Course Code:	Course Title	Credit
CSDC7022	**Blockchain**	**3**

Prerequisite: Cryptography and System Security	
Course Objectives:	
1	Understand blockchain platforms and its terminologies.
2	Understand the use of cryptography required for blockchain
3	Understand smart contracts, wallets, and consensus protocols.
4	Design and develop blockchain applications.
Course Outcomes:	
1	Explain blockchain concepts
2	Apply cryptographic hash required for blockchain
3	Apply the concepts of smart contracts for an application.
4	Design a public blockchain using Ethereum.
5	Design a private blockchain using Hyperledger
6	Use different types of tools for blockchain applications.

Module		Content	Hours
1		**Introduction to Blockchain:**	04
	1.1	What is a blockchain, Origin of blockchain (cryptographically secure hash functions), Foundation of blockchain: Merkle trees	
	1.2	Components of blockchain, Block in blockchain, Types: Public, Private, and Consortium, Consensus Protocol, Limitations and Challenges of blockchain	
2		**Cryptocurrency:**	08
	2.1	Cryptocurrency: Bitcoin, Altcoin, and Tokens (Utility and Security), Cryptocurrency wallets: Hot and cold wallets, Cryptocurrency usage, Transactions in Blockchain, UTXO and double spending problem	

	2.2	Bitcoin Blockchain, Consensus in Bitcoin, Proof of Work (PoW), Proof of Burn(PoB), Proof of Stake (PoS), Proof of Elapsed Time (PoET), Life of a miner, Mining Difficulty, Mining Pools and its methods	
3		**Programming for Blockchain:**	08
	3.1	Introduction to Smart Contracts, Types of Smart Contracts, Structure of a Smart Contract, Smart Contract Approaches, Limitations of Smart Contracts	
	3.2	Introduction to Programming: Solidity Programming – Basics, functions, Visibility and Activity Qualifiers, Address and Address Payable, Bytes and Enums, Arrays-Fixed and Dynamic Arrays, Special Arrays-Bytes and strings, Struct, Mapping, Inheritance, Error handling	
	3.3	Case Study – Voting Contract App, Preparing for smart contract development	
4		**Public Blockchain**	08
	4.1	Introduction to Public Blockchain, Ethereum and its Components, Mining in Ethereum, Ethereum Virtual Machine (EVM), Transaction, Accounts, Architecture and Workflow, Comparison between Bitcoin and Ethereum	
	4.2	Types of test-networks used in Ethereum, Transferring Ethers using Metamask, Mist Wallet, Ethereum frameworks, Case study of Ganache for Ethereum blockchain, Exploring etherscan.io and ether block structure	
5		**Private Blockchain**	08
	5.1	Introduction, Key characteristics, Need of Private Blockchain, Smart Contract in a Private Environment, State Machine Replication, Consensus Algorithms for Private Blockchain - PAXOS and RAFT, Byzantine Faults: Byzantine Fault Tolerant (BFT) and Practical BFT, Byzantine Faults: Byzantine Fault Tolerant (BFT) and Practical BFT	
	5.2	Introduction to Hyperledger, Tools and Frameworks, Hyperledger Fabric, Comparison between Hyperledger Fabric & Other Technologies.	
6		**Tools and Applications of Blockchain:**	
	6.1	Blockchain in Action: Use Cases Financial Services, Insurance, Government, Supply Chain Management, Healthcare, Healthcare payments pre-authorization, The Internet of Things (IoT)	03

			Total	39

Textbooks:	
1	Blockchain Technology, Chandramouli Subramanian, Asha A. George, Abhilash K. A and Meena Karthikeyen, Universities Press.
2	Mastering Ethereum, Building Smart Contract and Dapps, Andreas M. Antonopoulos Dr. Gavin Wood, O'reilly.
3	Imran Bashir, Mastering Blockchain: A deep dive into distributed ledgers, consensus protocols, smart contracts, DApps, cryptocurrencies, Ethereum, and more, 3rd Edition, Packt Publishing
4	"Mastering Bitcoin, PROGRAMMING THE OPEN BLOCKCHAIN", 2nd Edition by Andreas M. Antonopoulos, June 2017, Publisher(s): O'Reilly Media, Inc. ISBN: 9781491954386.
5	"Blockchain for Enterprise Application Developers", Ambadas, Arshad SarfarzAriff, Sham – Wiley
Reference Books:	
1	Blockchain for Beginners, Yathish R and Tejaswini N, SPD
2	Blockchain Basics, A non Technical Introduction in 25 Steps, Daniel Drescher, Apress.
3	Blockchain with Hyperledger Fabric,Luc Desrosiers, Nitin Gaur, Salman A. Baset, Venkatraman Ramakrishna, Packt Publishing

Digital Useful Links	
1	Blockchain By Example, Bellaj Badr, Richard Horrocks, Xun (Brian) Wu, November 2018, Implement decentralized blockchain applications to build scalable Dapps.
2	Blockchain for Business, https://www.ibm.com/downloads/cas/3EGWKGX7
3	https://www.hyperledger.org/use/fabric
4	NPTEL: https://onlinecourses.nptel.ac.in/noc19_cs63/preview

Internal Assessment:
Assessment consists of one Mid Term Test of 20 marks and Continuous Assessment of 20 marks. The Mid Term test is to be conducted when approximately 50% syllabus is completed and its duration will be one hour.
Continuous Assessment:
Continuous Assessment is of 20 marks. The rubrics for assessment will be considered on approval by the subject teachers. It should be minimum 2 or maximum 4 from the following table.

Sr. No	Rubrics	Marks

1	Multiple Choice Questions (Quiz)	5 Marks
2	Literature review of papers/journals	5 Marks
3	Participation in event/ workshop/ talk / competition followed by small report and certificate of participation relevant to the subject	5 Marks
4	Wins in the event/competition/hackathon pertaining to the course	10 Marks
5	Case study, Presentation, group discussion, technical debate on recent trends in the said course	10 Marks
6	Project based Learning and evaluation / Extra assignment / Question paper solution	10 Marks
7	NPTEL/ Coursera/ Udemy/any MOOC Certificate course for 4 weeks or more	10 Marks
8	Content beyond syllabus presentation	10 Marks
9	Creating Proof of Concept	10 Marks
10	Mini Project / Extra Experiments/ Virtual Lab	10 Marks
11	GATE Based Assignment test/Tutorials etc	10 Marks

*For sr.no.7, the date of certification exam should be within the term and in case a student is unable to complete the certification, the grading has to be done accordingly.

Indirect Assessment

1	Mock Viva/Practical
2	Skill Enhancement Lecture
3	Extra Assignments/lab/lecture

End Semester Theory Examination:

1	Question Paper will comprise a total of six questions
2	All Question carries equal Marks
3	Questions will be mixed in nature(For Ex.-Suppose question 2 has part (a) from module 3 then part (b) will be from any other module other than module 3
4	Only Four Questions need to be solved
5	In the question paper, the weightage of each module will be proportional to the number of respective lecture hours as mentioned in the syllabus.