RTMNU B.TECH. SCHEME OF EXAMINATION

Scheme of Teaching & Examination of Bachelor of Technology VII Semester B.Tech. Computer Science and Engineering [CBCS]

S. N.	Course Code	Category	Subject	Hours/ Week			Credits	Maximum Marks					Min Passing Marks	
								Theory		Practical		Total	Theory	Practical
				L	T	P		Internal	University	Internal	University			
1	BTECHCSE701T	Professional Core Course	Cryptography & Network Security	3	1	-	4	30	70	-	-	100	45	-
2	BTECHCSE701P	Professional Core Course	Cryptography & Network Security	-	-	2	1	-	-	25	25	50	-	25
3	BTECHCSE702T	Professional Core Course	Program Elective-IV	3	-	-	3	30	70	-	-	100	45	-
4	BTECHCSE703T	Professional Core Course	Program Elective-V	3	-	-	3	30	70	-	-	100	45	-
5	BTECHCSE704T	Professional Core Course	Open Elective-II	3	-	-	3	30	70	-	-	100	45	-
7	BTECHCSE705T	Professional Core Course	Project	-	-	6	3	-	-	50	50	100	-	50
8	BTECHCSE706T	HSMC	Research Methodology (Audit Course)	2	-	-	Audit	-	-	-	-	Grade	-	-
Total				14	1	8	17	120	280	75	75	550	180	75

Elective-IV: i) Deep Learning ii) Optimization Techniques iii) Gaming Architecture iv) Salesforce Technology

Elective-V: i) Natural Language Processing ii) Big Data Analytics iii) Mobile Computing

Open Elective-II: i) Python Programming ii) JAVA Programming iii) Basics of Database Management System

(P.S.P RASAD) (Ashish Sharma) (Dr. V.P. Mahatme) A.S. SABHLOG Dr A.M. Thakare A.M. Kuthe Dr D Malik

RASHTRASANT TUKADOJI MAHARAJ NAGPUR UNIVERSITY, NAGPUR

FOUR YEAR BACHELOR OF TECHNOLOGY (B.TECH.) DEGREE COURSE

SEMESTER: SEVENTH

BRANCH: COMPUTER SCIENCE AND ENGINEERING

Subject:	Cryptography and Network Security			Subject Code	BTECHCSE701T
Load	Credit	Total Marks	Internal Marks	University Marks	Total
03Hrs (Theory)	03	100	30	70	100

Aim: To highlight the features of different technologies involved in Network Security.

Prerequisite(s): Mathematics, Algorithm, Networking

Course Objective:

1	To develop the student's ability to understand the concept of security goals in various applications.
2	To provide the students with some fundamental cryptographic mathematics used in various symmetric and asymmetric key cryptography.
3	To develop the student's ability to analyze the cryptographic algorithms.
4	To familiarize the student the need of security in computer networks.

Course Outcome:

At the end of this course student are able to:

CO1	Acquire knowledge about security goals, background of cryptographic mathematics and identification of its application
CO2	Understand, analyze and implement – the symmetric key algorithm
CO3	Acquire knowledge about the background of mathematics of asymmetric key cryptography and understand and analyze – asymmetric key encryption algorithms, digital signatures
CO4	Analyze the concept of message integrity and the algorithms for checking the integrity of data.
CO5	Understand and analyze the existing cryptosystem used in networking

UNIT I: **(08 Hrs)**

Introduction : Security goals, cryptographic attacks. Mathematics of cryptography: modular arithmetic, Euclidean and extended Euclidean algorithm. Traditional symmetric key ciphers; Monoalphabetic ciphers: addition and multiplication ciphers, Polyalphabetic ciphers: Vigenere's ciphers, Hill ciphers, playfair ciphers.

UNIT II: **(07 Hrs)**

Symmetric key cryptography: Block ciphers and its components, Stream cipher, Blowfish, DES, AES, RC4, Key distribution

UNIT III: **(07 Hrs)**

Asymmetric key cryptography: Euler's Phi-Function, Fermat's Little Theorem, Euler's theorem, Chinese remainder theorem. Diffie-Hellman, RSA, ECC, Entity authentication Digital signature

UNIT IV: **(07 Hrs)**

Message Integrity and authentication: Authentication requirement, MAC, HMAC. Cryptographic Hash Function: MD5, SHA, User authentication, Kerberos

UNIT V: **(07 Hrs)**

Network Security: Key Management, PGP, IPSec, SSL, Firewalls, Intrusion Detection, Password management, Virus, Virtual Private Network. Web Security

Textbooks:

- William Stallings ,"Cryptography and Network Security: Principles and Standards", Prentice Hall India, 7th Edition, 2017.
- Behrouz A. Forouzan, "Cryptography and Network Security", McGraw-Hill publication, 2nd Edition, 2010.

References:

- Richard H. Baker, Network Security, McGraw Hill International 3rd Edition,1996
- Bruce Schneier, Applied Cryptography, John Wiley New York, 2nd Edition, 1996.

