV B. Tech I Semester	ROBOTIC PROCESS AUTOMATION (V231416142)	L	T	P	C
		3	0	0	3

Course Objectives:

1. To understand the basics of Robotic Process Automation.
2. To demonstrate the use of sequence and control flow for a task.
3. To understand different mouse and keyboard activities
4. To design an Assistant bot on a keyboard event
5. To understand deploying and managing the bot.

Course Outcomes: At the end of the course students will be able to

1. Enumerate the benefits of Robotic Process Automation.
2. Make use of sequence and control flow for a task.
3. Apply different mouse and keyboard activities
4. Design an Assistant bot on a keyboard event
5. Create the bot for a workflow

UNIT-I: INTRODUCTION TO ROBOTIC PROCESS AUTOMATION: Scope and techniques of automation, Robotic process automation, Benefits of RPA, Components of RPA, RPA platforms, UiPath studio, UiPath Robot, UiPath orchestrator, the future of automation.

UNIT-II: RECORD AND PLAY: UiPath Stack, Types of Robots, the user interface, Quick Access Toolbar, Different panels, Task recorder, Step by step examples using recorder. Sequence, Activities, Control flow, various types of loops, decision making, step by step example using sequence and flow chart, step by step example using sequence and control flow.

UNIT-III: DATA MANIPULATION AND CONTROLS: Variables and Scope, Collections, Arguments, Data table usage, clipboard management, File operations, CSV/Excel to data table and vice versa. Finding and attaching windows, finding the control, techniques for a waiting for a control, act on controls, mouse and keyboard activities, working with UiExplorer, Handling events, Screen scraping, OCR.

UNIT-IV: ASSISTANT BOTS, EXCEPTION HANDLING: Assistant bots, Monitoring system event triggers, Hotkey trigger, Mouse trigger, System trigger Monitoring image and element triggers, Example of monitoring email, Example of monitoring a copying event and blocking it - Launching an assistant bot on a keyboard event. Exception Handling, common exceptions, logging and taking screenshots, Debugging techniques, collecting crash dumps, error reporting.

UNIT-V: DEPLOYING AND MAINTAINING THE BOT: Publishing using publish utility, publish a workflow in Uipath, Overview of Orchestartion server, using orchestration server to control bots, using orchestration server to deploy bots, license management, publishing and managing updates.

TEXT BOOKS:

1. Alok Mani Tripathi, "Learning Robotic Process Automation", Packt Publishing, 2018.

REFERENCES:

1. Frank Casale , Rebecca Dilla, Heidi Jaynes , Lauren Livingston, "Introduction to Robotic Process Automation: a Primer", Institute of Robotic Process Automation,1st Edition 2015.
2. Richard Murdoch, Robotic Process Automation: Guide To Building Software Robots, Automate Repetitive Tasks & Become An RPA Consultant", Independently Published, 1st Edition 2018.
3. Srikanth Merianda,"Robotic Process Automation Tools, Process Automation and their benefits:Understanding RPA and Intelligent Automation", Consulting Opportunity Holdings LLC, 1st Edition 2018.
4. Lim Mei Ying, "Robotic Process Automation with Blue Prism Quick Start Guide: Create software robots and automate business processes", Packt Publishing, 1st Edition 2018.

WEB REFERENCES:

1. https://www.uipath.com/rpa/robotic-process-automation
2. https://www.academy.uipath.com

IV B. Tech I Semester	EXPLAINABLE AI (V231416143)	L	T	P	C
		3	0	0	3

Course Objectives:

The main objectives of the course are to

- Understand the importance of explainability in AI and its impact on stakeholders.
- Explore different techniques and methods for making AI systems explainable.
- Analyze the trade-offs between model complexity and interpretability.
- Examine the ethical and societal implications of XAI.
- Apply XAI techniques to real-world datasets and scenarios.

Course Outcomes: At the end of the Course student will be able to:

CO1: Understand the fundamental concepts, principles, and importance of Explainable AI.

CO2: Apply appropriate XAI techniques to interpret machine learning and deep learning predictions.

CO3: Analyze AI models with respect to interpretability, transparency, fairness, and limitations.

