



# HINDUSTAN

INSTITUTE OF TECHNOLOGY & SCIENCE  
(DEEMED TO BE UNIVERSITY)

## DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

### SPECIALIZATION IN BLOCKCHAIN

### CURRICULUM AND SYLLABUS

S.NO	COURSE CATEGORY	COURSE CODE	NAME OF THE COURSE	L	T	P	C	S	TCH
<b>DEPARTMENT ELECTIVE – II (SEMESTER IV)</b>									
1	DE	CSC4281	Cryptography and Network Security	2	0	2	3	0	4
2	DE	CSC4282	Cryptocurrency and Cyber Security	2	0	2	3	0	4
<b>DEPARTMENT ELECTIVE – III (SEMESTER V)</b>									
3	DE	CSC4382	Fundamentals of Blockchain Technology	2	0	2	3	0	4
4	DE	CSC4383	Bitcoin Essentials and Use-Cases	2	0	2	3	0	4
<b>DEPARTMENT ELECTIVE – IV (SEMESTER VI)</b>									
5	DE	CSC4384	Building Private Blockchain	2	0	2	3	0	4
6	DE	CSC4385	Blockchain Business Models	2	0	2	3	0	4
<b>DEPARTMENT ELECTIVE – V (SEMESTER VII)</b>									
7	DE	CSC4468	Blockchain and IoT	2	0	2	3	0	4
8	DE	CSC4469	Blockchain and AI	2	0	2	3	0	4

COURSE TITLE	CRYPTOGRAPHY AND NETWORK SECURITY			Credit	3
COURSE CODE	CSC4281	COURSE CATEGORY	DE	L-T-P-S	2-0-2-0
Version	1.0	Approval Details		LEARNING LEVEL	BTL-3
<b>ASSESSMENT SCHEME</b>					
First Periodical Assessment	Second Periodical Assessment	Lab Component			ESE
15%	15%	20%			50%
Course Description	This course will enable the students to acquire knowledge about security fundamentals and cryptographic algorithms, apply email and IP security and design a trusted system.				
Course Objective	<ol style="list-style-type: none"> <li>To understand the basic network security concepts.</li> <li>To acquire knowledge of several cryptographic algorithms.</li> <li>To illustrate various data integrity algorithms and to design a trusted system.</li> </ol>				

<b>Course Outcome</b>	<p>Upon completion of this course, the students will be able to</p> <ol style="list-style-type: none"> <li>1. Recall the basic network security concepts.</li> <li>2. Apply several Cryptographic Algorithms.</li> <li>3. Illustrate data integrity algorithms.</li> <li>4. Apply Email and IP security.</li> <li>5. Design a trusted system.</li> </ol>
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**Prerequisites: NIL**

**CO, PO AND PSO MAPPING**

CO	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
CO-1	3	3	2	-	-	2	-	-	-	1	1	3	2	1	-
CO-2	3	3	3	3	3	1	-	1	3	2	2	3	3	2	1
CO-3	3	3	3	3	3	1	-	1	3	2	2	2	3	2	2
CO-4	3	3	3	3	3	2	1	1	3	2	2	2	3	3	1
CO-5	3	3	3	3	3	2	1	1	3	2	2	2	3	3	1

**1: Weakly related, 2: Moderately related and 3: Strongly related**

**MODULE 1: INTRODUCTION (6L+6P)**

Security Trends-The OSI Security Architecture, Security Attacks, Security Services and Security Mechanisms, A model for Network Security-Classical Encryption Techniques.

**Practical Component:**

1. Implementation of Caesar Cipher technique
2. Implement the Play fair Cipher
3. Implement the Pure Transposition Cipher

**CO1  
BTL3**

**MODULE 2: CRYPTOGRAPHIC ALGORITHMS (6L+6P)**

Number Theory- Modern Block Ciphers: DES, 3DES, AES, Blowfish, CAST-128 - Stream Cipher - Public Key Cryptography: RSA, Diffie-Hellman, Elgamal, ECC.

**Practical Component:**

1. Implement Simple DES Encryption and Decryption
2. Implement the AES Encryption and decryption
3. Implement RSA Encryption Algorithm

**CO2  
BTL3**

**MODULE 3: DATA INTEGRITY ALGORITHMS (6L+6P)**

MD5 message digest algorithm - Secure hash algorithm (SHA) Digital Signatures: Digital Signatures - authentication protocols - digital signature standards (DSS) - proof of digital signature algorithm - Authentication Applications: Kerberos and X.509 - directory authentication service - electronic mail security-pretty good privacy (PGP) - S/MIME.

**Practical Component:**

1. Calculate the message digest of a text using the SHA-1 algorithm
2. Implement the SIGNATURE SCHEME - Digital Signature Standard

**CO3  
BTL3**

**MODULE 4: EMAIL AND IP SECURITY (6L+6P)**

Pretty Good Privacy (PGP) and S/MIME. IP SECURITY: Overview, IP Security Architecture, Authentication Header, Encapsulating Security Payload, Combining Security Associations and Key Management.

**Practical Component:**

1. Study of GnuPG tool.
2. Demonstrate how to provide secure data storage and secure data transmission.

**CO4  
BTL3**

<b>MODULE 5: WEB AND SYSTEM SECURITY</b>		<b>(6L+6P)</b>
Web Security: Secure socket layer and transport layer security - secure electronic transaction - System Security: Intruders - Viruses and related threads - firewall design principals – trusted systems. <b>Practical Component:</b> 1. Installation of Rootkits.		<b>CO5 BTL3</b>
<b>TEXT BOOKS</b>		
1.	William Stallings, “Cryptography and Network security Principles and Practices”, Pearson/PHI,2017.	
2.	William Stallings, Network Security Essentials (Applications and Standards), Pearson Education, India,2017	
<b>REFERENCE BOOKS</b>		
1.	W. Mao, “Modern Cryptography – Theory and Practice”, Pearson Education,2011.	
2.	Charles P. Pfleeger, Shari Lawrence Pfleeger – Security in computing, Prentice Hall of India,2015.	
3.	Atul Kahate, Cryptography and Network Security, Tata Mc Grawhill, India, 2019.	
<b>E BOOKS</b>		
1.	<a href="http://uru.ac.in/uruonlinelibrary/Cyber_Security/Cryptography_and_Network_Security.pdf">http://uru.ac.in/uruonlinelibrary/Cyber_Security/Cryptography_and_Network_Security.pdf</a>	
2.	<a href="https://www.pearson.com/us/higher-education/product/Stallings-Cryptography-and-Network-Security-Principles-and-Practice-5th-Edition/9780136097044.html">https://www.pearson.com/us/higher-education/product/Stallings-Cryptography-and-Network-Security-Principles-and-Practice-5th-Edition/9780136097044.html</a>	
<b>MOOC</b>		
1.	<a href="http://nptel.ac.in/courses/106105031/">http://nptel.ac.in/courses/106105031/</a>	
2.	<a href="https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-033-computer-system-engineering-spring-2009/video-lectures/">https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-033-computer-system-engineering-spring-2009/video-lectures/</a>	

<b>COURSE TITLE</b>	<b>CRYPTOCURRENCY AND CYBER SECURITY</b>			<b>Credit</b>	<b>3</b>
<b>COURSE CODE</b>	<b>CSC4282</b>	<b>COURSE CATEGORY</b>	<b>DE</b>	<b>L-T-P-S</b>	<b>2-0-2-0</b>
<b>Version</b>	<b>1.0</b>	<b>Approval Details</b>		<b>LEARNING LEVEL</b>	<b>BTL-3</b>
<b>ASSESSMENT SCHEME</b>					
<b>First Periodical Assessment</b>	<b>Second Periodical Assessment</b>	<b>Lab Component</b>			<b>ESE</b>
<b>15%</b>	<b>15%</b>	<b>20%</b>			<b>50%</b>
<b>Course Description</b>	This course will enable the students to acquire knowledge about security fundamentals and cryptographic algorithms, explore the basics of cryptocurrencies and use Ethereum programming.				
<b>Course Objective</b>	1. To understand the fundamentals of network and symmetric ciphers. 2. To apply asymmetric ciphers and data integrity algorithms. 3. To explore the basics of cryptocurrencies and use Ethereum programming.				