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FOUR YEAR BACHELOR OF TECHNOLOGY (B.TECH.) DEGREE COURSE

SEMESTER: SEVENTH

BRANCH: COMPUTER SCIENCE AND ENGINEERING

Subject:	Cryptography and Network Security			Subject Code:	BTECHCSE701P
Load	Credit	Total Marks	Internal Marks	University Marks	Total
02Hrs (Practical)	01	50	25	25	50

Aim: To highlight the features of different technologies involved in Network Security.

Prerequisite(s): Mathematics, Algorithm, Networking

Course Objective:

1	To develop the student's ability to understand the concept of security goals in various applications.
2	To provide the students with some fundamental cryptographic mathematics used in various symmetric and asymmetric key cryptography.
3	To develop the student's ability to analyze the cryptographic algorithms.
4	To familiarize the student the need of security in computer networks.

Course Outcome:

At the end of this course student are able to:

CO1	Acquire knowledge about security goals, background of cryptographic mathematics and identification of its application
CO2	Understand, analyze and implement – the symmetric key algorithm
CO3	Acquire knowledge about the background of mathematics of asymmetric key cryptography and understand and analyze – asymmetric key encryption algorithms, digital signatures
CO4	Analyze the concept of message integrity and the algorithms for checking the integrity of data.
CO5	Understand and analyze the existing cryptosystem used in networking

Note : Minimum 10 Practicals based on given syllabus

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FOUR YEAR BACHELOR OF TECHNOLOGY (B.TECH.) DEGREE COURSE

SEMESTER: SEVENTH (C.B.C.S.)

BRANCH: COMPUTER SCIENCE AND ENGINEERING

Subject :	Elective-IV Deep Learning			Subject Code :	BTECHCSE702T
Load	Credit	Total Marks	Internal Marks	University Marks	Total
03Hrs (Theory)	03	100	30	70	100

Course Objective:

1	To introduce basic deep learning algorithms.
2	To understand real world problem which will be solved by deep learning methods.
3	To identify deep learning techniques suitable for a real world problem.

Course Outcome:

At the end of this course student are able to:

CO1	Understand basic of deep learning algorithms.
CO2	Represent feedforward Neural Network
CO3	Evaluate the performance of different deep learning models with respect to the optimization, bias variance trade-off, overfitting and underfitting.
CO4	Apply the convolution networks in context with real world problem solving.
CO5	Apply recurrent neural networks in context with real world problem solving.

UNIT I **(08 Hrs)**

Basic of Deep Learning - History of Deep Learning, McCulloch Pitts Neuron, Thresholding Logic, Perceptrons, Perceptron Learning Algorithm and Convergence, Multilayer Perceptrons (MLPs), Representation Power of MLPs, Sigmoid Neurons, Feed forward Neural Networks.

UNIT II **(07 Hrs)**

Training of feedforward Neural Network - Representation Power of Feed forward Neural Networks, Training of feed forward neural network, Gradient Descent, Gradient Descent (GD), Momentum Based GD, Nesterov Accelerated GD, Stochastic GD, AdaGrad, RMSProp, Adam.

UNIT III **(07 Hrs)**

Optimization Algorithm - Gradient Descent (GD), Momentum Based GD, Nesterov Accelerated GD, Stochastic GD, AdaGrad, RMSProp, Adam, Activation Function and Initialization Methods: Sigmoid,

Tanh, Relu, Xavier and He initialization, Regularization: Bias and variance, Overfitting. Hyperparameters tuning, L1 and L2 regualarization, Data Augmentation and early stopping, Parameter sharing and tying.

UNIT IV **(07 Hrs)**

Convolution Neural Network (CNN) - Convolutional operation, Pooling, LeNet, AlexNet, ZF-Net, VGGNet, GoogLeNet, ResNet. Visualizing Convolutional Neural Networks, Guided Backpropagation.

UNIT V **(07 Hrs)**

Recurrent Neural Network (RNN) - Recurrent Neural Networks, Backpropagation through Time (BPTT), Vanishing and Exploding Gradients, Long Short Term Memory (LSTM) Cells, Gated Recurrent Units (GRUs).

Text Books:

- Sandro Skansi, Introduction to Deep Learning ,Springer.
- Charu C. , Aggarwal. Neural Networks and Deep Learning: A Textbook. Springer. 2019.
- Ian Goodfellow , Yoshua Bengio and Aaron Courville. Deep Learning. An MIT Press book. 2016.
- Dr. S Lovelyn Rose, Dr. L Ashok Kumar, Dr.D Karthika Renuka ,Deep Learning using Python,Willey Publication.

Reference Books:

- Yegnanarayana, B., Artificial Neural Networks PHI Learning Pvt. Ltd, 2009.
- A. Ravindran, K. M. Ragsdell , and G. V. Reklaitis, Engineering Optimization: Methods and Applications , John Wiley & Sons, Inc. , 2016.