CO4: Design and develop explainable AI solutions for real-world applications.

CO5: Evaluate AI explanations for reliability, robustness, fairness, and ethical considerations.

UNIT I: Introduction to Explainable AI (XAI): Motivations for XAI, Importance of interpretability and transparency Techniques for XAI, Model-specific interpretability methods (e.g., decision trees, rule based systems) Model-agnostic interpretability methods (e.g., LIME, SHAP) Post-hoc explanation techniques (e.g., feature importance, counterfactual explanation

UNIT II: Interpretable Models: Linear models, Decision trees and rule-based systems Symbolic AI approaches, Interpretable Neural Networks, Sparse neural networks, Attention mechanisms, Layer-wise relevance propagation (LRP)

UNIT III: Methods for Explainable AI: Partial Dependence Plot (PDP), Conformal Prediction, Individual Conditional Expectation (ICE), Feature Importance, Saliency Maps, Local Interpretable Model-Agnostic Explanations (LIME), SHAP, Integrated Gradient (IG), Explainability for Linear Models, Non-linear models and Deep Learning Models.

UNIT IV: Evaluation of XAI Methods: Quantitative metrics for interpretability, Human-centric evaluation methods, Ethical and Societal Implications of XAIB, is and fairness in interpretable AI, Trust and accountability in AI systems, Regulatory considerations.

UNIT V: Applications of XAI: Healthcare (e.g., medical diagnosis, personalized treatment) Finance (e.g., credit scoring, fraud detection), Autonomous systems (e.g., self-driving cars, drones). Explainability in Time Series Forecasting, Natural Language Processing, and Computer Vision

Text Books:

1. "Interpretable Machine Learning" by Christoph Molnar
2. "Explainable AI: Interpreting, Explaining and Visualizing Deep Learning" by L. Liu and G. Hu

Reference Books:

1. "Interpretable Machine Learning: A Guide for Making Black Box Models Explainable" by Christoph Molnar
2. "Explainable AI: Interpreting, Explaining and Visualizing Deep Learning" by L. Liu and G. Hu –
3. "Explainable AI in Healthcare: Exploring Interpretable Models and Learning from Patient Data" edited by F. E. Elsayed and B. G. Stoecklin

Online Resources:

1. https://christophm.github.io/interpretable-ml-book/

IV B. Tech I Semester	SOFTWARE PROJECT MANAGEMENT (V231416144)	L	T	P	C
		3	0	0	3

Course Objectives: At the end of the course, the student shall be able to:

- To describe and determine the purpose and importance of project management from the perspectives of planning, tracking and completion of project
- To compare and differentiate organization structures and project structures
- To implement a project to manage project schedule, expenses and resources with the application of suitable project management tools

Course Outcomes: At the end of the Course student will be able to:
CO1: Understand the fundamental concepts and practices of Software Project Management.
CO2: Apply project planning, estimation, scheduling, and resource management techniques to software projects.
CO3: Analyze software project risks, requirements, constraints, and performance factors.
CO4: Develop effective software project plans incorporating cost, schedule, quality, resources, and risk management.
CO5: Evaluate software project performance using appropriate monitoring, control, and quality-management techniques.

UNIT-I: Conventional Software Management: The waterfall model, conventional software Management performance. **Evolution of Software Economics: Software Economics, pragmatic software cost estimation.**
Improving Software Economics: Reducing Software product size, improving software processes, improving team effectiveness, improving automation, Achieving required quality, peer inspections. **The old way and the new:** The principles of conventional software Engineering, principles of modern software management, transitioning to an iterative process.

UNIT-II: Life cycle phases: Engineering and production stages, inception, Elaboration, construction, transition phases. **Artifacts of the process:** The artifact sets, Management artifacts, Engineering artifacts, programmatic artifacts.

UNIT- III: Model based software architectures: A Management perspective and technical perspective**. Work Flows of the process: Software process workflows, Iteration workflows. Checkpoints of the process:** Major mile stones, Minor Milestones, Periodic status assessments. **Iterative Process Planning:** Work breakdown structures, planning guidelines, cost and schedule estimating, Iteration planning process, Pragmatic planning.