<b>Course Outcome</b>	Upon completion of this course, the students will be able to
	<ol style="list-style-type: none"> <li>1. Recall the network security fundamentals.</li> <li>2. Employ various symmetric ciphers.</li> <li>3. Apply asymmetric ciphers and data integrity algorithms.</li> <li>4. Explore the basics of cryptocurrencies.</li> <li>5. Use Ethereum programming</li> </ol>

**Prerequisites: Nil**

**CO, PO AND PSO MAPPING**

CO	PO -1	PO- 2	PO- 3	PO- 4	PO- 5	PO- 6	PO- 7	PO- 8	PO- 9	PO - 10	PO- 11	PO- 12	PSO- 1	PSO- 2	PSO- 3
CO-1	3	3	2	-	-	2	-	-	-	1	1	3	2	1	-
CO-2	3	3	3	3	3	1	-	1	3	2	2	3	3	2	1
CO-3	3	3	3	3	3	1	-	1	3	2	2	2	3	2	2
CO-4	3	3	3	3	3	2	1	1	3	2	2	2	3	3	1
CO-5	3	3	3	3	3	2	1	1	3	2	2	2	3	3	2

**1: Weakly related, 2: Moderately related and 3: Strongly related**

**MODULE 1: INTRODUCTION TO CYBER SECURITY**

**(6L+6P)**

Introduction to Cyber Security, Need for security, Concept of Cyber Space, Cyber Crimes and Cyber- attack. Fundamental security principles – threats, attacks and vulnerability. Key Security triad – Confidentiality, Integrity and Availability. Key components of cybersecurity network architecture. Introduction to basic Security Management and Policies - Authentication, Authorization, Access control, Identification and Accounting.

**Practical component:**

Detection of various cyber-attacks using Wireshark.

**CO1**

**BTL3**

**MODULE 2: SYMMETRIC CIPHERS**

**(6L+6P)**

Cryptography – Private key Cryptography - Classical Encryption Techniques - Substitution Techniques - Transposition Techniques - Rotor Machines - Steganography - Data Encryption Standard - Advanced Encryption Standard - Multiple Encryption and Triple DES -

**Practical Component:**

1. Transposition Technique
2. Data Encryption Standard.

**Suggested Readings:**

Stream Ciphers

**CO2**

**BTL3**

**MODULE 3: ASSYMMETRIC CIPHERS AND DATA INTEGRITY ALGORITHMS**

**(6L+6P)**

Public-Key Cryptography - RSA algorithm - Diffie-Hellman Key Exchange - Elgamal Cryptographic System - Elliptic Curve Arithmetic - Elliptic Curve Cryptography.

<p>MD5 message digest algorithm - Secure hash algorithm (SHA) Digital Signatures: Digital Signatures - authentication protocols - digital signature standards (DSS) - proof of digital signature algorithm -</p> <p><b>Practical Component:</b></p> <ol style="list-style-type: none"> <li>1. RSA algorithm</li> <li>2. Elliptic Curve Cryptography</li> <li>3. Calculate the message digest of a text using the SHA-1 algorithm.</li> </ol> <p><b>Suggested Readings:</b></p> <p>Applications of RSA Algorithm.</p>	<p><b>CO3</b></p> <p><b>BTL3</b></p>
<p><b>MODULE 4: CRYPTOCURRENCIES</b> <span style="float: right;"><b>(6L+6P)</b></span></p>	
<p>History, A basic crypto currency, Creation of coins, Payments and double spending, Bitcoin – Digital Signatures as Identities – eWallets – Personal Crypto security - Bitcoin Mining – Mining Hardware – Energy Consumption – Mining Pools – Mining Incentives and Strategies.</p> <p><b>Practical Component:</b></p> <ol style="list-style-type: none"> <li>1. Find the exchange rate of cryptocurrencies with necessary data.</li> <li>2. Mining Puzzles</li> </ol>	<p><b>CO4</b></p> <p><b>BTL3</b></p>
<p><b>MODULE 5: ETHEREUM</b> <span style="float: right;"><b>(6L+6P)</b></span></p>	
<p>The Ethereum Network – Components of Ethereum Ecosystem – Ethereum Programming Languages: Runtime Byte Code, Blocks and Blockchain, Fee Schedule – Supporting Protocols – Solidity Language.</p> <p><b>Practical Component:</b></p> <ol style="list-style-type: none"> <li>1. Study of Ethereum tool -Ganache.</li> </ol>	<p><b>CO5</b></p> <p><b>BTL3</b></p>
<p><b>TEXT BOOKS</b></p>	
1.	William Stallings, “Cryptography and Network security Principles and Practices”, Pearson/PHI,2017.
2.	Arvind Narayanan, Joseph Bonneau, Edward Felten, Andrew Miller and Steven Goldfeder, “Bitcoin and Cryptocurrency Technologies: A Comprehensive Introduction”, Princeton University Press, July, 2016.
<p><b>REFERENCE BOOKS</b></p>	
1.	William Stallings, Network Security Essentials (Applications and Standards), Pearson Education, India,2017
2.	Imran Bashir, “Mastering Blockchain: Distributed Ledger Technology, Decentralization and Smart Contracts Explained”, Second Edition, Packt Publishing, 2018.
<p><b>E BOOKS</b></p>	
1.	<a href="https://www.pearson.com/us/higher-education/product/Stallings-Cryptography-and-Network-Security-Principles-and-Practice-5th-Edition/9780136097044.html">https://www.pearson.com/us/higher-education/product/Stallings-Cryptography-and-Network-Security-Principles-and-Practice-5th-Edition/9780136097044.html</a>
2.	<a href="https://www.lopp.net/pdf/princeton_bitcoin_book.pdf">https://www.lopp.net/pdf/princeton_bitcoin_book.pdf</a>
3.	<a href="https://www.blockchainexpert.uk/book/blockchain-book.pdf">https://www.blockchainexpert.uk/book/blockchain-book.pdf</a>
<p><b>MOOC</b></p>	
1.	<a href="http://nptel.ac.in/courses/106105031/">http://nptel.ac.in/courses/106105031/</a>

2.	<a href="https://www.coursera.org/specializations/introduction-to-blockchain">https://www.coursera.org/specializations/introduction-to-blockchain</a>
3.	<a href="https://www.coursera.org/learn/wharton-cryptocurrency-blockchain-introduction-digital-currency">https://www.coursera.org/learn/wharton-cryptocurrency-blockchain-introduction-digital-currency</a>

