**Savitribai Phule Pune University**
**(Formerly University of Pune)**

**Department of Technology**
**Board of Studies Electronics and Electrical Technology (EE)**
**STRUCTURE OF ONE YEAR FULL TIME POST GRADUATE DIPLOMA IN BLOCKCHAIN TECHNOLOGIES (PGDBT)**

Each Trimester is of 14 weeks followed by examination in subsequent week.

**Trimester 1**

| Sr. No. | Course Code | Course Name | Teaching Scheme | | | Credits |
|---|---|---|---|---|---|---|
| | | | L | T | P | |
| 1 | PGDBT 1 | The Fundamentals of Blockchain & Cryptocurrencies | 3 | 0 | 0 | 3 |
| 2 | PGDBT 2 | Core Applications of Blockchain | 2 | 1 | 0 | 3 |
| 3 | PGDBT 3 | Types of Blockchain Networks and Implementation | 1 | 1 | 1 | 3 |
| 4 | PGDBT 4 | Blockchain Platforms | 1 | 1 | 1 | 3 |
| 5 | PGDBT 5 | Smart Contracts | 1 | 1 | 1 | 3 |
| 6 | PGDBT 6 | The Business Applications and Blockchain Lab | | | 4 | 2 |
| 7 | PGDBT 7 | Blockchain Use Cases Lab | | | 4 | 2 |
| | | **Total Credits** | | | | **19** |

**Trimester 2**

| Sr. No. | Course Code | Course Name | Teaching Scheme | | | Credits |
|---|---|---|---|---|---|---|
| | | | L | T | P | |
| 1 | PGDBT 8 | Basics of Blockchain Architecture | 1 | 1 | 1 | 3 |
| 2 | PGDBT 9 | Technicalities & Implementation of Blockchain | 1 | 1 | 1 | 3 |
| 3 | PGDBT 10 | Elective 1 | 2 | 0 | 2 | 3 |
| 4 | PGDBT 11 | Elective 2 | 2 | 0 | 2 | 3 |
| 5 | PGDBT 12 | Deep Dive Ethereum Project | 0 | 0 | 4 | 2 |
| 6 | PGDBT 13 | Deep Dive Hyperledger Project | 0 | 0 | 8 | 4 |
| | | **Total Credits** | | | | **18** |

**Trimester 3**

| Sr. No. | Course Code | Course Name | Teaching Scheme | | | Credits |
|---|---|---|---|---|---|---|
| | | | L | T | P | |
| 1. | PGDBT 14 | On Job Training/ Internship | | | | 12 |
| | | | | | | |
| | | **Total** | | | | **12** |
| | | **Total Course Credits** | | | | **49** |

**List of Electives**

| | Course Name |
|---|---|
| **A** | Solana |
| **B** | Solidity |
| **C** | Corda |
| **D** | Quorum |

**Eligibility Criteria- Graduation in Engineering/Technology (Any Branch), BCS, BSc in Computer/IT/ Electronics/Instrumentation (or allied branches) with a good knowledge of computing and programming.**

PGDBT 1: The Fundamentals of Blockchain & Cryptocurrencies

Contents:

- Why blockchain matters more than you think
- What is Blockchain?
- How does a Blockchain work
- The origins of blockchain
- Blockchain came from Bitcoin
- Why is Blockchain a Distributed, P2P Network?
- Blockchain Vs Cryptocurrency
- Types of Blockchain
- What Are Different Blockchain Technologies?
- Benefits of using Blockchain Technology
- The Origin of BlockchainCompleted
- Blockchain came from Bitcoin
- Why blockchain matters more than you think What is Blockchain and what is it going to change The Origin of Blockchain
- A deeper dive into understanding Blockchain Overview of Blockchain
- Blockchain Technology
- The Evolution of Blockchain Technology
- Blockchain Technology - Basics
- Introduction to the Decentralized Web Introduction to Distributed Ledgers
- Merkle Tree and Hashing
- Blocks, Wallets, and Addresses
- Public and Private Key
- Cryptography and Cryptographic Algorithms
- Transaction Execution and Distribution
- Components of Blockchain Ecosystem
- Blockchain Architecture

Books:

1. The Basics of Bitcoins and Blockchains by Anthony Lewis, Two Rivers Distribution
2. Blockchain Explained: A Pragmatic Approach by Srihari Kapu,
3. Blockchain Technology by Chandramouli Subramanian , University Press India