UNIT- IV: Project Organizations and Responsibilities: Line-of-Business Organizations, Project Organizations, evolution of Organizations.
Process Automation: Automation Building blocks, The Project Environment.

Project Control and Process instrumentation: The seven core Metrics, Management indicators, quality indicators, life cycle expectations, pragmatic Software Metrics, Metrics automation.

UNIT-V: Agile Methodology, ADAPTing to Scrum, Patterns for Adopting Scrum, Iterating towards Agility. Fundamentals of DevOps: Architecture, Deployments, Orchestration, Need, Instance of applications, DevOps delivery pipeline, DevOps eco system. DevOps adoption in projects: Technology aspects, Agiling capabilities, Tool stack implementation, People aspect, processes

Text Books:

1. Software Project Management, Walker Royce, PEA, 2005.
2. Succeeding with Agile: Software Development Using Scrum, Mike Cohn, Addison Wesley.
3. The DevOps Handbook: How to Create World-Class Agility, Reliability, and Security in Technology Organizations, Gene Kim , John Willis , Patrick Debois , Jez Humb,1st Edition, O'Reilly publications, 2016.

Reference Books:

1. Software Project Management, Bob Hughes,3/e, Mike Cotterell, TMH
2. Software Project Management, Joel Henry, PEA
3. Software Project Management in practice, Pankaj Jalote, PEA, 2005,
4. Effective Software Project Management, Robert K.Wysocki, Wiley,2006.
5. Project Management in IT, Kathy Schwalbe, Cengage.

IV B. Tech I Semester	AGILE METHODOLOGIES (V231416146)	L	T	P	C
		3	0	0	3

Course Objectives:

- The main objectives of this course are to introduce the important concepts of Agile software development Process, emphasize the role of stand-up meetings in software collaboration, impart the knowledge on values and principles in understanding agility

Course Outcomes: At the end of the Course student will be able to:

CO1: Understand the principles, values, practices, and frameworks of Agile methodologies.

CO2: Apply Agile practices for requirements management, sprint planning, development, testing, and delivery.

CO3: Analyze project requirements, team dynamics, and changing business needs to select suitable Agile approaches.

CO4: Design and implement Agile-based software projects using Scrum, Kanban, XP, and Lean practices.

CO5: Evaluate Agile project performance using appropriate metrics, quality practices, customer feedback, and continuous improvement techniques.

UNIT –I: Agile Methodology: Theories for Agile Management, Agile Software Development – Traditional Model vs. Agile Model, Classification of Agile Methods, Agile Manifesto and Principles, Agile Project Management, Agile Team Interactions, Ethics in Agile Teams, Agility in Design, Testing, Agile Documentations, Agile Drivers, Capabilities and Values.

UNIT-II: Agile Process: Lean Production - SCRUM, Crystal, Feature Driven Development- Adaptive Software Development - Extreme Programming: Method Overview – Lifecycle – Work Products, Roles and Practices.

UNIT-III: Agile Knowledge Sharing – Role of Story-Cards – Story-Card Maturity Model (SMM).

UNIT-IV: Agility and Requirements Engineering: Impact of Agile Processes in RE, Current Agile Practices, Variance, Overview of RE Using Agile, Managing Unstable Requirements, Requirements Elicitation, Agile Requirements Abstraction Model, Requirements Management in Agile Environment, Agile Requirements Prioritization, Agile Requirements Modelling, Generation – Concurrency in Agile Requirements Generation.

UNIT-V: Agility and Quality Assurance: Agile Product Development, Agile Metrics, Feature Driven Development (FDD), Financial and Production Metrics in FDD, Agile Approach to Quality Assurance, Test Driven Development, Agile Approach in Global Software Development.

