Medi-Caps University

Department of Computer Science and Engineering
Scheme for PhD

PhD CSE Course Work, Session: July 2020 and onwards

Sr.No	Course Code	Courses	L	T	P	Hrs	Credits
1	EN6RD01	Research Methodology	4	0	0	4	4
2	MU6RD01	Research and Publication Ethics	2	0	0	2	2
3	EN6CSXX	Elective	4	0	0	4	4
		Total	**10**	**0**	**0**	**10**	**10**

Elective Courses:
EN6CS01 Cloud Computing and Analytics
EN6CS02 Cryptography and High Performance Computing
EN6CS03 Advance Computer Network Architecture
EN6CS04 Natural Language Processing
EN6CS05 Big Data Analytics
EN6CS06 Cyber Security
EN6CS07 Machine Learning
EN6CS08 Blockchain Architecture

Course Code	Course Name	Hours per Week			Total	Total
		L	T	P	Hrs.	Credits
EN5RD01	Research Methodology	4	0	0	4	4

Unit-I Introduction to Research Techniques

Meaning of research, objectives of research, motivation in research, types of research- empirical and experimental research, algorithmic research, simulation research, mathematical modelling approach, characteristics and prerequisites of research, significance of research, research process, Sources of research problem, criteria of identifying the problem, necessity of defining the problem, formulation of a research problem, errors in selecting research problem, technique involved in defining the problem, Report and paper writing.

Unit II Statistical analysis

Statistical analysis, Measures of central tendency and dispersion, mean, median, mode, range, mean and standard deviations, computing correlation in variables, linear and non-linear regression.

Unit III Probability and Probability distributions

Probability: classical, relative frequency and axiomatic definitions of probability, addition rule and conditional probability, multiplication rule, total probability, Bayes'Theorem and independence. Probability distributions: binomial, poison, geometric, negative binomial uniform exponential, normal and log normal distribution.

Random Variables: Discrete, continuous and mixed random variables, probability mass, probability density and cumulative distribution functions, mathematical expectation, moments, probability and moment generating function, median and quintiles, Markov inequality, correlation and regression, independence of random variables.

Unit IV Sampling & Distributions

The Central Limit Theorem, distributions of the sample mean and the sample variance for a normal population, ChiSquare, t and F distributions, problems. Hypothesis Testing: Basic ideas of testing hypothesis, null and alternative hypotheses, the critical and acceptance regions, two types of error, tests for one sample and two sample problems for normal populations, tests for proportions, Chi-square goodness of fit test and its applications. Software and Tools to be learnt: Statistical packages like SPSS and R.

Unit V Simulation and Soft Computing Techniques

Introduction to soft computing, Artificial neural network, Genetic algorithm, Fuzzy logic and their applications, Tools of soft computing, Need for simulation, types of simulation, simulation language, fitting the problem to simulation study, simulation models, verification of simulation models, calibration and validation of models, Output analysis.
Introduction to any one simulation tool e.g. MATLAB, NS2, ANSYS, Cadence etc. (Department Specific).

Text:

1. R. Panneerselvam, " Research Methodologies," PHI.
2. C.R. Kothari: Research methodology, Methods and Techniques, New Age Publication.
3. S.M. Ross. A First Course in Probability, 8 th Edition, Prentice Hall.

Subject Code	Subject Name	Hours per Week			Total Hrs.	Total Credits
		L	T	P		
EN6CS01	CLOUD COMPUTING AND ANALYTICS	4	0	0	4	4

Unit 1- FOUNDATIONS

Introduction to Cloud Computing, Definition, Characteristics, Components, Cloud provider, SAAS, PAAS, IAAS and Others, Organizational scenarios of clouds, Administering & Monitoring cloud services, benefits and limitations, Deploy application over cloud, Comparison among SAAS, PAAS, IAAS Cloud computing platforms: Infrastructure as service: Amazon EC2,Platform as Service: Google App Engine, Microsoft Azure, Utility Computing, Elastic Computing

Unit 2- INFRASTRUCTURE AS A SERVICE (IaaS)

Introduction to Cloud Technologies, Study of Hypervisors, Compare SOAP and REST Webservices, AJAX and mashups-Web services: SOAP and REST, SOAP versus ,REST, AJAX: asynchronous 'rich' interfaces, Mashups: user interface services Virtualization Technology: Virtual machine technology, virtualization applications in enterprises, Pitfalls of virtualization Multitenant software: Multi-entity support, Multi-schema approach, Multi-tenance using cloud data stores, Data access control for enterprise applications.