### SEMESTER-V

<b>COURSE TITLE</b>		<b>FUNDAMENTALS OF BLOCKCHAIN TECHNOLOGY</b>				<b>CREDITS</b>		<b>3</b>							
<b>COURSE CODE</b>		<b>CSC4382</b>		<b>COURSE CATEGORY</b>		<b>DE</b>		<b>L-T-P-S</b>		<b>2-0-2-0</b>					
<b>Version</b>		<b>1.0</b>		<b>Approval Details</b>				<b>LEARNING LEVEL</b>		<b>BTL-3</b>					
<b>ASSESSMENT SCHEME</b>															
<b>First Periodical Assessment</b>		<b>Second Periodical Assessment</b>		<b>Lab Component</b>		<b>ESE</b>									
<b>15%</b>		<b>15%</b>		<b>20%</b>		<b>50%</b>									
<b>Course Description</b>		This course provides a broad overview of the essential concepts of blockchain technology – by initially exploring the Bitcoin protocol followed by the Ethereum protocol – to lay the foundation necessary for developing applications and programming.													
<b>Course Objective</b>		<ol style="list-style-type: none"> <li>1. To understand the history, types and applications of Blockchain</li> <li>2. To acquire knowledge about cryptography and consensus algorithms.</li> <li>3. Deploy projects using Web3j and design blockchain based applications.</li> </ol>													
<b>Course Outcome</b>		<p>Upon completion of this course, the students will be able to</p> <ol style="list-style-type: none"> <li>1. Contentedly discuss and describe the history, types and applications of Blockchain</li> <li>2. Gains familiarity with cryptography and Consensus algorithms.</li> <li>3. Create and deploy projects using Web3j.</li> <li>4. Implement an ICO on Ethereum</li> <li>5. Design blockchain based application with Swarm and IPFS</li> </ol>													
<b>Prerequisites: NIL</b>															
<b>CO, PO AND PSO MAPPING</b>															
<b>CO</b>	<b>PO - 1</b>	<b>PO-2</b>	<b>PO-3</b>	<b>PO-4</b>	<b>PO-5</b>	<b>PO-6</b>	<b>PO-7</b>	<b>PO-8</b>	<b>PO-9</b>	<b>PO - 10</b>	<b>PO- 11</b>	<b>PO- 12</b>	<b>PSO- 1</b>	<b>PSO- 2</b>	<b>PSO- 3</b>

CO-1	3	3	2	-	1	1	-	-	1	1	-	3	2	3	-
CO-2	3	3	3	2	2	2	-	-	1	2	-	3	2	3	-
CO-3	3	3	3	1	2	2	-	1	2	2	1	3	2	3	2
CO-4	3	3	3	1	2	2	-	1	2	2	1	3	2	3	2
CO-5	3	3	3	-	2	2	-	1	2	2	1	3	2	3	2

1: Weakly related, 2: Moderately related and 3: Strongly related

<b>MODULE 1: INTRODUCTION TO BLOCKCHAIN</b>	<b>(6L+6P)</b>
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<p>Distributed DBMS – Limitations of Distributed DBMS, Introduction to Block chain – History, Definition, Distributed Ledger, Blockchain Categories – Public, Private, Consortium, Blockchain Network and Nodes, Peer-to-Peer Network, Mining Mechanism, Generic elements of Blockchain, Features of Blockchain, and Types of Blockchain.</p> <p><b>Practical Component:</b></p> <ol style="list-style-type: none"> <li>1. Create a Public Ledger vs. Private Ledger with the various attributes like Access, Network Actors, Native token, Security, Speed and examples.</li> <li>2. How would a blockchain help in processing insurance claims of the insurance industry, which suffers from a number of issues like fraud, contract complexity, human error, information flows in reinsurance and claims processing? Use various aspects to summarize the solution.</li> </ol> <p><b>Suggested Readings:</b></p> <p><a href="https://blockchainhub.net/blockchains-and-distributed-ledger-technologies-in-general/">https://blockchainhub.net/blockchains-and-distributed-ledger-technologies-in-general/</a></p> <p><a href="https://blog.todotnet.com/2019/03/solving-real-world-problems-with-distributed-ledger-technology/">https://blog.todotnet.com/2019/03/solving-real-world-problems-with-distributed-ledger-technology/</a></p>	<p><b>CO-1</b></p> <p><b>BTL-2</b></p>
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<b>MODULE 2: BLOCKCHAIN ARCHITECTURE</b>	<b>(6L+6P)</b>
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<p>Operation of Bitcoin Blockchain, Blockchain Architecture – Block, Hash, Distributer P2P, Structure of Blockchain- Consensus mechanism: Proof of Work (PoW), Proof of Stake (PoS), Byzantine Fault Tolerance (BFT), Proof of Authority (PoA) and Proof of Elapsed Time (PoET)</p> <p><b>Practical component:</b></p> <ol style="list-style-type: none"> <li>1. Prepare your build system and Building Bitcoin Core.</li> <li>2. Write Hello World smart contract in a higher programming language (Solidity).</li> <li>3. Solidity example using arrays and functions</li> </ol>	<p><b>CO-2</b></p> <p><b>BTL-2</b></p>
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<b>MODULE 3: BLOCKCHAIN-BASED FUTURES SYSTEM</b>	<b>(6L+6P)</b>
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<p>Project presentation- Futures smart contract: Blockchain oracles- Web3j: Setting up the Web3J- Installing web3j- Wallet creation, Java client: The wrapper generator- Initializing web3j- Setting up Ethereum accounts- Deploying the contract</p> <p><b>Practical component:</b></p> <ol style="list-style-type: none"> <li>1. create a Maven project using Web3j.</li> <li>2. Construct and deploy your contract (Use deploy method)</li> </ol>	<p><b>CO-3</b></p> <p><b>BTL-3</b></p>
<p><b>MODULE 4: BLOCKCHAINS IN BUSINESS AND CREATING ICO (6L+6P)</b></p>	
<p>Public versus private and permissioned versus permission less blockchains- Privacy and anonymity in Ethereum- Why are privacy and anonymity important? - The Ethereum Enterprise Alliance- Blockchain-as-a-Service- Initial Coin Offering (ICO): Project setup for ICO implementation- Token contracts- Token sale contracts-Contract security and testing the code.</p> <p><b>Practical Component:</b></p> <p>Implement an ICO on Ethereum.</p>	<p><b>CO-4</b></p> <p><b>BTL-3</b></p>
<p><b>MODULE 5: DISTRIBUTED STORAGE IPFS AND SWARM (6L+6P)</b></p>	
<p>Ethereum Virtual Machine- Swarm and IPFS: Installing IPFS, Hosting our frontend: Serving your frontend using IPFS, Serving your frontend using Swarm, IPFS file uploader project: Project setup the web page</p> <p><b>Practical component:</b></p> <p>Install IPFS locally on our machine, initialize your node, view the nodes in network and add files and directories install Swarm and run any test file.</p>	<p><b>CO-5</b></p> <p><b>BTL-3</b></p>
<p><b>TEXT BOOKS</b></p>	
<p>Imran Bashir, "Mastering Blockchain: Distributed Ledger Technology, decentralization, and smart contracts explained", 2<sup>nd</sup> Edition, Packt Publishing Ltd, March 2018.</p>	
<p>Bellaj Badr, Richard Horrocks, Xun (Brian) Wu, "Blockchain By Example: A developer's guide to creating decentralized applications using Bitcoin, Ethereum, and Hyperledger", Packt Publishing Limited, 2018.</p>	
<p><b>REFERENCE BOOKS</b></p>	
<p>Andreas M. Antonopoulos , "Mastering Bitcoin: Unlocking Digital Cryptocurrencies", O'Reilly Media Inc, 2015</p>	
<p>Arvind Narayanan, Joseph Bonneau, Edward Felten, Andrew Miller and Steven Goldfeder, "Bitcoin and Cryptocurrency Technologies: A Comprehensive Introduction", Princeton University Press, 2016.</p>	
<p><b>E BOOKS</b></p>	



1.	<a href="https://www.velmie.com/practical-blockchain-study">https://www.velmie.com/practical-blockchain-study</a>
<b>MOOC</b>	
1.	<a href="https://www.udemy.com/course/build-your-blockchain-az/">https://www.udemy.com/course/build-your-blockchain-az/</a>