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FOUR YEAR BACHELOR OF TECHNOLOGY (B.TECH.) DEGREE COURSE

SEMESTER: SEVENTH (C.B.C.S.)

BRANCH: COMPUTER SCIENCE AND ENGINEERING

Subject :	Elective IV : Optimization Technique			Subject Code :BTECHCSE702T	
Load	Credit	Total Marks	Internal Marks	University Marks	Total
03Hrs (Theory)	03	100	30	70	100

Aim : To understand the implementation of various data structures and algorithms.

Prerequisite(s): C Language

Course Objective/Learning Objective:

1	Ability to apply the theory of optimization methods and algorithms to develop and for solving various types of optimization problems.
2	Ability to go in research by applying optimization techniques in problems of Engineering and Technology

Course Outcome:

At the end of this course Student are able to:

CO1	Explain the theoretical workings of the graphical, simplex and analytical methods for making effective decision on variables so as to optimize the objective function.
CO2	Identify appropriate optimization method to solve complex problems involved in various industries.
CO3	Demonstrate the optimized material distribution schedule using transportation model to minimize total distribution cost.
CO4	Identify appropriate equipment replacement technique to be adopted to minimize maintenance cost by eliminating equipment break-down.
CO5	Apply the knowledge of game theory concepts to articulate real-world competitive situations to identify strategic decisions to counter the consequences.

UNIT I: **(08 Hrs)**

Introduction of operation research: LP Formulations, Graphical method for solving LP's with 2 variables, Simplex method, Duality theory in linear programming and applications, Integer linear programming, dual simplex method.

UNIT II: **(07 Hrs)**

Dynamic Programming : Basic Concepts, Bellman's optimality principles, Dynamics Programming approach in decision making problems, optimal subdivision problem. **Sequencing Models:** Sequencing problem, Johnson's Algorithm for processing n jobs through 2 machines, Algorithm for processing n jobs through 3 or more machines, Processing 2 jobs through n machines.

UNIT III: **(07 Hrs)**

Project Management : PERT and CPM : Project management origin and use of PERT, origin and use of CPM, Applications of PERT and CPM, Project Network, Diagram representation, Critical path calculation by network analysis and critical path method (CPM), Determination of floats, Construction of time chart and resource labelling, Project cost curve and crashing in project management, Project Evaluation and review Technique (PERT)

UNIT IV: **(07 Hrs)**

Queuing Models : Essential features of queuing systems, operating characteristics of queuing system, probability distribution in queuing systems, classification of queuing models, solution of queuing M/M/1: ∞ /FCFS,M/M/1 : N/FCFS, M/M/S : ∞/FCFS, M/M/S : N/FCFS.

UNIT V: **(07 Hrs)**

Inventory Models : Introduction to the inventory problem, Deterministic Models, The classical EOQ (Economic Order Quantity) model, Inventory models with deterministic demands (no shortage & shortage allowed), Inventory models with probabilistic demand, multi item determines models

Textbooks:

- Gillet B.E. : Introduction to Operation Research, Computer Oriented Algorithmic approach – Tata McGraw Hill Publising Co. Ltd. New Delhi.
- P.K. Gupta & D.S. Hira, "Operations Research", S.Chand & Co

References:

- J.K. Sharma, "Operations Research: Theory and Applications", Mac Millan
- S.D. Sharma, "Operations Research", Kedar Nath Ram Nath, Meerut (UP)
- S.S. Rao "Optimization Theory and Application", Wesley Eastern

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FOUR YEAR BACHELOR OF TECHNOLOGY (B.TECH.) DEGREE COURSE

SEMESTER: ~~FOURTH~~ SEVENTH (C.B.C.S.)

BRANCH: COMPUTER SCIENCE AND ENGINEERING

Subject :	Elective IV : Gaming Architecture			Subject Code :BTECHCSE702T	
Load	Credit	Total Marks	Internal Marks	University Marks	Total
03 Hrs (Theory)	03	100	30	70	100

Aim : To understand the concepts of Gaming Architecture

Prerequisite(s):

Course Objective/Learning Objective:

1	Understand the concepts of Game design and development.
2	Learn the processes, mechanics and issues in Game Design.
3	Be exposed to the Core architectures of Game Programming.
4	Know about Game programming platforms, frame works and engines. Learn to develop games.

Course Outcome:

At the end of this course Student are able to:

CO1	Discuss the concepts of Game design and development.
CO2	Design the processes, and use mechanics for game development.
CO3	Explain the Core architectures of Game Programming.
CO4	Use Game programming platforms, frame works and engines.
CO5	Create interactive Games.

UNIT I:

3D GRAPHICS FOR GAME PROGRAMMING **(08)**

3D Transformations, Quaternions, 3D Modeling and Rendering, Ray Tracing, Shader Models, Lighting, Color, Texturing, Camera and Projections, Culling and Clipping, Character Animation, Physics-based Simulation, Scene Graphs.

