University of Mumbai Blockchain											
Year & Sem	**Course Code and Course Title**	**Teaching Scheme Hours / Week**			**Examination Scheme and Marks**						**Credit Scheme**
		Theory	Seminar / Tutorial	Pract	Internal Assessment		End Sem Exam	Term Work	Oral/ Pract	Total	Credits
					Mid Term	Continuous Assessment					
TE Sem V	**HBCC501: Bitcoin and Crypto currency**	04	--	--	20	20	60	--	--	100	04
	Total	**04**	**-**	**--**	**100**			**-**	**-**	**100**	**04**
Total Credits = 04											
TE Sem. VI	**HBCC601: Blockchain Platform**	04	--	--	20	20	60	--	--	100	04
	Total	**04**	**-**	**-**	**100**			**-**	**-**	**100**	**04**
Total Credits = 04											
BE Sem. VII	**HBCC701: Block chain Development**	04	--	--	20	20	60	--	--	100	04
	HBCSBL701: Private Blockchain Setup Lab(SBL)	--	--	04	--	--	--	50	50	100	02
	Total	**04**	**-**	**04**	**100**			**50**	**50**	**200**	**06**
Total Credits = 06											
BE Sem. VIII	**HBCC801: DeFi (Decentralized Finance)**	04	-	--	20	20	60	--	--	100	04
	Total	**04**	**-**	**-**	**100**			**-**	**-**	**100**	**04**
Total Credits = 04											
Total Credits for Semesters V,VI, VII &VIII = 04+04+06+04=18											

Course Code:	Course Title	Credit
HBCC701	Blockchain Development	
Prerequisite: Blockchain cryptocurrency, Blockchain platform		
Course Objectives:		
1	To understand Ethereum Ecosystem.	
2	To understand aspects of different programming languages	
3	To explain how to use the solidity programming language to develop a smart contract for blockchain	
4	To demonstrate deployment of smart contracts using frameworks	
5	To understand principles of Hyperledger fabric.	
6	To understand challenges to apply blockchain in emerging areas.	
Course Outcomes:		
1	To use Ethereum Components	
2	To analyse different blockchain programming languages	
3	To implement smart contracts in Ethereum using solidity.	
4	To analyse different development frameworks.	
5	To implement a private blockchain network with Hyperledger fabric.	
6	To illustrate blockchain integration with emerging technologies and security issues.	

Module		Content	Hrs
0		**Prerequisite**	2
		Blockchain cryptocurrency, Blockchain platform	
1		**Ethereum Ecosystem**	4
		Ethereum components: miner and mining node, Ethereum virtual machine, Ether, Gas, Transactions, accounts, swarm and whisper, Ethash, end to end transaction in Ethereum, architecture of Ethereum. Self-learning Topics: Emerging blockchain platforms	
2		**Blockchain Programming**	8
		Types of Blockchain Programming, Solidity, GoLang, Vyper, Java, Simplicity, Rholang, ~~Game Theory and Cryptonomics~~, Comparative study of different blockchain programming languages, Decentralized file system-IPFS. Self-learning Topics: Emerging blockchain programming languages	
3		**Smart Contract**	10
	3.1	Solidity programming, Smart Contract programming using solidity, mapper function, ERC20 and ERC721 Tokens, comparison between ERC20 & ERC721, ICO, STOMetamask (Ethereum Wallet), setting up development environment, use cases of smart contract, smart Contracts: Opportunities, Risks Self-learning Topics: Cryptocurrencies and their security issues, Consensus mechanisms, Digital Signatures	
4		**Blockchain Deployment**	10
	4.1	Ethereum client, Ethereum Network, Introduction to Go Ethereum (Geth), Geth Installation and Geth CLI, Setting up a Private Ethereum Blockchain. Introduction to Truffle, Smart Contract deployment on a Private Blockchain. Introduction to Ganache Introduction to Dapp, Dapp architecture, Daaps Scalability, testing Connecting to the Blockchain and Smart Contract, Web3js, Deployment	

		Self-learning Topics: Smart Contract deployment using Ganache	
5		**Hyperledger Application Development**	12
		Installing Hyperledger Fabric, Hyperledger Fabric Network , Building Your First Network, Hyperledger Fabric Demo, Hyperledger Fabric Network Configuration, Certificate Authorities, Chaincode Development and Invocation, Deployment and testing of chaincode on development network, Hyperledger Fabric Transactions. Self-learning Topics: Hyperledger sawtooth, Hyperledger caliper	
6		**Blockchain integration and Research challenges**	6
	6.1	Integrating Blockchain with cloud, IoT, AI, ERP, End to end blockchain integration, Risks and Limitations of Blockchain: Privacy & Security. Criminal Use of Payment Blockchains, The “Dark” Side of Blockchain Research challenges in blockchain Self-learning Topics: Use Cases: Blockchain for Health Insurance, Blockchain in Supply chain management, Blockchain & PropTech, Blockchain in Banking	
		Total	**39**

Textbooks:	
1	Mastering Ethereum, Building Smart Contract and Dapps, Andreas M. Antonopoulos Dr. Gavin Wood, O'reilly.
2	Blockchain Technology, Chandramouli Subramanian, Asha A George, Abhillash K. A and Meena Karthikeyen, Universities press
Reference Books:	
1	Blockchain enabled Applications,Vikram Dhillon, Devid Metcalf, Max Hooper, Apress
2	Building Blockchain Projects, Narayan Prusty, Packt

Online References:	
1	https://ethereum.org/en
2	https://hyperledger-fabric.readthedocs.io/en/release-2.2/whatis.html
3	https://www.blockchain.com/
4	https://docs.soliditylang.org/en/v0.7.4/

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

11	Multiple Choice Questions (Quiz)	5 marks
12	Literature review of papers/journals	5 marks
13	Library related work	5 marks
*For sr.no.1, 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 be of 60 marks and the duration will be 2 hours.	
2	Question paper will have a total of five questions	
3	All questions have equal weightage and carry 20 marks each	
4	Any three questions out of five need to be solved.	