Text Books :

1. Andrew Stellman, Jill Alison Hart, Learning Agile, O'Reilly, 2015.

Reference Books:

1. Andrew stellman, Jennifer Green, Head first Agile, O'Reilly, 2017.
2. Rubin K , Essential Scrum : A practical guide to the most popular Agile process, Addison-Wesley, 2013

IV B. Tech I Semester	HIGH PERFORMANCE COMPUTING (V231416147)	L	T	P	C
		3	0	0	3

Course Objectives:

- The main objectives of the course is to study parallel computing hardware and programming models, performance analysis and modeling of parallel programs

Course Outcomes: **On completion of the course, student will be able to–**

1. Describe different parallel architectures, inter-connect networks, programming
2. Models
3. Develop an efficient parallel algorithm to solve given problem
4. Analyze and measure performance of modern parallel computing systems
5. Build the logic to parallelize the programming task

UNIT I INTRODUCTION: Motivating Parallelism, Scope of Parallel Computing, Parallel Programming Platforms: Implicit Parallelism, Trends in Microprocessor and Architectures, Limitations of Memory, System Performance, Dichotomy of Parallel Computing Platforms, Physical Organization of Parallel Platforms, Communication Costs in Parallel Machines, Scalable design principles, Architectures: N-wide superscalar architectures, Multi-core architecture.

UNIT II PARALLEL PROGRAMMING: Principles of Parallel Algorithm Design: Preliminaries, Decomposition Techniques, Characteristics of Tasks and Interactions, Mapping Techniques for Load Balancing, Methods for Containing Interaction Overheads, Parallel Algorithm Models, The Age of Parallel Processing, the Rise of GPU Computing, A Brief History of GPUs, Early GPU.

UNIT III BASIC COMMUNICATION: Operations- One-to-All Broadcast and All-to-One Reduction, All-to-All Broadcast and Reduction, All-Reduce and Prefix-Sum Operations, Scatter and Gather, All-to-All Personalized Communication, Circular Shift, Improving the Speed of Some Communication Operations. Programming shared address space platforms: threads- basics, synchronization, OpenMP programming

UNIT IV: ANALYTICAL MODELS: Sources of overhead in Parallel Programs, Performance Metrics for Parallel Systems, and The effect of Granularity on Performance, Scalability of Parallel Systems, Minimum execution time and minimum cost, optimal execution time. **Dense Matrix Algorithms**: MatrixVector Multiplication, Matrix-Matrix Multiplication.

UNIT V : PARALLEL ALGORITHMS- SORTING AND GRAPH : Issues in Sorting on Parallel Computers, Bubble Sort and its Variants, Parallelizing Quick sort, All-Pairs Shortest Paths, Algorithm for sparse graph, Parallel Depth-First Search, Parallel BestFirst Search. **CUDA Architecture**: CUDA Architecture, Using the CUDA Architecture, Applications of CUDA Introduction to CUDA C-Write and launch CUDA C kernels, Manage GPU memory, Manage communication and synchronization, Parallel programming in CUDA- C.

Text Books:

1. Ananth Grama, Anshul Gupta, George Karypis, and Vipin Kumar, "Introduction to Parallel Computing", 2nd edition, Addison-Wesley, 2003, ISBN: 0-201-64865-2
2. Jason sanders, Edward Kandrot, “CUDA by Example”, Addison-Wesley, ISBN-13: 978-0-13-138768-3

Reference Books:

1. Kai Hwang, ”Scalable Parallel Computing”, McGraw Hill 1998, ISBN:0070317984
2. Shane Cook, “CUDA Programming: A Developer's Guide to Parallel Computing with GPUs”, Morgan Kaufmann Publishers Inc. San Francisco, CA, USA 2013 ISBN: 9780124159884
3. David Culler Jaswinder Pal Singh, ”Parallel Computer Architecture: A Hardware/ Software Approach”, Morgan Kaufmann,1999, ISBN 978-1-55860-343-1
4. Rod Stephens, “Essential Algorithms”, Wiley, ISBN: ISBN: 978-1-118-61210-1

IV B. Tech I Semester	BLOCK CHAIN TECHNOLOGY (V231416148)	L	T	P	C
		3	0	0	3

Course Outcomes: At the end of the Course student will be able to:

CO1: Discuss the Cryptographic primitives used in Block chain (K2)
CO2: Discuss about various technologies borrowed in block chain (K2)
CO3: Illustrate various models for block chain (K2)
CO4: Discuss about Ethereum (K2)
CO5: Discuss about Hyperledger Fabric (K2)

UNIT I: INTRODUCTION TO BLOCKCHAIN: Introduction, history of Bitcoin and origins of Blockchain, Fundamentals of Blockchain and key components (Chapter 1-book1), Permission and Permission-less platforms(Chapter 1-book2), Introduction to Cryptography, SHA256 and ECDSA, Hashing and Encryption, Symmetric/ Asymmetric keys, Private and Public Keys(Chapter 3-book2).