UNIT II:

GAME ENGINE DESIGN **(07)**

Game engine architecture, Engine support systems, Resources and File systems, Game loop and real-time simulation, Human Interface devices, Collision and rigid body dynamics, Game profiling.

UNIT III:

GAME PROGRAMMING **(07)**

Application layer, Game logic, Game views, managing memory, controlling the main loop, loading and caching game data, User Interface management, Game event management.

UNIT IV:

GAMING PLATFORMS AND FRAMEWORKS **(07)**

2D and 3D Game development using Flash, DirectX, Java, Python, Game engines - Unity. DX Studio, Development: The Development Process. Code Quality. Coding Priorities. Debugging and Module Completion. The Seven Golden Gambits. The Three Lead Balloons.

Initialization and the Main Loop: Initializing Game objects ,Game Loop, Cleanup.

UNIT V: **(07)**

Loading and Caching Game Resources: Image and Audio Formats, Compression Resource, Files Resource File builder, Resource Cache, 3D Graphics and 3D Engines: 3D Graphics Pipeline,3D Middleware

Game and Development: Developing 2D and 3D interactive games using DirectX or Python – Isometric and Tile Based Games, Puzzle games, Single Player games, Multi Player games.

Introduction to Augumented and Virtual Reality in game development.

Textbooks:

- Mike Mc Shaffrfy and David Graham, "Game Coding Complete", Fourth Edition, Cengage Learning, PTR, 2012.
- Jason Gregory, "Game Engine Architecture", CRC Press / A K Peters, 2009.
- David H. Eberly, "3D Game Engine Design, Second Edition: A Practical Approach to Real-Time Computer Graphics" 2 nd Editions, Morgan Kaufmann, 2006.
- Radha Shankarmani , Saurabh Jain ,Gaurang Sinha,Game Architecture and Programming Kindle Edition

References:

- Ernest Adams and Andrew Rollings, "Fundamentals of Game Design", 2 nd Edition Prentice Hall New Riders, 2009.
- Eric Lengyel, "Mathematics for 3D Game Programming and Computer Graphics", 3 rd Edition, Course Technology PTR, 2011.
- Jesse Schell, The Art of Game Design: A book of lenses, 1 st Edition, CRC Press, 2008.

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FOUR YEAR BACHELOR OF TECHNOLOGY (B.Tech.)DEGREE COURSE

SEMESTER:SEVENTH (C.B.C.S.)

BRANCH: Computer Science & Engineering

Subject :	Elective IV : Salesforce Technology			Subject Code :BTECHCSE702T	
Load	Credit	Total Marks	Internal Marks	University Marks	Total
03 Hrs (Theory)	03	100	30	70	100

Aim: To provide a comprehensive understanding of the Salesforce platform, its core features, and its various components.

Prerequisite: OOPS (Object Oriented Programming) or any programming language

Course Objectives:

1.	To make learn how to create and customize objects, fields, and records; building workflows and automation processes.
2.	To learn designing and managing reports and dashboards; and utilizing the Salesforce AppExchange.
3.	To provide knowledge and hands-on experience in programming using Apex (Salesforce's proprietary programming language)

Course Outcome:

At the end of this course students are able to:

CO1	Develop skills in configuring and managing Salesforce orgs.
CO2	Understanding Salesforce Data Management:
CO3	Implementing automation, security and debugging data.
CO4	Acquire programming skills in Apex, Salesforce's programming language.
CO5	Enable to extend and customize Salesforce to meet specific business requirements.

Text /Reference Books:

- "Salesforce Platform App Builder Certification Handbook" by SiddheshKabe and Muhammad Ehsan Khan (Packt Publishing).
- "Salesforce CRM: The Definitive Admin Handbook" by Paul Goodey (Packt Publishing).
- "Force.com Enterprise Architecture" by Andrew Fawcett (Packt Publishing).
- "Mastering Salesforce CRM Administration" by Rakesh Gupta (Packt Publishing).
- "Salesforce Essentials for Administrators" by Mohith Shrivastava (Packt Publishing).
- "Learning Salesforce Lightning Application Development" by Mohith Shrivastava (Packt Publishing).
- "Apex Design Patterns" by Jitendra Zaa (Packt Publishing).
- "Mastering Apex Programming" by ChamilMadusanka (Packt Publishing).

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FOUR YEAR BACHELOR OF TECHNOLOGY (B.TECH.) DEGREE COURSE

SEMESTER: SEVENTH (C.B.C.S.)