## PGDBT 2: Core Applications of Blockchain

Contents:

- Gartner's Hype Curve & Evolution of Blockchain Technology
- Blockchain Need and Genesis Key
- Characteristics of Blockchain
- P2P System Cryptography, Hashing and Transactions
- Digital Signatures
- Blockchain Structure
- Mining and Consensus
- Centralization and Decentralization
- Byzantine General Problems
- Forks: soft & hard forks, Ummer blocks
- Different forks from Bitcoin Wallets, Transactions, Public & Private keys

Books:

1. Building Blocks of Blockchain by Anil Sinha, University Press
2. Blockchain Basis: The Core Concepts and Technical Foundations for Beginners by Mark ArcherPGDBT 3: Types of Blockchain Networks, O'Rielly

## PGDBT 2: Types of Blockchain Networks

Contents:

- Types of Blockchain Networks
- The 4 Types of Blockchain Networks
- Network Applications
- Network Challenges
- Blockchain Network Security
- How Can Blockchain Help in Cyber Security?
- Conceptualizing Blockchains - Characteristics and Applications
- How Blockchain is set to change transactions, information flow and business processes
- Which Networks to use

Books:

1. Blockchain Economics: Implications Of Distributed Ledgers - Markets, Communications Networks, And Algorithmic Reality by Frank Witte and Paolo Tasca, Standard Press
2. Blockchain Consortiums - A Comprehensive Handbook: Analyzing the Business Model of the future by Varun Singhi, Notion Press

## PGDBT 4: Types of Blockchain Platforms

Contents:

- Hyperledger Applications and Tools
- Hyperledger Fabric Explained
- Hyperledger vs. Permission-less Blockchains
- Ethereum VS Hyperledger Fabric
- What is the difference between a cryptocurrency coin and a token?
- Hyperledger Fabric: Project

Books:

1. Matt Zand, Xun (Brian) Wu, and Mark Anthon, “Hands-on Smart Contract Development with Hyperledger Fabric V2: Building
2. Enterprise Blockchain Applications”, O’ReillyMastering Ethereum: Building Smart Contracts and DApps by Andreas M. Antonopoulos and Dr. Gavin Wood, O’ Reilley

## PGDBT 5: Smart Contracts

Contents:

- What is a smart contract?
- Smart contracts and why they’re increasing in popularity for a variety of applications
- Contract Dimensions
- Legal Considerations
- Security Challenges & Measures
- Smart contract platforms
- Smart Contract Implementation Ricardian Contracts & Smart Contracts Practice: Deploy a Smart Contract

Books:

1. Andreas M. Antonopoulos and Gavin Wood, “Mastering Ethereum: Building Smart Contracts and DApps”, O’Reilly Melanie Swan, “Blockchain: Blueprint for a New Economy”, O’Reilly
2. Hands-On Smart Contract Development with Solidity and Ethereum: From Fundamentals to Deployment Paperback – 6 December 2019 by David Hoover, O’ Really
3. Smart Contracts and Comparative Law: A Western Perspective by Andrea Stazi, Springer Publications

## PGDBT 6: The Business Applications and Blockchain

Contents:

- Use cases on a variety of blockchain applications including supply chain, healthcare, consumer, and social impact
- Learn how companies can use new technologies such as blockchain to enter new markets or turn around a flagging business
- Overview of the developing blockchain ecosystem from service providers to initial coin offerings
- Insights for entrepreneurs and investors on the market and how it's evolving
- Identifying new opportunities in the blockchain ecosystem
- Regulatory and Policy Considerations of Blockchain Technology
- Latest regulatory and policy developments and governance of blockchain in major economies
- Privacy and Risks in Using Blockchain Technology
- Risks associated with adopting new technologies such as blockchain, including hacking
- Privacy considerations around the blockchain
- Future of Blockchain Technology
- Trends to keep your eye on
- Ways to apply these emerging technologies to your organization through a final capstone project

Books:

1. Enterprise Blockchain: A Definitive Handbook by Navveen Balani and Rajeev Hathi
2. The Business Blockchain: Promise, Practice, and Application of the Next Internet Technology by Vitalik Buterin and William Mougayar, Wiley
3. Blockchain Revolution: How the Technology Behind Bitcoin and Other Cryptocurrencies is Changing the World by Don Tapscott and Alex Tapscott, Penguin Publishers