UNIT II: TECHNOLOGIES BORROWED IN BLOCKCHAIN: Technologies Borrowed in Blockchain –hash pointers- - Digital cash etc.- Bitcoin blockchain - Wallet – Blocks Merkley Tree - hardness of mining - Transaction verifiability - Anonymity - forks - Double spending - Mathematical analysis of properties of Bitcoin - Bitcoin- the challenges and solutions. (Chapter 3-book2).

UNIT III CONSENSUS MECHANISMS: Consensus Algorithms: Proof of Work (PoW) as random oracle - Formal treatment of consistency- Liveness and Fairness - Proof of Stake (PoS) based Chains -Hybrid models (PoW + PoS), Byzantine Models of fault tolerance. ((Chapter 1-book2))

UNIT IV ETHEREUM: Ethereum -Ethereum Virtual Machine (EVM) -Wallets for Ethereum -Solidity - Smart Contracts **(Chapter 5-book1),** - The Turing Completeness of Smart Contract Languages and verification challenges- Using smart contracts to enforce legal contracts- Comparing Bitcoin scripting vs. Ethereum Smart Contracts-Some attacks on smart contracts (**Chapter 6 and Chapter 7-book2)**

UNIT V HYPERLEDGER FABRIC: Hyperledger fabric- the plug and play platform and mechanisms in permissioned blockchain - Beyond Cryptocurrency – applications of blockchain in cyber security- integrity of information- E-Governance and other contract enforcement mechanisms - Limitations of blockchain as a technology and myths vs reality of blockchain technology **(Chapter 16-book1),** (**Chapter 9 -book2)**

TEXT BOOKS:

1. Blockchain Technology Chandramouli Subramanian, Asha A George, Abhilash K A and Meena Karthikeyan, University Press, 2020.
2. Mastering Blockchain - Distributed ledger technology, decentralization, and smart contracts explained, Imran Bashir,2nd ed. Edition,2018, pakct publication

REFERENCES:

1. S.Shukla, M.Dhawan, S.Sharma,S. Venkatesan "Blockchain Technology: Cryptocurrency and Applications" ,Oxford University Press 2019 .
2. Cryptography and network security principles and practice, William Stallings, Pearson, 8th edition,

WEB REFERENCES:

1. https://drive.google.com/file/d/1PtYaDmWYaqPVGjKDnMYGWO5eoI5wMPtJ/view
2. https://archive.nptel.ac.in/courses/106/104/106104220/
3. https://www.tutorialspoint.com/blockchain/index.htm

IV B. Tech I Semester	NOSQL DATABASES (V231416149)	L	T	P	C
		3	0	0	3

Course Outcomes: At the end of the Course the student will be able to

CO1: Explain and compare different types of NoSQL Databases

CO2: Compare and contrast RDBMS with different NoSQL databases.

CO3: Demonstrate the detailed architecture and performance tune of Document-oriented NoSQL databases.

CO4: Explain performance tune of Key-Value Pair NoSQL databases.

CO5: Apply NoSQL development tools on different types of NoSQL Databases.

UNIT-I: Overview and History of NoSQL Databases. Definition of the Four Types of NoSQL Database, The Value of Relational Databases, Getting at Persistent Data, Concurrency, Integration, Impedance Mismatch, Application and Integration Databases, Attack of the Clusters, The Emergence of NoSQL, Key Points.

UNIT-II: Comparison of relational databases to new NoSQL stores, MongoDB, Cassandra, HBASE, Neo4j use and deployment, Application, RDBMS approach, Challenges NoSQL approach, Key-Value and Document Data Models, Column-Family Stores, Aggregate-Oriented Databases. Replication and sharding, Map Reduce on databases. Distribution Models, Single Server, Sharding, Master-Slave Replication, Peer-to-Peer Replication, Combining Sharding and Replication.