BRANCH: COMPUTER SCIENCE & ENGINEERING

Subject :	Elective V : Natural Language Processing			Subject Code :BTECHCSE703T	
Load	Credit	Total Marks	Internal Marks	University Marks	Total
03 Hrs (Theory)	03	100	30	70	100

Prerequisite(s):

Course Objective/Learning Objective:

1	To introduce the basic concepts and applications of Natural Language Processing (NLP)
2	To provide an understanding of the challenges in NLP and their solutions
3	To teach the different techniques and algorithms used in NLP, such as text classification, information retrieval and extraction, syntactic and semantic analysis, and deep learning models
4	To enable students to analyze text data and build NLP models
5	To equip students with the skills to evaluate and compare different NLP techniques and algorithms

Course Outcome:

At the end of this course Student are able to:

CO1	Understand the basic concepts and applications of Natural Language Processing (NLP)
CO2	Identify the challenges in NLP and evaluate the solutions to these challenges
CO3	Analyze and preprocess text data for NLP tasks
CO4	Apply different NLP techniques and algorithms such as text classification, information retrieval and extraction, syntactic and semantic analysis, and deep learning models
CO5	Evaluate and compare different NLP techniques and algorithms using appropriate metrics

UNIT I: **(08Hrs)**

Introduction to NLP: Definition and scope of NLP, Historical overview and applications of NLP, Challenges in NLP and their solutions, Basic concepts in linguistics and language processing, Text preprocessing and normalization

UNIT II: **(07 Hrs)**

Language Models and Text Classification: Language modeling and n-gram models, Classification and categorization of text data, Text classification algorithms such as Naive Bayes, Decision Trees, and Support Vector Machines (SVM), Evaluation measures for text classification.

UNIT III: **(07 Hrs)**

Information Retrieval and Extraction: Information retrieval models such as vector space model and probabilistic model, Retrieval of relevant documents using query expansion, Named Entity Recognition (NER), Relation Extraction and Open Information Extraction (OIE)

UNIT IV: **(07 Hrs)**

Syntactic and Semantic Analysis: Parts of Speech (POS) tagging and parsing, Dependency Parsing, Semantic Analysis and Sentiment Analysis, Word Embeddings and Semantic Similarity

UNIT V: **(07 Hrs)**

Advanced Topics in NLP: Neural Network models for NLP tasks , Deep Learning models for NLP tasks, Natural Language Generation (NLG),
Dialogue Systems and Chatbots

Textbooks:

- Speech and Language Processing" by Daniel Jurafsky and James H. Martin
- Natural Language Processing" by Jacob Eisenstein

References:

- "Foundations of Statistical Natural Language Processing" by Christopher D. Manning and Hinrich Schütze
- "Natural Language Processing with Python" by Steven Bird, Ewan Klein, and Edward Loper

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FOUR YEAR BACHELOR OF TECHNOLOGY (B.TECH.) DEGREE COURSE

SEMESTER: SEVENTH (C.B.C.S.)

BRANCH: COMPUTER SCIENCE & ENGINEERING

Subject :	Elective V : Big Data Analytics			Subject Code :BTECHCSE703T	
Load	Credit	Total Marks	Internal Marks	University Marks	Total
03Hrs (Theory)	03	100	30	70	100

Pre- requisites : Should have knowledge of Programming Language (Java preferably), Practice of SQL (queries and sub queries), exposure to Linux Environment.

Course Objective/Learning Objective:

1	Student should able to learn and understand the basic concept, characteristics and application of Big Data.
2	To learn Concept of Distributed system with Apache Hadoop.
3	To learn application of Hadoop to solve real world problem

Course Outcome:

At the end of this course Student are able to:

CO1	Understand Concept, characteristics, types of big data
CO2	Build and maintain reliable, scalable, distributed systems with Apache Hadoop.
CO3	Apply Hadoop ecosystem components to solve real world problems.
CO4	Apply machine learning algorithm for big data analysis.
CO5	Implement Big Data Activities using Hive

UNIT I : **(08 Hrs)**

Introduction to Big Data: Data, Characteristics of data and Types of digital data: Unstructured, Semi-structured and Structured, Sources of data, working with unstructured data, Evolution and Definition of big data, Characteristics and Need of big data, Challenges of big data, Data environment versus big data environment, Big Data Analysis Life Cycle.

UNIT II : **(07 Hrs)**

Big data analytics tools and Technologies: Overview of business intelligence, Characteristics and need of big data analytics, Classification of analytics, Challenges to big data analytics. Analytical operations: Associations rules, classifications, clustering, Mahout ML, etc.

UNIT III :

(07 Hrs)

Hadoop foundation for analytics: Features, Hadoop ecosystems, Evolution of Hadoop architectures Hadoop 1.0, Hadoop 2.0, Hadoop3.0, Key aspects and Components of Hadoop 3.0. Hadoop Technology Stack: Hive, Pig, Zookeeper, Swoop, oozie, flume, etc.

Unit IV :

(07 Hrs)

MapReduce and YARN framework: Introduction to MapReduce, Processing data with MapReduce, Introduction to YARN, Components YARN, Data serialization and Working with common serialization formats, Big data serialization formats

UNIT V :

(07 Hrs)

NoSQL Databases: Schema-less Models, Increasing Flexibility for Data ManipulationKey Value Stores- Document Stores – Tabular Stores – Object Data Stores Hive – Sharding –Hbase – Analyzing big data NoSQL Database Architectures.