<b>COURSE TITLE</b>	<b>BITCOIN ESSENTIALS AND USE CASES</b>			<b>CREDITS</b>	<b>3</b>
<b>COURSE CODE</b>	<b>CSC4383</b>	<b>COURSE CATEGORY</b>	<b>DE</b>	<b>L-T-P-S</b>	<b>2-0-2-0</b>
<b>Version</b>	<b>1.0</b>	<b>Approval Details</b>		<b>LEARNING LEVEL</b>	<b>BTL-3</b>
<b>ASSESSMENT SCHEME</b>					
<b>First Periodical Assessment</b>	<b>Second Periodical Assessment</b>	<b>Lab Component</b>	<b>ESE</b>		
<b>15%</b>	<b>15%</b>	<b>20%</b>	<b>50%</b>		
<b>Course Description</b>	This course was designed who want to learn how to navigate investment in cryptocurrencies. You'll learn how to define a currency, analyse the foundations of digital signatures and block chain technology in cryptocurrency, and accurately assess the risks of cryptocurrency in a modern investment portfolio.				
<b>Course Objective</b>	<ol style="list-style-type: none"> <li>1. To build a bitcoin payment system and to perform auctions in Ethereum.</li> <li>2. To study about cryptocurrencies and their functions.</li> <li>3. To understand about Bitcoin and Ethereum and the role of Blockchain in various domains.</li> </ol>				

<b>Course Outcome</b>	<p>Upon completion of this course, the students will be able to</p> <ol style="list-style-type: none"> <li>1. Build a bitcoin payment system.</li> <li>2. Building their own Cryptocurrency and perform Auctions in Ethereum.</li> <li>3. Grasp what is Cryptocurrency and how it functions</li> <li>4. Recall about Bitcoin and Ethereum</li> <li>5. Apply Blockchain in various domains</li> </ol>
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**Prerequisites: NIL**

**CO, PO AND PSO MAPPING**

CO	PO - 1	PO- 2	PO- 3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
CO-1	3	3	2	-	3	1	-	-	1	1	-	3	2	3	2
CO-2	3	3	3	2	3	2	-	-	1	2	-	3	2	3	2
CO-3	3	3	3	1	3	2	-	1	2	2	1	3	2	3	-
CO-4	3	3	3	1	3	2	-	1	2	2	1	3	2	3	2
CO-5	3	3	3	-	3	2	-	1	2	2	1	3	2	3	1

**1: Weakly related, 2: Moderately related and 3: Strongly related**

**MODULE 1: BUILDING A BITCOIN PAYMENT SYSTEM**

**(6L+6P)**

The emergence of blockchain and cryptocurrency-What is blockchain? - Interact with the blockchain-Types of blockchains: Classification of blockchains, Building A Bitcoin payment system: Getting started with Bitcoin, Building a payment gateway.

**Practical Component:**

1. Run a bitcoin client.
2. Synchronize the blockchain
3. Set up a Regtest environment
4. Build a payment request URI

**CO-1**  
**BTL-3**

**MODULE 2: CRYPTOCURRENCY AND AUCTIONS IN ETHEREUM**

**(6L+6P)**

Building Your Own Cryptocurrency- Compiling Bitcoin from source- New cryptocurrency – Readercoin: Cloning Bitcoin, Readercoin rebranding- Peer-to-Peer Auctions in Ethereum: Introduction to Ethereum, Building an auction DApp: Auction description, Auction contract in Solidity- Contract code analysis- Enumerations, Arrays, Mappings, Structures, Functions, Modifiers, Inheritance.

**CO-2**  
**BTL-3**

<p><b>Practical component:</b></p> <ol style="list-style-type: none"> <li>1.Prepare your build system and Building Bitcoin Core.</li> <li>2.Write Hello World smart contract in a higher programming language (Solidity).</li> <li>3. Solidity example using arrays and functions.</li> </ol>	
<p><b>MODULE 3: CRYPTOCURRENCIES AND BITCOIN (6L+6P)</b></p>	
<p>Introduction to Cryptocurrencies, Tokens – Cryptosecurities, Players involved - Cryptocurrency Users, Miners, Cryptocurrency exchanges, Trading platforms, Wallet providers, Coin inventors, Coin offerors. Distributed Ledger Technology (DLT), Bitcoin (BTC) – Genesis Block, Buy Bitcoin, Transactions, Unspent Transaction Output (UTXO), Bitcoin Mining, Value of Bitcoin, Advantages and Disadvantages,</p> <p><b>Practical Component:</b></p> <ol style="list-style-type: none"> <li>1. Find the exchange rate for bitcoin with the help of necessary data.</li> <li>2. Find the number of bitcoins by applying the equation over the defined values.</li> </ol> <p><b>Suggested Readings:</b></p> <p><a href="https://www.investopedia.com/tech/most-important-cryptocurrencies-other-than-bitcoin/">https://www.investopedia.com/tech/most-important-cryptocurrencies-other-than-bitcoin/</a></p> <p><a href="https://intelligenttrading.org/guides/cryptoasset-classifications/">https://intelligenttrading.org/guides/cryptoasset-classifications/</a></p>	<p><b>CO-3</b></p> <p><b>BTL-3</b></p>
<p><b>MODULE 4: ETHEREUM CRYPTOCURRENCY (6L+6P)</b></p>	
<p>Ethereum (ETH) – Smart Contracts, UTXO, Types of Accounts - Externally controlled accounts and Contract account, Merkley Tree, Ether, Components of Ethereum Transaction, DApps, Hard &amp; Soft Fork, Bitcoin Stack versus Ethereum Stack.</p> <p><b>Practical Component:</b></p> <ol style="list-style-type: none"> <li>1. Calculate the ‘number of ethers’ for the transaction of gas limit for the scenario in which the sender sets the gas limit to 50,000 and a gas price to 20 gwei.</li> <li>2. Represent the Ethereum Merkley Tree for the given list of Transactions.</li> </ol> <p><b>Suggested Readings:</b></p> <p><a href="https://medium.com/@preethikasireddy/how-does-ethereum-work-anyway-22d1df506369">https://medium.com/@preethikasireddy/how-does-ethereum-work-anyway-22d1df506369</a></p> <p><a href="https://medium.com/@jochasinga/implementing-a-bitcoin-merkle-tree-cb0af3d53ec9">https://medium.com/@jochasinga/implementing-a-bitcoin-merkle-tree-cb0af3d53ec9</a></p>	<p><b>CO-4</b></p> <p><b>BTL-3</b></p>
<p><b>MODULE 5: USE CASES (6L+6P)</b></p>	

Blockchain in Supply Chain - Blockchain in Manufacturing - Blockchain in Automobiles - Blockchain in Healthcare - Blockchain in Cyber security - Blockchain in Financial Industry	<b>CO-5</b> <b>BTL-3</b>
<p><b>Practical Component:</b></p> <p>1. Do a survey on the various real-time applications in cryptocurrencies (Bitcoin and Ethereum) and give pictorial representation of the same by considering the common aspects.</p> <p><b>Suggested Readings:</b></p> <p><a href="https://builtin.com/blockchain/blockchain-applications">https://builtin.com/blockchain/blockchain-applications</a></p>	

#### REFERENCE BOOKS

1.	Imran Bashir, "Mastering Blockchain: Distributed Ledger Technology, decentralization, and smart contracts explained", 2 <sup>nd</sup> Edition, Packt Publishing Ltd, March 2018.
2.	Arvind Narayanan, Joseph Bonneau, Edward Felten, Andrew Miller, Steven Goldfeder, "Bitcoin and Cryptocurrency Technologies", Princeton University Press, 2016.