UNIT-III: NoSQL Key/Value databases using MongoDB, Document Databases, Document oriented Database Features, Consistency, Transactions, Availability, Query Features, Scaling, Suitable Use Cases, Event Logging, Content Management Systems, Blogging Platforms, Web Analytics or Real-Time Analytics, E-Commerce Applications, Complex Transactions Spanning Different Operations, Queries against Varying Aggregate Structure.

UNIT-IV: Column-oriented NoSQL databases using Apache HBASE, Column-oriented NoSQL databases using Apache Cassandra, Architecture of HBASE, Column-Family Data Store Features, Consistency, Transactions, Availability, Query Features, Scaling, Suitable Use Cases, Event Logging, Content Management Systems, Blogging Platforms, Counters, Expiring Usage.

UNIT-V: NoSQL Key/Value databases using Riak, Key-Value Databases, Key-Value Store, Key-Value Store Features, Consistency, Transactions, Query Features, Structure of Data, Scaling, Suitable Use Cases, Storing Session Information, User Profiles, Preferences, Shopping Cart Data, Relationships among Data, Multi operation Transactions, Query by Data, Operations by Sets. Graph NoSQL databases using Neo4, NoSQL database development tools and programming languages, Graph Databases, Graph Database. Features, Consistency, Transactions, Availability, Query Features, Scaling, Suitable Use Cases.

TEXT BOOKS:

1. Sadalage,P.&Fowler,NoSQLDistilled:ABriefGuidetotheEmergingWorldof PolyglotPersistence, Wiley Publications,1st Edition,2019.

WEB REFERENCES:

1. https://www.ibm.com/cloud/learn/nosql-databases
2. https://www.coursera.org/lecture/nosql-databases/introduction-to-nosql-VdRNp
3. https://www.geeksforgeeks.org/introduction-to-nosql/
4. https://www.javatpoint.com/nosql-databa

IV B. Tech I Semester	PROMPT ENGINEERING (SKILL ENHANCEMENT COURSE) (V231416161)	L	T	P	C
		0	1	2	2

Course Objectives:

The main objectives of the course are to

- Apply iterative prompting for clarity and context.
- Create varied prompts to steer model outputs.
- Construct chain-of-thought and structured prompts.
- Develop retrieval-augmented pipelines to ground outputs.
- Evaluate LLM agents and multimodal apps for ethics and robustness.

Course Outcomes: At the end of the Course student will be able to:

CO1: Understand the fundamentals of Generative AI, LLMs, prompt structures, and prompting principles.

CO2: Apply various prompt engineering techniques to solve problems using Generative AI tools.

CO3: Analyze AI-generated responses to identify ambiguity, hallucination, bias, and other limitations.

CO4: Design effective prompts and prompt workflows for real-world applications.

CO5: Evaluate the effectiveness, reliability, safety, and ethical aspects of AI-generated outputs.

Unit I: Foundations of Prompt Engineering: Definition of prompt engineering, Distinction between prompt engineering and model fine-tuning, Motivation and benefits of prompt engineering, Core principles of effective prompt design**,** Anatomy of a prompt, Setting up the Python environment for LLM interaction, Iterative prompting lifecycle, Common prompt pitfalls and remediation

Lab Experiments:

1. Environment & Connectivity: Install required packages (e.g., transformers, openai); securely configure the API key; run a simple "Hello, world" prompt to verify model access.
2. Baseline vs. Enhanced Prompts: Execute a naïve prompt ("Write a one-paragraph bio of Ada Lovelace.") and an enhanced prompt that adds role framing, specificity, and explicit format instructions; compare both outputs for relevance, completeness, and style.
3. Iterative Refinement on a Simple Task: Summarize the plot of the Shakespearean play Romeo and Juliet in two sentences through three rounds of prompt tweaking:
    a. Minimal instruction.
    b. Addition of length and style constraints
    c. Specification of key content elements (setting and theme)

    Document how each iteration changes and improves the result.