Text Books :

- Tom White " Hadoop: The Definitive Guide" Third Edit on, O'reily Media, 2012.
- Seema Acharya, Subhasini Chellappan, "Big Data Analytics" Wiley 2015
- Big Data,Big Data Analytics by Michael Minelli, Michele Chambers, Ambiga Dhira
- David Loshin, "Big Data Analytics: From Strategic Planning to Enterprise Integration with Tools, Techniques, NoSQL, and Graph", Morgan Kaufmann/El sevier Publishers, 2013.

References

- Michael Berthold, David J. Hand, "Intelligent Data Analysis", Springer, 2007.
- Jay Liebowitz, "Big Data and Business Analytics" Auerbach Publications, CRC press (2013)
- Tom Plunkett, Mark Hornick, "Using R to Unlock the Value of Big Data: Big Data Analytics with Oracle R Enterprise and Oracle R Connector for Hadoop", McGraw-Hill/Osborne Media (2013),

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FOUR YEAR BACHELOR OF TECHNOLOGY (B.TECH.) DEGREE COURSE

SEMESTER: SEVENTH (C.B.C.S.)

BRANCH: COMPUTER SCIENCE AND ENGINEERING

Subject :	Elective V : Mobile Computing			Subject Code :BTECHCSE703T	
Load	Credit	Total Marks	Internal Marks	University Marks	Total
03Hrs (Theory)	03	100	30	70	100

Pre- requisites : Computer Networks.

Course Objective/Learning Objective:

1	To study Wireless Communication with Cellular system Model.
2	To study GSM system with Radio, Network Switching and Operation subsystem.
3	To learn Wireless LAN with MAC Layer.
4	To study Mobile MANET with WAP protocol.

Course Outcome:

At the end of this course Student are able :

CO1	To Understand the basic concepts of Wireless Communication with Cellular system.
CO2	To learn about GSM System with Cell layout, Radio, Network Switching and Operation subsystem, HLR & VLR.
CO3	To learn Wireless LAN with its Architecture and MAC Layer.
CO4	To learn Mobile IP, Dynamic Host Configuration Protocol, Mobile Ad hoc Networks.
CO5	To learn about TCP over Wireless Networks. with Wireless Application protocol.

UNIT I : **(08 Hrs)**

Introduction to Mobile Computing, Features of Wireless Communication, Applications of Wireless Communication, A simplified Reference Model in Mobile Computing, Cellular system Infrastructure with generic Block diagram, frequency reuse, Medium Access Control (Wireless): Motivation for a specialized MAC, Hidden and exposed terminals, near and far terminals, Wireless Network over Wired Network.

UNIT II : **(07 Hrs)**

Introduction to GSM system: Mobile Services, GSM Architecture, GSM operational and technical requirements. Cell layout and frequency planning, GSM radio subsystem, Network and Switching

Subsystem, Operation subsystem. Echo canceller, Localization and calling, Handovers.

UNIT III :

(07 Hrs)

Wireless LAN: Advantages of Wireless LAN, Applications, IEEE 802.11 standards, system Architecture, protocol architecture, physical layer, medium access control layer, MAC management, Mobile Agents, Requirement for mobile agent system, Bluetooth, Roaming.

UNIT IV :

(07 Hrs)

Mobile Network Layer: Mobile IP-IP Packet delivery, Dynamic Host Configuration Protocol (DHCP), Mobile Ad hoc Networks (MANETs): Overview, Properties of a MANET, routing, DSDV, DSR, AODV & Hybrid Routing Protocol

UNIT V :

(07 Hrs)

Mobile Transport Layer: Traditional TCP, Indirect TCP, Snooping TCP, Selective retransmission, Transaction oriented TCP, Wireless Application Protocol (WAP), Architecture, Wireless datagram protocol.

Text Books :

- Mobile Communications, Jochen Schiller, Second edition, Pearson, 2006.
- Mobile Computing for beginners, Raksha Shende, Arizona Business Alliance, 2012.
- Handbook of Wireless Networks and Mobile Computing, Ivan Stojmenovic, Wiley, 2002.

References

- Fundamentals of Mobile and Pervasive Computing, Adelstein, Frank, Gupta and Sandeep KS, McGraw-Hill, 2005.
- Principles of Mobile Computing, Hansmann, Merk and Nicklous, Stober, Springer, Second Edition, 2003.
- Mobile Communication, T. Shivakami, Annaji M. Kuthe, Scientific International Publishing House, 2022.

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FOUR YEAR BACHELOR OF TECHNOLOGY (B.TECH.) DEGREE COURSE

SEMESTER: SEVENTH (C.B.C.S.)

BRANCH: COMPUTER SCIENCE AND ENGINEERING

Subject :	Open Elective II : Python Programming			Subject Code :BTECHCSE704T	
Load	Credit	Total Marks	Internal Marks	University Marks	Total
03Hrs (Theory)	03	100	30	70	100

Prerequisite(s): C Language

Course Objective/Learning Objective:

1	To understand the fundamentals of Python programming language.
2	To develop problem-solving and programming skills using Python.
3	To use Python in different applications such as web development, data analysis, and artificial intelligence.

