INSTITUTE OF AERONAUTICAL ENGINEERING
(Autonomous)
Dundigal - 500 043, Hyderabad, Telangana

COURSE CONTENT

BLOCKCHAIN TECHNOLOGY

V Semester: CSE(DS) / CSE(CS)

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
ACSD57	Elective	3	0	0	3	40	60	100
Contact Classes: 48	Tutorial Classes: Nil	Practical Classes: Nil				Total Classes: 48		
Prerequisites: Basic Programming (preferably Python or JavaScript), Cryptography Fundamentals, Computer Networks.								

I. COURSE OVERVIEW:

This course introduces the core concepts and technologies behind Blockchain systems. Students will learn about distributed ledgers, consensus mechanisms, cryptocurrencies, smart contracts, and blockchain platforms like Ethereum and Hyperledger. The course covers practical development of decentralized applications (DApps), along with emerging trends such as NFTs, DeFi, DAOs, and Zero-Knowledge Proofs. Through hands-on labs and projects, students gain skills to design, develop, and deploy secure blockchain-based solutions aligned with current industry practices.

II. COURSE OBJECTIVES:
The students will try to learn:

I.   The core concepts of blockchain technology, including how distributed ledgers, cryptographic techniques, and consensus mechanisms form the backbone of decentralized systems.
II. The architecture and functionalities of popular blockchain platforms like Ethereum and Hyperledger, along with the process of creating smart contracts and decentralized applications.
III. The working principles and real-world use cases of emerging blockchain trends such as NFTs, DeFi, DAOs, and Layer-2 solutions.
IV. The methods to address blockchain security challenges, understand privacy enhancements like Zero-Knowledge Proofs, and the regulatory and ethical considerations of blockchain adoption.

III. COURSE OUTCOMES:

CO1   Explain the structure and functioning of blockchain systems, distributed ledgers, and consensus mechanisms.
CO2   Demonstrate the use of cryptographic techniques such as hashing and digital signatures in blockchain transactions.
CO3   Design and develop smart contracts using Solidity and deploy them on Ethereum test networks.
CO4   Build and test basic decentralized applications (DApps) using tools like Web3.js, Remix, and Truffle.
CO5   Analyze the application of blockchain in domains like DeFi, NFTs, DAOs, and supply chain systems.
CO6   Evaluate blockchain security threats, privacy techniques like Zero-Knowledge Proofs, and current trends in regulatory frameworks.

IV. COURSE CONTENT:

MODULE–I: INTRODUCTION TO BLOCKCHAIN & DISTRIBUTED LEDGER TECHNOLOGY (9)
Evolution of Blockchain: From Bitcoin to Web3, Basic concepts: Distributed Ledger Technology, Blockchain structure, Blocks, Chains, Transactions, Types of Blockchain: Public, Private, Consortium, Blockchain vs Traditional Databases, Consensus Mechanisms: Proof of Work, Proof of Stake, Delegated PoS, BFT, Cryptocurrency fundamentals: Bitcoin overview, setting up a Bitcoin testnet node, Simulating transactions on a test network.

MODULE–II: CRYPTOGRAPHY & SMART CONTRACTS (9)
Hash Functions: SHA256, Merkle Trees, Digital Signatures and Public Key Cryptography, Wallets, Addresses, and Keys, Smart Contracts: Introduction and Lifecycle, Ethereum Blockchain: Architecture, EVM, Gas, Solidity Language Basics, Writing and deploying basic Solidity contracts on Remix IDE, Wallet creation using MetaMask.

MODULE–III: BLOCKCHAIN PLATFORMS AND DEVELOPMENT (9)
Ethereum Detailed Architecture, DApps: Frontend-backend interaction with blockchain, Web3.js / Ethers.js Introduction, Introduction to Truffle & Ganache.
Hyperledger Fabric and Composer: Enterprise Blockchain, Chaincode basics, Building a simple DApp (e.g., Voting or Crowdfunding), Smart contract deployment on Ganache.

MODULE–IV: ADVANCED BLOCKCHAIN USE CASES & TECHNOLOGIES (9)
Decentralized Finance (DeFi): AMMs, Yield Farming, Stablecoins, Non-Fungible Tokens (NFTs): Standards (ERC-721, ERC-1155), DAOs (Decentralized Autonomous Organizations), Cross-chain and Layer-2 Solutions: Polkadot, Optimism, Arbitrum, Oracles: Chainlink, Band Protocol, InterPlanetary File System (IPFS) for decentralized storage, Minting NFTs on Ethereum testnets, Using Chainlink for Oracle data fetching.

MODULE-V: SECURITY, PRIVACY, AND FUTURE TRENDS (12)
Blockchain Security: Common attacks, Auditing Smart Contracts and Best Practices, Zero Knowledge Proofs and zk-SNARKs, Regulatory and Legal Aspects of Blockchain, Web3 and the Metaverse, Recent Trends: CBDCs, Green Blockchain, AI + Blockchain integration, Simulating smart contract vulnerabilities (Reentrancy bug), Intro to zkApps on platforms like Mina or StarkNet (overview + simulation).

V. TEXTBOOKS:

1. Imran Bashir, Mastering Blockchain: Unlocking the Power of Cryptocurrencies, Smart Contracts, and Decentralized Applications, 4th Edition, Packt Publishing, 2023.
2. Andreas M. Antonopoulos, Mastering Bitcoin: Programming the Open Blockchain, O'Reilly Media, 2nd Edition, 2017.
3. Ritesh Modi, Blockchain for Architects, Packt Publishing, 2018.

VI. REFERENCE BOOKS:

1. Arvind Narayanan, Joseph Bonneau, Edward Felten, Andrew Miller, Steven Goldfeder, Bitcoin and Cryptocurrency Technologies, Princeton University Press, 2016.
2. Elad Elrom, The Blockchain Developer, Apress, 2019.
3. Xun (Brian) Wu & Ling (Alex) Zhang, Blockchain by Example, Packt Publishing, 2019.
4. Koshik Raj, Blockchain: Architecture, Use Cases, and Future Trends, Wiley India, 2021.

VII. WEB REFERENCES

1. NPTEL & MOOC courses titled Blockchain Technology
   🔗 https://nptel.ac.in/courses/106105184
2. Smart world – Blockchain Technology Notes and Study Materials
   🔗 https://www.smartzworld.com/notes/blockchain-technology-notes-pdf-bt-notes-pdf/
3. Vidyarthi plus – Blockchain Technology Lecture Notes (All Units)
   🔗 https://www.vidyarthiplus.com/vp/thread-Blockchain-Technology-Lecture-Notes.html
4. Coursera – Blockchain Specialization (by University at Buffalo & SUNY)

🔗 https://www.coursera.org/specializations/blockchain

VIII. MATERIALS ONLINE

1. Course template
2. Tutorial question bank
3. Tech talk topics
4. Open-ended experiments
5. Definitions and terminology
6. Assignments
7. Model question paper – I
8. Model question paper – II
9. Lecture notes
10. PowerPoint presentation
11. E-Learning Readiness Videos (ELRV)