4. Diagnosing Prompt Failures & Edge Cases: Craft a vague or contradictory prompt; analyze the failure mode (ambiguity, missing context, or format errors); refine the prompt by adding examples or clarifying instructions.

Unit II: Advanced Prompt Patterns & Techniques: Enhanced prompt anatomy: contextual detail and explicit output specifications, Few-shot in-context prompting, Prompt structuring and template design, Role-based prompting to establish personas or system behavior, Negative prompting to filter or suppress undesired content, Constraint specification and instruction enforcement (e.g., length, format), Iterative prompt refinement and optimization.

Lab Experiments:

1. Few-Shot vs. Zero-Shot Comparison: Design and execute a zero-shot prompt and a few-shot prompt (with 2–3 exemplar input-output pairs) for a chosen text task (e.g., sentiment classification or translation); compare outputs for accuracy, consistency, and adherence to examples.
2. Role-Based & Negative Prompting: Craft a role-based prompt to establish a specific persona (e.g., "You are a financial advisor…"); then create a negative prompt to suppress undesired content (e.g., "Do not mention any brand names"); evaluate how each influences the model's response.
3. Constraint Specification & Iterative Refinement: Select an open-ended task (e.g., summarizing a technical article); issue a basic prompt; identify failures in length or format; refine the prompt by adding explicit constraints (word count, bullet format, etc.); document improvements over two refinement cycles.

Unit III: Structured Output & Reasoning Techniques: Importance of structured outputs for real-world applications, Prompting for specific formats (lists, tables, Markdown), Generating valid JSON and YAML via explicit instructions, Eliciting chain-of-thought reasoning in zero-shot prompts, Decomposing complex tasks into manageable sub-tasks

Lab Experiments:

1. Structured Format Prompting: Instruct the model to output information as bullet lists and Markdown tables (e.g., "List three benefits of daily exercise in a Markdown table with columns 'Benefit' and 'Description.'"); verify the output matches the requested structure.
2. JSON/YAML Generation: Provide a brief dataset description (e.g., three books with title, author, publication year) and prompt the model to produce valid JSON or YAML; use a parser to validate syntax and refine the prompt if errors occur.
3. Chain-of-Thought & Task Decomposition: Present a multi-step problem (e.g., a logic puzzle) and apply zero-shot CoT prompting (e.g., "Let's think step by step. Explain your reasoning before the final answer."); separately, decompose the problem into sequential sub-questions, collect partial answers, combine them, and compare accuracy against a direct-answer baseline.

Unit IV: Retrieval-Augmented Generation & LangChain Workflows: Limitations of LLM internal knowledge, Need for external data sources, Introduction to Retrieval-Augmented Generation (RAG), Overview of RAG architecture (indexing vs. retrieval + generation), Getting started with LangChain for LLM applications, Basics of LangChain Expression Language (LCEL), Simplified indexing pipeline: document loading & text splitting, Fundamentals of embeddings and vector stores, Building a basic retrieval-generation pipeline with an LCEL chain.

Lab Experiments:

1. Building a Simple LCEL Chain: Create a minimal LCEL script that accepts a fixed instruction (e.g., "Summarize this text: …"), passes it to an LLM, and prints the result; verify end-to-end execution.
2. Basic Data Indexing for RAG: Load a small collection of documents; split into uniform chunks (e.g., 200 tokens); generate embeddings for each chunk; store them in an in-memory vector store; inspect for consistency.
3. Constructing & Running a Basic RAG Chain: Build a pipeline that:
    a. Receives a user query
    b. Retrieves the top-k relevant chunks
    c. Constructs a combined prompt with context + query
    d. Send it to the LLM
    e. Returns the answer

Test with sample queries and compare factual accuracy against a prompt without retrieval.