Course Outcome:

At the end of this course, Student are able to:

CO1	Develop programming skills in Python programming language.
CO2	Implement object-oriented programming concepts using Python.
CO3	Utilize Python libraries for data analysis and visualization.
CO4	Develop web applications using Flask framework.
CO5	Apply machine learning concepts using Scikit-Learn.

UNIT I: **(08 Hrs)**

Introduction to Python Programming: Overview of Python programming language, Variables, data types, and operators, Conditional statements and loops, Functions, and modules

UNIT II: **(07 Hrs)**

Object-Oriented Programming in Python: Object-oriented programming concepts, Classes, objects, and methods, Inheritance, and polymorphism

UNIT III: **(07 Hrs)**

Python Libraries for Data Analysis: Introduction to NumPy and Pandas, Data manipulation with NumPy and Pandas, Data visualization with Matplotlib and Seaborn.

UNIT IV: **(07 Hrs)**

Web Development with Flask: Introduction to Flask framework, creating web applications using Flask, Flask extensions for database integration

UNIT V: **(07 Hrs)**

Introduction to Machine Learning with Python: Introduction to Scikit-Learn, Supervised and unsupervised learning, Classification, and regression algorithms

Textbooks:

- "Python for Everybody: Exploring Data in Python 3" by Charles Severance.
- "Python Crash Course, 2nd Edition: A Hands-On, Project-Based Introduction to Programming" by Eric Matthes.

References:

- "Learning Python, 5th Edition" by Mark Lutz.
- "Python Data Science Handbook: Essential Tools for Working with Data" by Jake VanderPlas.

RASHTRASANT TUKADOJI MAHARAJ NAGPUR UNIVERSITY, NAGPUR

FOUR YEAR BACHELOR OF TECHNOLOGY (B.TECH.) DEGREE COURSE

SEMESTER: SEVENTH (C.B.C.S.)

BRANCH: COMPUTER SCIENCE AND ENGINEERING

Subject :	Open Elective II : JAVA Programming			Subject Code :BTECHCSE704T	
Load	Credit	Total Marks	Internal Marks	University Marks	Total
03 Hrs (Theory)	03	100	30	70	100

Prerequisite(s): C Language

Course Objective/Learning Objective:

1	To introduce the concepts of Java programming language and its application in software development.
2	To develop a sound understanding of Java programming constructs such as variables, operators, control statements, loops, and arrays.
3	To provide students with a strong foundation in object-oriented programming concepts such as inheritance, polymorphism, encapsulation, and abstraction.
4	To enable students to create and use classes, objects, and methods in Java programs.
5	To teach students how to handle exceptions and use various input/output techniques in Java programs.

Course Outcome:

At the end of this course Student are able to:

CO1	Understand the fundamentals of Java programming language and its application in software development.
CO2	Implement Java programming constructs such as variables, operators, control statements, loops, and arrays.
CO3	Design and implement object-oriented programs using inheritance, polymorphism, encapsulation, and abstraction concepts in Java.
CO4	Create and use classes, objects, and methods in Java programs.
CO5	Handle exceptions and use input/output techniques in Java programs.

UNIT I: **(08 Hrs)**

Introduction to Java Programming: Introduction to Java programming language

Java Virtual Machine (JVM), Java Development Kit (JDK), Overview of Java programming environment, Simple Java program and its execution

UNIT II: **(07 Hrs)**

Java Programming Constructs: Variables and data types, Operators, and expressions Control statements: if-else, switch, for, while, do-while, Arrays: single-dimensional and multi-dimensional arrays, Strings and string manipulation

UNIT III: **(07 Hrs)**

Object-Oriented Programming Concepts in Java: Classes and objects, Methods and constructors, Inheritance: single and multilevel inheritance, Polymorphism: method overloading and overriding, Encapsulation and abstraction

UNIT IV: **(07 Hrs)**

Handling Exceptions in Java: Exception handling: try-catch, throw, throws, Exception hierarchy in Java, Checked and unchecked exceptions, Creating custom exceptions

UNIT V: **(07 Hrs)**

Input/Output Techniques in Java: File handling in Java, Reading and writing data using streams, Serialization and deserialization, Networking programming in Java: sockets and URLs

Textbooks:

- Java: The Complete Reference by Herbert Schildt, McGraw Hill Education, 11th edition, 2018.Severance, C. (2016).
- "Head First Java" by Kathy Sierra and Bert Bates.

References:

- Core Java Volume I – Fundamentals by Cay S. Horstmann and Gary Cornell, Prentice Hall, 11th edition, 2018.
- Java How To Program by Paul Deitel and Harvey Deitel, Pearson Education, 11th edition, 2017.

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FOUR YEAR BACHELOR OF TECHNOLOGY (B.TECH.) DEGREE COURSE

SEMESTER: SEVENTH (C.B.C.S.)