Unit 3-

Data Acquiring and Storage Data Generation, Data Acquisition Data Validation, Assembly of Events, Data Store, Spatial Storage, Organising Data, Organising data, Databas and RDBMS, SQL and NOSQL, Extract, Transform and Load, Online Transactions Processing, Event stream processing/Complex Event Processing, Descriptive Analytics, Advanced Analytics: Predictive Analytics, Event Analytics, Real Time Analytics Management.

Unit 4- PLATFORM AND SOFTWARE AS A SERVICE

Data in the cloud: Relational databases, Cloud file systems: GFS and HDFS, BigTable, HBase and Dynamo. Map-Reduce and extensions: Parallel computing, The map-Reduce model, Parallel efficiency of Map-Reduce, Relational operations using Map-Reduce, Enterprise batch

processing using Map-Reduce, Introduction to cloud development, Example/Application of Mapreduce, Features and comparisons among GFS,HDFS etc, Map-Reduce model.

Unit 5- KNOWLEDGE REPRESENTATION

First order logic – representation revisited – Syntax and semantics for first order logic – Using first order logic – Knowledge engineering in first order logic - Inference in First order logic – prepositional versus first order logic – unification and lifting – forward chaining – backward chaining – Resolution.

Unit 6- LEARNING

Learning from observations - forms of learning - Inductive learning - Learning decision trees - Ensemble learning - Knowledge in learning – Logical formulation of learning – Explanation based learning – Learning using relevant information – Inductive logic programming - Statistical learning methods - Learning with complete data - Learning with hidden variable - EM algorithm - Instance based learning - Neural networks

TEXT BOOKS Unit I to IV

1. Cloud Computing for Dummies by Judith Hurwitz, R.Bloor, M.Kanfman, F.Halper (Wiley India Edition)

2. Enterprise Cloud Computing by Gautam Shroff,Cambridge

3. Internet of Things by Raj Kamal, McGraw Hill, New Delhi, (in print)

4. Stuart Russell, Peter Norvig, "Artificial Intelligence – A Modern Approach", 3rd Edition, Pearson Education / Prentice Hall of India, 2014.

REFERENCE BOOKS

1. Google Apps by Scott Granneman,Pearson

2. Cloud Security & Privacy by Tim Malhar, S.Kumaraswammy, S.Latif (SPD,O'REILLY)

3. Cloud Computing : A Practical Approach, Antohy T Velte, et.al McGraw Hill,

4. Cloud Computing Bible by Barrie Sosinsky, Wiley India

5. Nils J. Nilsson, "Artificial Intelligence: A new Synthesis", Harcourt Asia Pvt. Ltd., 2000.
6. Elaine Rich and Kevin Knight, "Artificial Intelligence", Second Edition , Tata McGraw-Hill, 2003.
7. George F. Luger, "Artificial Intelligence-Structures And Strategies For Complex Problem Solving", Pearson Education / PHI, 2002.