#### E BOOKS

1.	<a href="https://users.cs.fiu.edu/~prabakar/cen5079/Common/textbooks/Mastering_Blockchain_2nd_Edition.pdf">https://users.cs.fiu.edu/~prabakar/cen5079/Common/textbooks/Mastering_Blockchain_2nd_Edition.pdf</a>
2.	<a href="https://www.lopp.net/pdf/princeton_bitcoin_book.pdf">https://www.lopp.net/pdf/princeton_bitcoin_book.pdf</a>
3.	<a href="https://www.blockchainexpert.uk/book/blockchain-book.pdf">https://www.blockchainexpert.uk/book/blockchain-book.pdf</a>

#### MOOC

1.	<a href="https://www.coursera.org/specializations/introduction-to-blockchain">https://www.coursera.org/specializations/introduction-to-blockchain</a>
2.	<a href="https://www.coursera.org/learn/wharton-cryptocurrency-blockchain-introduction-digital-currency">https://www.coursera.org/learn/wharton-cryptocurrency-blockchain-introduction-digital-currency</a>
3.	<a href="https://www.velmie.com/practical-blockchain-study">https://www.velmie.com/practical-blockchain-study</a>

### SEMESTER- VI

COURSE TITLE	BUILDING PRIVATE BLOCKCHAIN			CREDITS	3
COURSE CODE	CSC4384	COURSE CATEGORY	DE	L-T-P-S	2-0-2-0

<b>Version</b>	<b>1.0</b>		<b>Approval Details</b>		<b>LEARNING LEVEL</b>		<b>BTL-3</b>								
<b>ASSESSMENT SCHEME</b>															
<b>First Periodical Assessment</b>	<b>Second Periodical Assessment</b>		<b>Lab Component</b>		<b>ESE</b>										
<b>15%</b>	<b>15%</b>		<b>20%</b>		<b>50%</b>										
<b>Course Description</b>	This course is intended to study the basics of Blockchain technology. During this course learner will explore various aspects of Blockchain technology like application in various domains. By implementing, learners will have idea about private and public Blockchain, and smart contract.														
<b>Course Objective</b>	<ol style="list-style-type: none"> <li>1. To deploy Private Blockchain and smart contracts on Ethereum.</li> <li>2. To understand the importance of consensus</li> <li>3. To implement Blockchain for various use cases.</li> </ol>														
<b>Course Outcome</b>	<p>Upon completion of this course, the students will be able to</p> <ol style="list-style-type: none"> <li>1. Recall the structure and mechanism of Bitcoin, Ethereum, Hyperledger and Multichain Blockchain platforms</li> <li>2. Infer the importance of consensus in transactions and how transactions are stored on Blockchain.</li> <li>3. Setup your own private Blockchain and deploy smart contracts on Ethereum.</li> <li>4. Deploy the business network using Hyperledger Composer.</li> <li>5. Implement Blockchain for various use cases</li> </ol>														
<b>Prerequisites: Nil</b>															
<b>CO, PO AND PSO MAPPING</b>															
<b>CO</b>	<b>PO - 1</b>	<b>PO- 2</b>	<b>PO- 3</b>	<b>PO- 4</b>	<b>PO- 5</b>	<b>PO- 6</b>	<b>PO- 7</b>	<b>PO- 8</b>	<b>PO- 9</b>	<b>PO - 10</b>	<b>PO- 11</b>	<b>PO- 12</b>	<b>PSO- 1</b>	<b>PSO- 2</b>	<b>PSO- 3</b>
<b>CO-1</b>	<b>3</b>	<b>-</b>	<b>2</b>	<b>-</b>	<b>1</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>2</b>	<b>3</b>	<b>2</b>
<b>CO-2</b>	<b>3</b>	<b>-</b>	<b>1</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>2</b>	<b>-</b>	<b>2</b>	<b>2</b>	<b>3</b>	<b>2</b>
<b>CO-3</b>	<b>3</b>	<b>-</b>	<b>1</b>	<b>-</b>	<b>-</b>	<b>1</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>2</b>	<b>-</b>	<b>-</b>	<b>2</b>	<b>3</b>	<b>-</b>
<b>CO-4</b>	<b>2</b>	<b>-</b>	<b>1</b>	<b>-</b>	<b>1</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>2</b>	<b>3</b>	<b>2</b>
<b>CO-5</b>	<b>2</b>	<b>-</b>	<b>2</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>3</b>	<b>-</b>	<b>-</b>	<b>2</b>	<b>-</b>	<b>-</b>	<b>2</b>	<b>3</b>	<b>1</b>
<b>1: Weakly related, 2: Moderately related and 3: Strongly related</b>															
<b>MODULE 1: INTRODUCTION TO BLOCKCHAIN</b>									<b>(6L+6P)</b>						

<p>What is Block chain? Basic ideas behind Blockchain, how it is changing the landscape of digitalization, Uses of Blockchain. Abstract Models for BLOCKCHAIN - GARAY model - RLA Model, what is Multichain? Objective of Multichain, Features of Multichain, Uses of Multichain, Process of mining in Multichain technology, Analyse Multichain platform, why it is better than other open platforms Blockchain Architecture and Design: Basic crypto primitives: Hash, Signature,) Hash chain to Blockchain, Basic consensus mechanisms</p> <p><b>Practical Component</b></p> <p>Building and Deploying MultiChain private Blockchain</p>	<p><b>CO-1</b> <b>BTL-2</b></p>
<p><b>MODULE 2: CONSENSUS &amp; DAPPS (6L+6P)</b></p>	
<p>Requirements for the consensus protocols, Proof of Work (PoW), Scalability aspects of Blockchain consensus protocols Permissioned Blockchains: Design goals, Consensus protocols for Permissioned Blockchains (DAPPS) - Characteristics of Decentralized application, Setting up a Private Blockchain, Multiple configurable Blockchains using Multichain Deployment scenarios of Multichain, Centralized currency settlement, Bond issuance and peer-to-peer trading Consumer-facing rewards scheme in Decentralized Applications</p> <p><b>Practical Component</b></p> <ol style="list-style-type: none"> <li>1. Deposit some Ether in your MetaMask accounts.</li> <li>2. Create several accounts and make some transactions between these accounts</li> </ol>	<p><b>CO-2</b> <b>BTL-2</b></p>
<p><b>MODULE 3: HYPERLEDGER FABRIC (6L+6P)</b></p>	
<p>Hyperledger Fabric (A): Decomposing the consensus process , Hyperledger fabric components, Chain code Design and Implementation Hyperledger Fabric (B): Beyond Chain code: fabric SDK and Front End (b) Hyperledger composer tool</p> <p><b>Practical Component</b></p> <ol style="list-style-type: none"> <li>1. Creating a Business Network using Hyperledger</li> <li>2. Creating a Business Network using Hyperledger – II</li> </ol>	<p><b>CO-3</b> <b>BTL-3</b></p>
<p><b>MODULE 4: USECASE MODEL – PRIVACY BLOCKCHAIN (6L+6P)</b></p>	
<p>Use case 1: Blockchain in Financial Software and Systems (FSS): (i) Settlements, (ii) KYC, (iii) Capital markets, (iv) Insurance</p> <p>Use case 2: Blockchain in trade/supply chain: (i) Provenance of goods, visibility, trade/supply chain finance, invoice management discounting, etc</p> <p><b>Practical Component</b></p> <p>Implementation of Use case – 1 &amp; 2</p>	<p><b>CO-4</b> <b>BTL-2</b></p>
<p><b>MODULE 5: USECASE MODEL – BLOCKCHAIN DIGITAL IDENTITY (6L+6P)</b></p>	