## PGDBT 7: Blockchain Use Cases

Contents:

- Blockchain Use Cases across industries
  - Automobile
  - Manufacturing
  - Renewable Energy
  - Supply Chain
  - Utilities
  - Agriculture
  - Logistics
  - Hospitality
  - Construction
  - Civil Engineering
- Blockchain convergence with multiple technologies
  - Blockchain with Artificial Intelligence
  - Blockchain and IoT
  - Blockchain and Cloud Computing
  - Blockchain and Machine Learning
  - Blockchain Cloud Computing
  - Blockchain and Cyber Security

Books:

1. Industry Use Cases on Blockchain Technology Applications in IoT and the Financial Sector Paperback – Import, 2 March 2021 by Zaigham Mahmood, Business Science Reference
2. Blockchain Applied: Practical Technology and Use Cases of Enterprise Blockchain for the Real World by Stephen Ashurst , Stefano Tempesta, Routledge

Trimester II

## PGDBT 8: Blockchain Architecture

Contents:

- Digital Assets and Multiple Parties
- Technical Approach
- Network Configuration
- Deciding Factors
- Additional Technologies Supporting Blockchain
- Programming Languages you can use to Build Blockchain solutions.
- Cryptography and Blockchain Algorithms
- Overview of Blockchain Platforms
- Public Platforms
- Commercial Platforms
- Blockchain Functional Architecture
- Blockchain Environment Considerations
- Cloud vs Native

Books:

1. Architecture for Blockchain Applications by Xiwei Xu, Springer
2. Architectures and Frameworks for Developing and Applying Blockchain Technology (Advances in Systems Analysis, Software Engineering, and High Performance Computing) by Nansi Shi, IGI Global

## PGDBT 9: Technicalities & Implementation of Blockchain

Contents:

- Blockchain Implementation & Use cases
- Finance & Banking Industry Introduction
- Case Study: Remittance with crypto-currencies
- Case Study: Ripple Supply Chain & Logistics Introduction
- Case Study: Tracking & Authenticity
- Case Study: Genuinety Health Care & Medicals Introduction
- Case Study: Electronic Health Record System

- Case Study: Biomedicines Research Governance & Public Services Introduction
- Case Study: Voting on Blockchain
- Case Study: Public Benefit Distribution System
- Case Study: Document Management & Storage

Books:

1. Blockchain For Business With Hyperledger Fabric: A Complete Guide To Enterprise Blockchain Implementation Using Hyperledger Fabric by Nakul Shah, BpB Publications
2. Blockchain Systems and Communication Networks: From Concepts to Implementation by Mubashir Husain Rehmani, Springer

## PGDBT 10: Elective: Solano

Contents:

- What Is Solana?
- Founder and Background
- Underlying Technology
- Inventions
- Proof Of History
- History Of Solana
- SOL Token
- Best SOL Wallets
- Best SOL Exchanges 30 min
- What Are Solana Clusters?
- Managing Forks
- Transaction Fees
- Future Outlook

Books:

1. Everything about SOLANA : The superfast blockchain: What is solana? SOL (Everything about cryptocurrencies Book 2) by Arya Ghobadi
2. Solana: The New Era: (nfts, polkadot, trading crypto, bitcoin, staking crypto, invest crypto, ethereum, blockchain, defi, cardano, binance, solana, dogecoin, shiba) by Guillermo Jimenez

## PGDBT 10: Elective: Solidity

Contents:

- Introduction to Solidity
- Solidity – Beginners to Intermediate
- Units in Ethereum
- Exception handling
- Introduction to Smart Contracts

- Tools and Deployment on Testnet
- Introduction to the Project
- Setting up the Project
- Creating ERC-20 Token
- Developing Smart contract for dApp
- Writing deployment Scripts
- Deployment on local development network (Ganache)
- Connecting Front-End with Smart Contract
- Setting up custom RPC and Ganache account
- Front-End of dApp
- Issue Rewards and wrap up the project

Books:


1. Solidity Programming Essentials: A beginner's guide to build smart contracts for Ethereum and blockchain by Ritesh Modi. Packt
2. Hands-On Smart Contract Development with Solidity and Ethereum: From Fundamentals to Deployment by David Hoover
3. Ethereum Smart Contract Development in Solidity by Gavin Zheng, Springer