WEB RESOURCES

- https://www.priv.gc.ca/resource/fs-fi/02_05_d_51_cc_e.pdf
- http://www.secc.org.eg/recocape/SECC_Tutorials_An%20Introduction%20to%20Cloud%20Computing%20Concepts.pdf
- http://c.ymcdn.com/sites/www.aitp.org/resource/resmgr/2013-ie-files/cloudrevolution.Pdf
- https://java.net/jira/secure/attachment/29265/CloudComputing.pdf
- http://bigdatawg.nist.gov/_uploadfiles/M0008_v1_7256814129.pdf
- http://csrc.nist.gov/publications/nistbul/june-2012_itl-bulletin.pdf
- http://www.oracle.com/technetwork/articles/cloudcomp/migrating-to-the-cloudchap-3-495856.pdf
- http://www.cisco.com/en/US/services/ps2961/ps10364/ps10370/ps11104/Migration_of_Enterprise_Apps_to_Cloud_White_Paper.pdf
- http://www.oracle.com/us/products/middleware/data-integration/dataintegration-for-cloud-1870536.pdf
- http://www.cloudbus.org/papers/Aneka-AzurePlatform.pdf
- http://www.vmware.com/files/pdf/VMware-Hybrid-Cloud-Brochure.pdf
- http://www.citrix.com/content/dam/citrix/en_us/documents/productssolutions/
- hybrid-cloud-provisioning-with-citrix-xendesktop-and-xenapp.pdf
- https://www.vmware.com/files/pdf/idc-hybrid-cloud-defined-white-paper.pdf
- http://research.iaun.ac.ir/pd/faramarz_safiold/pdfs/HomeWork_1591.pdf
- http://www.vmware.com/files/pdf/operational_readiness_for_cloud_computing.Pdf
- http://assets1.csc.com/cloud/downloads/IDC_WP_for_CSC_Cloud_Adoption.pdf
- http://www.centerbeam.com/uploads/pdf/CB_Cloud_Assessment.pdf
- http://www.cognizant.com/InsightsWhitepapers/cgReadinessBrochureWeb.pdf
- http://www.cloudwatchhub.eu/sites/default/files/CloudComputingSLAs-ExploitationofResearchResults.pdf
- http://www.cloudstandardscustomercouncil.org/2012_Practical_Guide_to_Cloud_SLAs.pdf
- http://www.infosys.tuwien.ac.at/staff/vincent/pub/Emeakaroha_CloudComp2010.pdf
- http://51lica.com/wp-content/uploads/2012/05/Artificial-Intelligence-A-Modern-Approach-3rd-Edition.pdf
- http://www.facweb.iitkgp.ernet.in/~pallab/ai.slides/lec1.pdf
- http://www.cs.ubbcluj.ro/~csatol/log_funk/prolog/slides/7-search.pdf
- http://spider.sci.brooklyn.cuny.edu/~kopec/Publications/Publications/O_5_AI.pdf
- http://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-825-techniques-in-artificial-intelligence-sma-5504-fall-2002/lecture-notes/Lecture2Final.pdf
- http://people.cs.pitt.edu/~milos/courses/cs2740/Lectures/class1.pdf
- http://stpk.cs.rtu.lv/sites/all/files/stpk/lecture_7.pdf
- http://www.time.mk/trajkovski/teaching/aim/chapter18.pdf

- https://www8.cs.umu.se/kurser/5DV063/HT07/utdelat/Learning_Chapter18.pdf
- http://www.bionet.nsc.ru/chair/grfb/presentations/hofestaedt.pdf
- https://cis.k.hosei.ac.jp/~rhuang/Miccl/AI-2/AI-2-L1.pdf
- http://www.micai.org/rcs/Vol-17-Applications.pdf
- http://www.hutter1.net/ai/sintro2ai.pdf

Course Code	Course Name	Hours per Week			Total Hrs.	Total Credits
		L	T	P		
EN6CS02	Cryptography & High Performance Computing	4	0	0	4	4

Unit I - Advanced Encryption Standard-Substitution:
Linear Cryptanalysis, Differential Cryptanalysis, The Data Encryption Standard, The Advanced Encryption Standard, Modes of Operation, Cryptography Hash Function- Hash Function and Data Integrity, Security of Hash Function, Iterated Hash Functions, Message Authentication Codes.

Unit II - Theory of Parallelism:
Parallel Computer Models, The State of Computing, Multiprocessors and Multicomputer, Multifactor and SIMD Computers, PRAM and VLSI Models, Architectural Development Tracks, Principles of Scalable Performance: Performance Metrics and Measures, Speedup and Performance Laws.

Unit III - Parallel Computer Models:
The state of computing, Multiprocessors and multi-computers, Multivector and SIMD computers, Architectural development tracks. Program And Network Properties: Conditions of parallelism, Data and resource dependences, Hardware and software parallelism, Program partitioning and scheduling, Grain size and latency, Program flow mechanisms, Control flow versus data flow, Data flow architecture.

Unit IV - Systems Engineering:
Introduction to Systems Engineering, Origins of Systems Engineering, Examples of Systems Requiring Systems Engineering, Systems Engineering as a Profession, Systems Engineer Career Development Model, The Power of Systems Engineering, Systems Engineering Viewpoint & Perspectives, Systems Domains, Systems Engineering Fields, Systems Engineering Approaches, Activities and Products.

Unit V - Intellectual Property:
Copyrights, Patents, Trade Secret Laws, Key Intellectual Property Issues, Plagiarism, Reverse Engineering, Open Source Code, Competitive Intelligence, Cyber squatting, Software Development, Strategies to Engineer Quality Software, The Importance of Software Quality, Software Development Process, Capability Maturity Model Integration for Software, Key Issues in Software Development, Development of Safety-Critical Systems.