Use case 3: Blockchain for Government: (i) Digital identity, land records and other kinds of record keeping between government entities, (ii) public distribution system social welfare systems Blockchain Cryptography, Privacy and Security on Blockchain		<b>CO-5</b> <b>BTL-2</b>
<b>Practical Component</b> Building a Private Ethereum Network and Deploying Smart Contract & Security		
<b>TEXT BOOKS</b>		
1.	Andreas M. Antonopoulos , “Mastering Bitcoin: Unlocking Digital Cryptocurrencies”, O’Reilly Media Inc, 2015	
2.	Melanie Swa “Blockchain”, First Edition, O’Reilly Jan 2015	
<b>REFERENCE BOOKS/E-BOOKS</b>		
1.	Hyperledger Fabric - <a href="https://www.hyperledger.org/projects/fabric">https://www.hyperledger.org/projects/fabric</a>	
2.	Zero to Blockchain - An IBM Redbooks course, by Bob Dill, David Smits - <a href="https://www.redbooks.ibm.com/Redbooks.nsf/RedbookAbstracts/crse0401.html">https://www.redbooks.ibm.com/Redbooks.nsf/RedbookAbstracts/crse0401.html</a>	
<b>MOOC</b>		
1.	<a href="https://www.udemy.com/course/build-blockchain/">https://www.udemy.com/course/build-blockchain/</a>	

COURSE TITLE	BLOCKCHAIN BUSINESS MODELS			CREDITS	3
COURSE CODE	CSC4385	COURSE CATEGORY	DE	L-T-P-S	2-0-2-0
Version	1.0	Approval Details		LEARNING LEVEL	BTL-3
<b>ASSESSMENT SCHEME</b>					
First Periodical Assessment	Second Periodical Assessment	Lab Component	ESE		
15%	15%	20%	50%		
Course Description	This course helps to apply Blockchain for Business models.				
Course Objective	<ol style="list-style-type: none"> <li>To learn the basics of Blockchain and apply cryptographic algorithms</li> <li>To identify the consensus methods for an application</li> <li>To use Blockchain for business models</li> </ol>				

<b>Course Outcome</b>	<ol style="list-style-type: none"> <li>1. Discuss the basics of Blockchain</li> <li>2. Apply the Cryptographic techniques in Blockchain</li> <li>3. Identify the appropriate Consensus methods for application</li> <li>4. Describe the technology stack for Blockchain</li> <li>5. Apply the Blockchain for business models</li> </ol>
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**Prerequisites: Basic Networking concepts**

**CO, PO AND PSO MAPPING**

CO	PO - 1	PO- 2	PO- 3	PO- 4	PO- 5	PO- 6	PO- 7	PO-8	PO- 9	PO- 10	PO- 11	PO- 12	PSO-1	PSO-2	PSO- 3
CO-1	3	3	-	-	1	-	-	-	-	-	-	-	2	3	-
CO-2	3	3	-	-	1	-	-	-	-	2	-	-	2	3	-
CO-3	3	3	3	-	-	1	-	-	-	-	-	-	2	1	2
CO-4	3	3	-	-	1	-	-	-	-	-	-	-	2	3	-
CO-5	3	3	3	-	3	-	-	-	-	-	-	3	-	2	-

**1: Weakly related, 2: Moderately related and 3: Strongly related**

**MODULE 1: Introduction (6L+6P)**

History of Blockchain-Terminologies in Blockchain-Types of Blockchain-Applications of Blockchain-How blockchain works-Ingredients of Blockchain.  <b>Practical Component:</b> 1. Create Survey report of various types of Blockchain and its real time use cases.	<b>CO-1</b>  <b>BTL-3</b>
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**Module 2: Cryptography Algorithms (6L+6P)**

Introduction to cryptography-Encryption and Decryption-Ciphers-Cryptography using arithmetic modulo primes-hashing algorithms-SHA-256 algorithm-Application of SHA algorithm.  <b>Practical Component:</b> 1.Implement program to convert given text in to hashes using SHA 256 algorithm.	<b>CO-2</b>  <b>BTL-3</b>
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**MODULE 3: Consensus Methods (6L+6P)**

Introduction to Consensus Methods-Proof of Work(PoW)-Proof of Stake(PoS)-Proof of Burn(PoB)-Proof of Activity(PoA)-Proof of Elapsed Time(PoET)-Simplified Byzantine fault Tolerance-Mining.  <b>Practical Component:</b>	<b>CO-3</b>  <b>BTL-3</b>
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Prepare comparison study report of various Consensus methods for financial transaction.	
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<b>MODULE 4: Blockchain Technology Stack</b>		<b>(6L+6P)</b>
Data structures for Blockchain-Merkle trees-Shared data- Protocols—Fat protocols-Platforms-DAPPS-Smart Contracts.  <b>Practical Component:</b>  1. Create simple smart contract for User identity management using Solidity language.		<b>CO-4</b>  <b>BTL-3</b>
<b>MODULE 5: Blockchain Business models</b>		<b>(6L+6P)</b>
Introduction to Blockchain Business Models-Need for Blockchain business models-Traditional business models-Types of Blockchain Business Models- Blockchain As A Service (BaaS)-Token Economy- Utility Token Business Model-Blockchain-Based Software Products-P2P Blockchain Business Model-Blockchain Professional Services. Block chain for Banking and Financial transactions.  <b>Practical Component:</b>  1.Create simple wallet transaction from one account to another account using Metamask.		<b>CO-5,</b>  <b>BTL-3</b>
<b>TEXT BOOKS</b>		
1.	Brojo Kishore Mishra , Sanjay Kumar Kuanar “Handbook of IoT and Blockchain: Methods, Solutions, and Recent Advancements (Internet of Everything (IoE)) “, CRC Press; 1st edition , November 2020.	
2.	Jai Singh Arun , Jerry Cuomo , Nitin Gaur Blockchain for Business- For Understanding transformation, growth and new models of Business -First Edition Published by Pearson Paperback–12December2019	
<b>REFERENCES</b>		
1.	<a href="https://iabtechlab.com/wp-content/uploads/2018/07/Blockchain-Technology-Primer.pdf">https://iabtechlab.com/wp-content/uploads/2018/07/Blockchain-Technology-Primer.pdf</a>	
2.	<a href="https://www.blockchain-council.org/blockchain/the-best-blockchain-business-models/">https://www.blockchain-council.org/blockchain/the-best-blockchain-business-models/</a>	
<b>E BOOKS</b>		
1.	<a href="https://www.researchgate.net/publication/337649428_Handbook_of_IoT_and_Blockchain_-_Methods_Solutions_and_Recent_Advancements">https://www.researchgate.net/publication/337649428_Handbook_of_IoT_and_Blockchain_-_Methods_Solutions_and_Recent_Advancements</a> .	
<b>MOOC</b>		
1.	<a href="https://www.coursera.org/learn/blockchain-business-models">https://www.coursera.org/learn/blockchain-business-models</a>	