## PGDBT 10: Elective: Corda

Contents:

- What is Corda?
- Features of Corda.
- Advantages and Disadvantages of Corda.
- How Corda is different from other blockchain technologies
- Structure of Corda
- Ledgers in Corda
- States in Corda
- The Vault
- Key Concepts of Corda
- Architecture of Corda
- Network in Corda
- Nodes in Corda
- Transactions in Corda
- Consensus in Corda
- Contracts in Corda
- Identity in Corda
- Flow in Corda
- Time Window in Corda

- Notary Services in Corda
- Oracle Services in Corda
- Tools, Plugins, Languages
- Getting set up for Corda Development
- A guide to run a simple CorDapp
- What is CorDapp?
- Structuring a CorDapp.
- Creating a CorDapp.
- Building a CorDapp.
- Debugging a CorDapp.
- Signing a CorDapp.

Books:

1. Mastering Corda: Blockchain for Java Developers (Grayscale Indian Edition) by Jamiel Sheikh, Greyscale

## PGDBT 10: Elective: Quorum

Contents:

- What is Quorum?
- Features of Quorum
- Advantages and Disadvantages of Quorum
- How Quorum is different from other Blockchain Technologies
- Data Structure
- Quorum Architecture
- Quorum Key Components
- What is Quorum Transaction?
- Quorum Private Transaction
- Quorum Public Transaction
- Quorum Contracts
- What is Quorum Consensus?
- What is zk-SNARKS?
- What is ZSL?
- Components of ZSL
- ZSL vs Transparent Layer
- Repositories, Tools, Libraries, Languages
- Installation Guideline for Quorum
- Building Quorum Node from Source
- Installing Constellation
- Installing Tessera
- Setting up your Quorum Client Environment
- Installing Virtual Box

- Installing Vagrant
- Installing Git
- Connecting Truffle to Quorum
- Deploying smart contracts
- Make transactions private
- Interacting with contracts privately
- Reducing the number of Nodes

Books:

1. Quorum Blockchain: Enterprise-Ready Distributed Ledger & Smart Contract Platform by Kunal Jauhari
2. Blockchain From Concept to Execution: BitCoin, Ethereum, Quorum, Ripple, R3 Corda, Hyperledger Fabric/SawTooth/Indy, MultiChain, IOTA, CoCo: From Concept to Execution-New by Debajani Mohanty, BPB Publications

## PGDBT 11: Deep Dive Ethereum

Contents:

- Ethereum Overview
- Ethereum Clients
- ERC-20 Overview
- Ethereum Test Networks
- Integrated Development Environment
- Local Test Nodes with RPC Interface
- Command Line Based Development Tools
- Code Analysers
- Browsers
- DAO Overview
- Use Cases
  - Cross-Border Payments
  - Supply Chain
  - Identity
  - Trade Finance
  - Smart Power Grids

Books:

1. Mastering Ethereum: Building Smart Contracts and DApps by Andreas M. Antonopoulos and Dr. Gavin Wood, SPD Publications
2. Ethereum Projects for Beginners: Build blockchain-based cryptocurrencies, smart contracts, and DApps by Kenny Vaneetvelde, Packxx

## PGDBT 12: Deep Dive Hyperledger

Contents:

- Try To Create Channel when Org is not Part Of Consortium
- System Channel Update – Consortium Info Update
- Create Channel and Join all Peers- After Updating Consortium with New Org
- Deploy Chaincode, Invoke Transaction and Verify data in State DB
- Add New Orderer in Existing Fabric Network – Flow Diagram
- Create All Certificates using Certificate Authority for whole Fabric Network
- Create Cryptomaterials For New Orderer

Books:


1. Hyperledger Fabric In-Depth: Learn, Build And Deploy Blockchain Applications Using Hyperledger Fabric: Learn, Build and Deploy Blockchain Applications Using Hyperledger Fabric (English Edition) by Ashwani Kumar, BPB Publications
2. Mastering Hyperledger Fabric: Master The Art of Hyperledger Fabric on docker, docker swarm and Kubernetes, 1st Edition by Narendranath Reddy Thota, BPB Publications
3. Blockchain For Business With Hyperledger Fabric: A Complete Guide To Enterprise Blockchain Implementation Using Hyperledger Fabric by Nakul Shah, BPB Publications