Text Books:
1. Cryptography Theory and Practice: Third Edition Douglas R. Stinson, Chapman & Hall/CRC, (2006).
2. "Systems Engineering Principles And Practice", Alexander Kossiakoff William N. Sweet Samuel J. Seymour Steven M. Biemer.
3. Kai Hwang, "Advanced Computer Architecture"; TMH.
4. George Reynolds, "Ethics in information Technology" Cengage Learning.

Reference Books :
1. Charles Severance, Kevin Dowd, O'reilly, "High Performance Computing", Second Edition July 1998.
2. Cryptography and network security - 2nd edition - Behrouz A. Forouzan, Debdeep Mukhopadhyay. Introduction to Cryptography with Coding Theory: Wade Trappe and Lawrence C. Washington, Second Edition, Pearson Education, (2007).
3. J. P. Hayes, "Computer Architecture and Organization"; MGH.
4. Sara Baase, "A Gift of Fire: Social, Legal and Ethical Issues, for Computing and the Internet," PHI Publications.

Course Code	Course Name	Hours per Week			Total	Total
		L	T	P	Hrs.	Credits
EN6CS03	**Advanced Computer Network Architecture**	4	0	0	4	4

UNIT-I
Key factors in communication Network Evaluation, Performance calculation of various Layer-2 medium access control protocol. Effect of Propagation Delay and Transmission rate, Delay and Loss Performance, Delay Analysis and Little's Formula. Basic Queueing models.

UNIT-II
Advance Network Architectures, TCP Services, TCP implementation Policy, Integrated Services in the Internet, RSVP, Differentiated Services, congestion control principles- TCP window management, TCP congestion control and reliability, Issues in allocation of resources, Queuing Disciplines, Random Early Detection, Enhancing Active Queue Management, Congestion avoid Mechanism.

UNIT-III
Quality of Service, Internet traffic management-the ISP perspective. Application layer protocols, DHCP-objective , architecture, implementation. Domain Name System-Host table, domain naming, DNS functions, messaging, obtaining DNS services.

UNIT-IV
Traditional Applications-SMTP,MIME,IMAP, HTTP, SNMP, Real-Time Transport Protocol, Session Control and Call Control-SDP, SIP H.323

UNIT-V
Network Management, Infrastructure of Network Management, The internet Network Management Framework, ASN.1, Firewalls, Security Requirements, Public Authentication and Digital Signature, Distributed Applications.

Text Books
1. William Stallings, Data and Computer Communications, Pearson Education.
2. James F.Kurose and Keith W.Ross, Computer Networking: A Top-Down Approach Featuring the Internet, Tata Mc-Graw Hill Publication.

Reference Book
1. Craig Zacker, The Complete Reference-Networking, Tata McGraw Hill Publication.
2. Michael Welzl, Network Congestion Control managing internet traffic, Wiley International Publication.

Course Code	Course Name	Hours per Week			Total Hrs.	Total Credits
		L	T	P		
EN6CS04	**Natural Language Processing**	4	0	0	4	4

Unit-I
Introduction: Why NLP is hard, why NLP is useful, classical problems, Human languages, Language models, ambiguity, processing paradigms, applications.

Unit-II
Stages of NLP: Phonology and Phonetics, Morphology- Morphology fundamentals; Morphological Diversity of Indian Languages; Morphology Paradigms; Finite State Machine Based Morphology; Automatic Morphology Learning, Lexicon, Parsing, Semantics, Pragmatics, Discourse.

Unit-III
Word Sense Disambiguation (WSD): Introduction about WSD, Difficulties in WSD-Difference between dictionaries, Part of Speech tagging, Inter-Judge variance, common sense, sense inventory and algorithm's task dependency.

Unit-IV
Approach for Word Sense Disambiguation: Dictionary or Knowledge based method, Supervised, semi-supervised and unsupervised based method. Parameters for WSD, Scoring function for word sense disambiguation.

Unit-V
Programming in Python: An introduction to programming in Python. Variables, numbers, strings, arrays, dictionaries, conditionals, iteration. Natural Language Toolkit (NTLK),
Regular Expressions, Chomsky hierarchy, regular languages, and their limitations. Finite-state automata. Practical regular expressions for finding and counting language phenomena. Context Free Grammars, Chomsky Normal Form. Top-down parsing, bottom-up parsing.

Textbooks
1. Daniel Jurafsky and James H. Martin, Speech and Language Processing, Pearson Education.
2. Christopher D. Manning and Hinrich Schutze, Foundations of Statistical Natural Language Processing, MIT press.