### SEMESTER-VII

<b>COURSE TITLE</b>	<b>BLOCKCHAIN AND IoT</b>										<b>CREDITS</b>	<b>3</b>			
<b>COURSE CODE</b>	<b>CSC4468</b>			<b>COURSE CATEGORY</b>			<b>DE</b>				<b>L-T-P-S</b>	<b>2-0-2-0</b>			
<b>Version</b>	<b>1.0</b>			<b>Approval Details</b>							<b>LEARNING LEVEL</b>	<b>BTL-3</b>			
<b>ASSESSMENT SCHEME</b>															
<b>First Periodical Assessment</b>	<b>Second Periodical Assessment</b>			<b>Lab Component</b>			<b>ESE</b>								
<b>15%</b>	<b>15%</b>			<b>20%</b>			<b>50%</b>								
<b>Course Description</b>	<b>This course helps to apply Blockchain to IoT applications</b>														
<b>Course Objective</b>	<ol style="list-style-type: none"> <li>To understand the working of IoT and Blockchain</li> <li>To identify consensus mechanism and apply blockchain for IoT sector.</li> <li>To understand the security challenges in IoT.</li> </ol>														
<b>Course Outcome</b>	<ol style="list-style-type: none"> <li>Demonstrate the working of IoT and Blockchain</li> <li>Identify Consensus mechanism for Blockchain Application</li> <li>Discover the security challenges in IoT</li> <li>Analyze the need of BaaS for Organizations</li> <li>Apply the Blockchain usecases for IoT sector</li> </ol>														
<b>Prerequisites: Basic Networking concepts</b>															
<b>CO, PO AND PSO MAPPING</b>															
<b>CO</b>	<b>PO - 1</b>	<b>PO- 2</b>	<b>PO- 3</b>	<b>PO- 4</b>	<b>PO- 5</b>	<b>PO- 6</b>	<b>PO- 7</b>	<b>PO- 8</b>	<b>PO- 9</b>	<b>PO- 10</b>	<b>PO- 11</b>	<b>PO- 12</b>	<b>PSO- 1</b>	<b>PSO- 2</b>	<b>PSO- 3</b>
<b>CO-1</b>	<b>3</b>	<b>3</b>	<b>-</b>	<b>-</b>	<b>1</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>2</b>	<b>2</b>	<b>1</b>

CO-2	3	3	-	-	1	-	-	-	-	2	-	-	2	2	1
CO-3	3	3	3	-	-	1	-	-	-	-	-	-	2	2	
CO-4	3	3	-	-	1	-	-	-	-	-	-	-	2	2	-
CO-5	3	3	3	-	3	-	-	-	-	-	-	3	-	2	-
<b>1: Weakly related, 2: Moderately related and 3: Strongly related</b>															

<b>MODULE 1: INTRODUCTION TO IoT &amp; BLOCKCHAIN</b>		<b>(6L+6P)</b>
<p>Introduction to Internet of Things (IoT)- Concepts and definitions of IoT-History of IoT –IoT vs Conventional Network-IoT Architecture- Introduction to Blockchain-Generations of Blockchain- Structure of Blockchain- Opportunities and challenges in IoT and Blockchain.</p> <p><b>Practical Component:</b></p> <ol style="list-style-type: none"> <li>2. Study of IoT simulators (Tinker cad/Cisco Packet Tracer).</li> <li>3. Study of Blockchain development frame works (Truffle/Hyperledger fabric).</li> </ol>		<p><b>CO-1</b></p> <p><b>BTL-3</b></p>
<b>MODULE 2: CONSENSUS ALGORITHMS</b>		<b>(6L+6P)</b>
<p>Building Blocks of Blockchain-Database-Block-Hash-Minor-Transaction-Smart Contracts-Consensus Mechanisms-PoW-PoS-Characteristics of Blockchain-Types of Blockchain-Permissioned Blockchain- Permissionless Blockchain-Consortium Blockchain.</p> <p><b>Practical Component:</b></p> <ol style="list-style-type: none"> <li>1. Use the MetaMask plugin to conduct transactions with Ether, a cryptocurrency</li> <li>2. Deploy a simple contract to the Ethereum blockchain.</li> </ol>		<p><b>CO-2</b></p> <p><b>BTL-4</b></p>
<b>MODULE 3: IOT SECURITY</b>		<b>(6L+6P)</b>
<p>IoT Layer Challenges – Sensing layer– Challenges in end nodes –Threat based on Network layer- Service layer based threats-Application Interface layer –Cross layer Challenges-Challenge to implementation of IoT in Blockchain-IoT Device Integration challenges.</p> <p><b>Practical Component:</b></p> <ol style="list-style-type: none"> <li>1. Develop your own Application that stores IoT data in open source IoT cloud platform analytic tools.</li> <li>2. Study of Cryptocurrencies and wallet in blockchain.</li> </ol>		<p><b>CO-3</b></p> <p><b>BTL-3</b></p>
<b>MODULE 4: BLOCKCHAIN AS A SERVICE (BAAS)</b>		<b>(6L+6P)</b>
<p>Defining of Blockchain as a Service - IoT Cloud server security challenges– Cloud computing with BaaS-Hybrid Cloud server with BaaS for Remote Monitoring-Case study: Industries adopting BaaS for security.</p> <p><b>Practical Component:</b></p> <ol style="list-style-type: none"> <li>1.Create study report of BaaS is adopted in industries.</li> </ol>		<p><b>CO-4</b></p> <p><b>BTL-4</b></p>

2. Create two Ether accounts and perform transactions using Metamask Wallet and analyze the gas consumption.

<b>MODULE 5: BLOCKCHAIN USECASES IN IOT SECTOR</b>		<b>(6L+6P)</b>
Autonomous Decentralized peer to peer telemetry-Blockchain Enabled Security for Smart cities- Blockchain Enabled Smart Home Architecture-Blockchain based self-managed VANETs-Security and privacy of data.  <b>Practical Component:</b> <ol style="list-style-type: none"> <li>1. Develop application for Smart Traffic that analyze the IoT data and predict the Traffic Jam.</li> <li>2. Create study report of how blockchain can be applied to IoT supply chain Management</li> </ol>		<b>CO-5,</b>  <b>BTL-4</b>
<b>TEXT BOOKS</b>		
1.	Brojo Kishore Mishra , Sanjay Kumar Kuanar “Handbook of IoT and Blockchain: Methods, Solutions, and Recent Advancements (Internet of Everything (IoE)) “ , CRC Press; 1st edition , November 2020.	
2.	Shiho Kim ,Ganesh, Chandra Deka, Peng Zhang, “ <i>Role of Blockchain Technology in IoT Applications</i> ”, Volume 115 in the <i>Advances in Computers series ,first edition ,Academic Press 2019</i>	
3.	Harshita Patel , Ghanshyam Singh Thakur,“Blockchain Applications in IoT Security” 1st Edition by IGI Global; 1st edition 2020	
4.	David Etter,“ IoT Security: Practical Guide Book”, CreateSpace Independent Publishing Platform, 2016.	
<b>REFERENCE BOOKS</b>		
1.	John Soldatos, “ Building Blocks for IoT Analytics”, River Publishers,2016	
<b>E BOOKS</b>		
1.	<a href="https://www.researchgate.net/publication/337649428_Handbook_of_IoT_and_Blockchain_-_Methods_Solutions_and_Recent_Advancements">https://www.researchgate.net/publication/337649428_Handbook_of_IoT_and_Blockchain_-_Methods_Solutions_and_Recent_Advancements</a> .	
<b>MOOC</b>		
1.	<a href="https://www.coursera.org/learn/blockchain-basics">https://www.coursera.org/learn/blockchain-basics</a>	