Unit V: Agents, Multimodal AI & Ethical Evaluation: Introduction to LLM agents and their basic architecture, Overview of multimodal AI models (VLMs), Prompting for text-to-image generation and image understanding, Importance of prompt evaluation beyond subjective judgment, Manual evaluation techniques (heuristic checks for accuracy, relevance, format), Introduction to "LLM-as-Judge" for automated evaluation, Security considerations (prompt injection, sensitive-information risks), Prompt-based mitigation strategies for safety and robustness, Ethical concerns (bias, misinformation, data privacy), Brief exploration of UI frameworks (Streamlit/Gradio) for deploying prompt-driven apps, Adapting to the evolving nature of prompt engineering through continuous learning

Lab Experiments:

1. Building a Simple LLM Agent: Register a tool (e.g., a calculator function) and craft prompts that instruct the agent to invoke it when required; implement using LangChain or a function-calling API; test on queries requiring tool execution.
2. Multimodal Prompting Exploration: Generate images from detailed text prompts; feed one generated image into an image-understanding model or API with an appropriate prompt; compare the returned caption to the original prompt to evaluate alignment.
3. Prompt Evaluation & Ethics Workshop:

a. Select two existing prompts and generate multiple outputs; apply manual heuristic checks for accuracy, relevance, and format compliance.
b. Use an "LLM-as-Judge" prompt (e.g., "Rate these outputs on a scale of 1–5 for clarity and correctness.") to automate evaluation.
c. Design a prompt- injection test (e.g., "Ignore previous instructions…"), observe the response, then refine system prompts to mitigate the vulnerability.

IV B. Tech I Semester	CONSTITUTION OF INDIA (V2314161C1)	L	T	P	C
		2	0	0	-

Course Objectives:

- Understand the premises informing the twin themes of liberty and freedom from a civil rights perspective.
- To address the growth of Indian opinion regarding modern Indian intellectuals' constitutional role and entitlement to civil and economic rights as well as the emergence of nationhood in the early years of Indian nationalism.
- To address the role of socialism in India after the commencement of the Bolshevik Revolution in 1917 and its impact on the initial drafting of the Indian Constitution.

Course Outcomes: At the end of the Course student will be able to:

CO1: Understand the historical background, salient features, structure, and philosophy of the Constitution of India.
CO2: Apply constitutional principles related to Fundamental Rights, Duties, and Directive Principles in civic life.
CO3: Analyze the roles and functions of the Union and State Governments, Legislature, Executive, and Judiciary.
CO4: Examine constitutional provisions related to elections, federalism, emergencies, amendments, and democratic governance.
CO5: Evaluate contemporary issues based on constitutional values and principles of responsible citizenship.

UNIT–I: History of Making of the Indian Constitution: History, Drafting Committee, (Composition & Working)
Philosophy of the Indian Constitution- Preamble, Salient, Features

UNIT–II: Contours of Constitutional Rights & Duties: Fundamental Rights, Right to Equality, Right to Freedom, Right against Exploitation, Right to Freedom of Religion, Cultural and Educational Rights, Right to Constitutional Remedies, Directive Principles of State Policy, Fundamental Duties.

UNIT–III: Organs of Governance: Parliament, Composition, Qualifications and Disqualifications, Powers and Functions, **Executive-** President, Governor, Council of Ministers, Judiciary, Appointment and Transfer of Judges, Qualifications, Powers and Functions

UNIT–IV: Local Administration: District's Administration head: Role and Importance, Municipalities: Introduction, Mayor and role of Elected Representative CEO of Municipal Corporation, Pachayati raj: Introduction, PRI: ZilaPachayat, Elected officials and their roles, CEO ZilaPachayat: Position and role, Block level: Organizational Hierarchy (Different departments), Village level: Role of Elected and Appointed officials, Importance of grass root democracy

UNIT–V: Election Commission: Election Commission: Role and Functioning, Chief Election Commissioner and Election Commissioners, State Election Commission: Role and Functioning, Institute and Bodies for the welfare of SC/ST/OBC and women.

Text Books:

1. The Constitution of India, 1st Edition, (Bare Act), Government Publication, 1950
2. Framing of Indian Constitution, 1st Edition, Dr. S. N. Busi, Dr. B. R. Ambedkar 2015

Reference Books:

1. Indian Constitution Law, 7th Edition, M. P. Jain, Lexis Nexis, 2014

B.Tech. – IV Year II Semester

S.No.	Category	Title	Subject Code	L	T	P	Credits
1	Internship & Project Work	Full semester Internship &Project Work	V2314261A1	0	0	24	12