Reference Books
1. James A., Natural language Understanding, Pearson Education.
2. Bharati A., Sangal R., Chaitanya V. Natural language processing: a Paninian perspective, PHI.
3. Peter Linz, An Introduction to Formal Languages and Automata, Narosa Publishing House.

Course Code	Course Name	Hours per Week			Total Hrs.	Total Credits
		L	T	P		
EN6CS05	Big Data Analytics	4	0	0	4	4

Unit I: Introduction to Big Data
Big Data – Definition, Characteristic Features – Big Data Applications - Big Data vs Traditional Data - Risks of Big Data - Structure of Big Data - Challenges of Conventional Systems, Analysis vs Reporting - Modern Data Analytic Tools

Unit II: Hadoop Distributed File System Architecture
Distributed File Systems - Large-Scale Filesystem Organization, HDFS Architecture – HDFS Concepts – Blocks – NameNode – Secondary NameNode – DataNode – HDFS Federation – Basic File System Operations..

Unit III: Processing Your Data with MapReduce
Getting to know MapReduce – MapReduce Execution Pipeline – Runtime Coordination and Task Management – MapReduce Application.

Unit IV: Data Analysis
Statistical Methods: Regression modelling, Multivariate Analysis - Classification: SVM & Kernel Methods - Rule Mining - Cluster Analysis, Types of Data in Cluster Analysis, Partitioning Methods, Hierarchical Methods, Density Based Methods, Grid Based Methods, Model Based Clustering Methods, Clustering High Dimensional Data - Predictive Analytics.

Unit V: Big Data Frameworks
Introduction to NoSQL, Aggregate Data Models Hbase, Hbase Clients Examples-Cassandra: Data Model Examples - Cassandra Clients - Hadoop Integration. Pig- Grunt- Pig Data Model -Pig Latin -Hive -Data Types and File Formats.

TEXT BOOKS:
1. David Dietrich, Barry Heller and Beibei Yang, Data Science and Big Data Analytics: Discovering, Analyzing, Visualizing and Presenting Data, Wiley.
2. Paul Zikopoulos, Chris Eaton, Dirk DeRoos, Tom Deutsch, George Lapis, Understanding Big Data: Analytics for Enterprise Class Hadoop and streaming Data", McGraw-Hill.
3. Tom White, "Hadoop: The Definitive Guide", O'Reilly.

REFERENCES:
1. David Dietrich, Barry Hiller, "Data Science & Big Data Analytics", EMC education services, Wiley publications.
2. Trevor Hastie, Robert Tibshirani, Jerome Friedman, The Elements of Statistical Learning, Springer.
3. Biris Lublinsky, Kevin T. Smith and Alexey Yakubovich, Professional Hadoop Solutions, Wiley.

Course Code	Course Name	Hours per Week			Total
		L	T	P	Credits
EN6CS06	Cyber Security	4	0	0	4

Unit 1 : Cyber Security Fundamentals

Information Security overview, data security, hardware security, application security, System Security : Security threats and vulnerabilities, Desktop Security(desktop firewall), Network Security(Modem Hardening, Browser hardening, email account hardening), Server Management and firewalls.

Unit 2 : Cyber Security Act, Policies, Laws and Standards

Cyber Security Acts : IT Act 2000 and IT Act 2008(important sections and its evolution), Cyber Security Policy 2020, Cyber Security Law and Cyber Crime cell management. Cyber Security standards(ISO 27001).

Unit 3 : Cyber Crime

Social media best practices. Cyber crime, cyber bullying, ethical hacking and penetration testing.

Unit 4 : Data Security in Network Environment

Symmetric and asummetric key cryptography, Digital Hash function, Digital Signature, PKI and digital certificates, SSL/TSL. HTTPS. Kerberos, VeraCrypt, VPNs, TOR, PGP, SSL Proxy, Access control and intrusion detection, Cyber Forensic.

Unit 5 : Contemporary Topics

Contemporary topics : Crypto Currencies, Data Security in Cloud computing(data security in cloud computing, data security risks, content level security – pros and cons), Cyber Security in IOT, Dark Web, Quantum Crypto.