<b>COURSE TITLE</b>	<b>AI &amp; BLOCKCHAIN TECHNOLOGY</b>			<b>CREDITS</b>	<b>3</b>
<b>COURSE CODE</b>	<b>CSC4469</b>	<b>COURSE CATEGORY</b>	<b>DE</b>	<b>L-T-P-S</b>	<b>2-0-2-0</b>
<b>Version</b>	<b>1.0</b>	<b>Approval Details</b>		<b>LEARNING LEVEL</b>	<b>BTL-3</b>
<b>ASSESSMENT SCHEME</b>					
<b>First Periodical Assessment</b>	<b>Second Periodical Assessment</b>	<b>Lab Component</b>	<b>ESE</b>		
<b>15%</b>	<b>15%</b>	<b>20%</b>	<b>50%</b>		
<b>Course Description</b>	This course provides an overview of the world of blockchain, AI, and machine learning. We explore artificial intelligence and machine learning and seek to understand the philosophical and ethical issues, relationship with consciousness and self-awareness, the categories and applications of the different families of AI algorithms, and what challenges and opportunities lie in the future.				
<b>Course Objective</b>	<ol style="list-style-type: none"> <li>1.To use Hyper ledger Fabric and Ethereum platform to implement Blockchain applications.</li> <li>2. To understand the machine learning techniques, the function of Blockchain and AI.</li> <li>3. To find out the major research challenges and gaps in crypto currency domain.</li> </ol>				
<b>Course Outcome</b>	<p>Upon completion of this course, the students will be able to</p> <ol style="list-style-type: none"> <li>1. Apply Hyperledger Fabric and Ethereum platform to implement the Block Chain Application</li> <li>2. Identify and apply the appropriate machine learning techniques for classification, Pattern recognition, optimization and decision problems.</li> <li>3. Provide conceptual understanding of the function of Blockchain &amp; AI as a method of securing distributed ledgers, how consensus on their contents is achieved, and the new applications that they enable.</li> <li>4. Identify major research challenges and technical gaps existing between theory and practice in crypto currency domain.</li> <li>5. Develop techniques in information science applications by applying Computational intelligence and appropriate machine learning techniques in Blockchain</li> </ol>				
<b>Prerequisites:</b>					
<b>CO, PO AND PSO MAPPING</b>					



CO	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
CO-1	2	-	-	-	1	-	-	-	-	-	-	-	3	-	2
CO-2	3	-	1	-	-	-	-	-	-	2	-	2	3	2	2
CO-3	3	-	-	-	-	1	-	-	-	2	-	-	2	2	1
CO-4	2	-	-	-	1	-	-	-	-	-	-	-	2	2	1
CO-5	3	-	3	-	-	-	3	-	-	2	-	-	-	-	1

1: Weakly related, 2: Moderately related and 3: Strongly related

### MODULE 1: OVERVIEW OF BLOCKCHAIN

(6L+6P)

Getting Started with Blockchain: Blockchain versus distributed ledger technology versus distributed databases - Comparing the technologies with examples - Public versus private versus permissioned Blockchain - Comparing usage scenarios - Privacy in Blockchain - Understanding Bitcoin - A brief overview of Bitcoin, Ethereum: A brief overview of Ethereum, Introduction to Hyperledger - Overview of the project - Hyperledger Fabric - Hyperledger Saw tooth - Other Hyperledger frameworks and tools.

CO-1  
BTL-2

#### Practical Component:

1. Creation of Hyperledger Fabric & Saw tooth.
2. Real case scenarios of setting up privacy in Blockchain

### MODULE 2: INTRODUCTION TO AI LANDSCAPE

(6L+6P)

AI – key concepts - History of AI - AI winter - Types of AI : Weak AI, Strong AI, Super AI - Forms of AI and approaches : Statistical and expert systems, Machine learning, Supervised learning, Unsupervised learning, Reinforcement learning - Neural networks - Evolutionary computation - Swarm computation - AI in digital transformation: Data extraction - Data transformation - Processing - Storyboarding - Data utilization, AI platforms and tools : Tensor Flow - Microsoft Cognitive Toolkit - IBM Watson

CO-2  
BTL-2

#### Practical component:

1. Study of PROLOG & Work on PROLOG
2. In this problem, you will complete a simple computer algebra system that reduces nested expressions made of sums and products into a single sum of products. For example, it turns the expression  $(2 * (x + 1) * (y + 3))$  into  $((2 * x * y) + (2 * x * 3) + (2 * 1 * y) + (2 * 1 * 3))$ . You could choose to simplify further, such as to  $((2 * x * y) + (6 * x) + (2 * y) + 6)$ , but it is not necessary.

<b>MODULE 3: BLOCKCHAIN AND ARTIFICIAL INTELLIGENCE</b>		<b>(6L+6P)</b>
<p>Domain Specific Applications - Applying AI &amp; Blockchain: Healthcare, Supply chain, Financial Services, Information Security, Document management, AI &amp; Blockchain Driven Databases - Centralized versus distributed data, Big data for AI analysis, Data Management in a DAO, Emerging patterns for Database Solutions</p> <p><b>Practical component:</b></p> <ol style="list-style-type: none"> <li>1. Real Case study working model of Applying AI &amp; Blockchain Applications in Healthcare, Supply chain &amp; Information Security.</li> </ol>		<p><b>CO-3</b></p> <p><b>BTL-3</b></p>
<b>MODULE 4: CRYPTOCURRENCY AND AI</b>		<b>(6L+6P)</b>
<p>Role of AI in Cryptocurrency - Cryptocurrency Trading: Issues &amp; Considerations, Benefits of AI in Crypto Trading - Making Price Predictions with AI: Issues with Price Prediction, Benefits of AI in Prediction, Time series forecasting with ARIMA, Applications of algorithmic or quant trading in Cryptocurrency</p> <p><b>Practical Component:</b></p> <ol style="list-style-type: none"> <li>1. Deployment of Cryptocurrencies &amp; Predictions using AI</li> </ol>		<p><b>CO-4</b></p> <p><b>BTL-2</b></p>
<b>MODULE 5: DEVELOPING AND FUTURE OF AI WITH BLOCKCHAINS</b>		<b>(6L+6P)</b>
<p>Applying SDLC practices in Blockchain: Introduction to DIApp - Architecture of a DIApp - Developing a DIApp - Testing a DIApp - Deploying DIApp - Monitoring a DIApp, Implementing DIApp - Evolution of decentralized applications, building a sample DIApp, Developing Smart Contracts, Solution approach with AI, Developing: Client code, Backend, Frontend, Future of converging AI &amp; Blockchain in enterprises &amp; Government.</p> <p><b>Practical component:</b></p> <ol style="list-style-type: none"> <li>1. Deploy DIApp and Smart Contracts.</li> <li>2. NPacket publishing in client code using AI &amp; Blockchain</li> </ol>		<p><b>CO-5</b></p> <p><b>BTL-2</b></p>
<b>TEXT BOOKS</b>		
1.	Ganesh Prasad Kumble, "Practical Artificial Intelligence and Blockchain", First Edition. Packt Publishing Lts, July 2020.	
2.	Imran Bashir, "Mastering Blockchain: Distributed Ledger Technology, decentralization, and smart contracts explained", 2 <sup>nd</sup> Edition, Packt Publishing Ltd, March 2018.	
<b>REFERENCE BOOKS</b>		
1.	Andreas M. Antonopoulos , "Mastering Bitcoin: Unlocking Digital Cryptocurrencies", O'Reilly Media Inc, 2015	

2.	Arvind Narayanan, Joseph Bonneau, Edward Felten, Andrew Miller and Steven Goldfeder, "Bitcoin and Cryptocurrency Technologies: A Comprehensive Introduction", Princeton University Press,2016.
<b>E BOOKS</b>	
1.	<a href="https://www.velmie.com/practical-blockchain-study">https://www.velmie.com/practical-blockchain-study</a>
<b>MOOC</b>	
1.	<a href="https://www.udemy.com/course/build-your-blockchain-az/">https://www.udemy.com/course/build-your-blockchain-az/</a>