Text Books:
1. William Stallings, "Cryptography and Network Security – Principles and Practices",
    Prentice Hall
2. Mark Rhodes- Ousley, "Information Security: The Complete Reference", Tata McGraw Hill

Reference Books:
1. Rajkumar Buyya, James Broberg and Anderzej Goscinski, "Cloud Computing Principles and Paradigms", Willey
2. Behrouz A. Forouzan and Debdeep Mukhopadhyay, "Cryptography and Network Security", Tata McGraw Hill

Course Code	Course Name	Hours Per Week			
	Machine Learning	**L**	**T**	**P**	**Credits**
EN6CS07		**4**	**0**	**0**	**4**

Unit -I

Inference, Curve Estimation, Non-Parametric Curve Estimation, Estimation with Cross-Validation Estimation Statistics, Hypothesis Testing, Stochastic Process, Statistical Decision Theory, Linear and Logistic Regression, Multivariate, Resampling Methods, Prediction Intervals Nonparametric Methods.

Unit-II

Supervised Learning: - Different influential supervised learning algorithms in the current research, Advantages and Disadvantages of these algorithms, Statistics involved in these algorithms. Different parameters used in result analysis.
Application areas of these algorithms, The available tools for supervised learning algorithm implementation.

Unit-III

Unsupervised Learning: - Different influential Unsupervised learning algorithms in the current research, Advantages and disadvantages of these algorithms, Statistics involved in these algorithms.
Application areas of these algorithms, The available tools for Unsupervised learning algorithm implementation.

Unit-IV

Reinforcement Learning: - Different influential Reinforcement Learning algorithms in the current research, Advantages and disadvantages of these algorithms, Statistics involved in these algorithms.
Application areas of these algorithms, The available tools for Reinforcement Learning implementation.

Unit-V

Case Studies: Two well-known case studies each for Supervised, Unsupervised and Reinforcement Machine Learning.

Text Book:

1. The Hundred-Page Machine Learning Book, Andriy Burkov, 1st edition, 2019.
2. Kevin Murphy, Machine Learning: A Probabilistic Perspective, MIT Press, 2012.
3. Deep Learning, Ian Goodfellow, The MIT Press, 2016
4. Artificial Intelligence: A Modern Approach, Stuart J. Russell and Peter Norvig, Pearson; 4th edition, 2020.
5. Larry Wasserman, All of Statistics: A Concise Course in Statistical Inference, Springer, 2004.

Reference Books:

1. The Elements of Statistical Learning, Trevor Hastie, Robert Tibshirani, Jerome Friedman, Springer, 2nd edition 2019.
2. Hands-On Machine Learning with Scikit-Learn and TensorFlow, Concepts, Tools, and Techniques to Build Intelligent Systems, Aurélien Géron, published by OʹReilly, 2nd edition, 2019.
3. Christopher Bishop, Pattern Recognition and Machine Learning, Springer 2006.
4. Applied Predictive Modeling, Max Kuhn and Kjell Johnson, Springer; 1st edition, 2013
5. Python Machine Learning: Machine Learning and Deep Learning with Python, Sebastian Raschka,VahidMirjalili, scikit-learn, and TensorFlow, Packt Publishing, 2nd edition, 2017.

Course Code	Course Name	Hours Per Week			
	Blockchain Architecture	**L**	**T**	**P**	**Credits**
EN6CS08		4	0	0	4

Unit I: Basic Cryptographic primitives used in Blockchain – Secure, Collison-resistant hash functions, digital signature, public key cryptosystems, zero-knowledge proof systems. Basic Distributed System concepts – distributed consensus and atomic broadcast, Byzantine fault-tolerant consensus methods

Unit II: Basic Blockchain (Blockchain 1.0) – concepts germane to Bitcoin and contemporary proof-of-work based consensus mechanisms, operations of Bitcoin blockchain, crypto-currency as application of blockchain technology.

Unit III: Blockchain 2.0 – Blockchains with smart contracts and Turing complete blockchain scripting – issues of correctness and verifiability, Ethereum platform and its smart contract mechanism.

Unit IV: Blockchain 3.0 – Plug-and-play mechanisms for consensus and smart contract evaluation engines, Hyperledger fabric platform.

Unit IV: Beyond Cryptocurrency – applications of blockchain in cyber security, integrity of information, E-Governance and other contract enforcement mechanisms. Research directions in Blockchain technology

Text Books:
1. Andreas Antonopoulos "Mastering Bitcoin Unlocking Digital Cryptocurrencies" O'Reilly publication.
2. Imran Bashir "Mastering Blockchain: Distributed ledger technology, decentralization", Packt publishing.

Reference Books:
1. Wattenhofer, The Science of the Blockchain
2. Arvind Narayanan, Joseph Bonneau, Edward Felten, Andrew Miller and Steven Goldfeder, "Bitcoin and Cryptocurrency Technologies: A Comprehensive Introduction" Princeton University.