BRANCH: COMPUTER SCIENCE AND ENGINEERING

Subject :	Open Elective II : Basics of Database Management System			Subject Code :BTECHCSE704T	
Load	Credit	Total Marks	Internal Marks	University Marks	Total
03 Hrs (Theory)	03	100	30	70	100

Aim: To understand basic concepts of Database Management System.

Prerequisite(s): NIL

Course Objective/Learning Objective:

1.	To introduce a general idea of a database management system.
2.	To develop skills to implement real life applications that involve database handling.
3.	To provide opportunities in subject areas of data handling and managing techniques

Course Outcome:

At the end of this course Student are able to:

CO1	Understand the basics of DBMS to analyze an information problem in the form of an Entity relation diagram and design an appropriate data model for it.
CO2	Demonstrate basics of File organizations and its types
CO3	Interpret functional dependencies and various normalization forms
CO4	Perform basic transaction processing and management
CO5	Demonstrate SQL queries to perform CRUD (Create, Retrieve, Update, Delete) operations on database

UNIT I: **(08 Hrs)**

Introduction to DBMS - Purpose of Database Systems,Database systems Applications, view of data,Database Languages,Database system structure,data methods,Database Design,& ER Model : Entity,Attributes ,Relationships,Constraints,Keys,Design Process, ER Models, E-R Diagram.

UNIT II: **(07 Hrs)**

File organizations and its types, indexing, types of indexing, hashing, hashing techniques.

UNIT III: **(07 Hrs)**

Functional Dependency (FD) – data integrity rules, functional dependency, need of normalization,first normal form, second normal form, third normal form

UNIT IV: **(07 Hrs)**

Database Transaction Processing : transaction system concepts, desirable properties(ACID) of transactions, schedules, serializability of schedules, concurrency control, recoverability and Deadlock handling.

UNIT V: **(07 Hrs)**

SQL Concepts - Basics of SQL, DDL, DML, DCL, structure – creation, alteration, defining constraints, Functions - aggregate functions, Built-in functions –numeric, date, string functions, set operations, Use of group by, having, order by, join and its types, Exist, Any, All

Textbooks:

- Abraham Silberschatz, Henry F. Korth and S. Sudarshan, Database System Concepts 4th Ed, McGraw Hill, 2010
- Ramez Elmasri and Shamkant B. Navathe, Fundamentals of Database Systems (5/e), Pearson Education, 2008
- Raghu Ramakrishnan and Johannes Gehrke, Database Management Systems (3/e), McGraw Hill

References:

- Peter Rob and Carlos Coronel, Database Systems- Design, Implementation and Management (7/e),Cengage Learning, 2007.

RTMNU B.TECH. SCHEME OF EXAMINATION

Scheme of Teaching & Examination of Bachelor of Technology VIII Semester B.Tech. Computer Science and Engineering [CBCS]

S. N.	Course Code	Category	Subject	Hours/ Week			Credits	Maximum Marks					Min Passing Marks	
								Theory		Practical		Total	Theory	Practical
				L	T	P		Internal	University	Internal	University			
1	BTECHCSE801T	Professional Core Course	Industry Project/Project**	-	-	16	8	-	-	75	75	150	-	75
2	BTECHCSE802T	Professional Core Course	Program Elective*-VI / MOOC	3	-	-	3	30	70	-	-	100	45	
3	BTECHCSE803T	Professional Core Course	Program Elective*-VII MOOC	3	-	-	3	30	70	-	-	100	45	
Total				6	-	16	14	60	140	75	75	350	90	75

** Industry Project/Project: Students are encouraged to complete this project in industry and one co guide should be assigned from institute. Rigorous monitoring and mid semester at least two progress to be monitored.

*Program Electives VI & VII can be opted from NPTEL/MOOCS. Final examination will be conducted by RTMNU.

Program Elective-VI

1. Social Networks
2. Reinforcement Learning
3. GPU Architectures and Programming

Program Elective-VII

1. Predictive Analytics - Regression and Classification
2. Blockchain and its Applications
3. Computer Vision

Subject : Social Networks **Subject Code : BTCME801.1T**

Load	Credit	Total Marks	Internal Marks	University Marks	Total
03Hrs (Theory)	03	100	30	70	100

Aim : To understand social networks and use of tools for social network analysis.
Prerequisite(s): Discrete Mathematics

Course Objectives:

1	To understand highly interconnected and highly complex social network
2	To represent connected social networks in form of graph
3	To apply graph theory, sociology, game theory
4	To use tools and extract statistics from social networks

Course Outcomes:
At the end of this course Student are able to:

CO1	Learn social networks , its types and representation
CO2	Understand weak ties, strong and weak relationships , homophily and calculate
CO3	Analyse links
CO4	Understand Power Laws and Rich-Get-Richer Phenomena
CO5	Understand Small World Phenomenon

Week 1: Introduction
Week 2: Handling Real-world Network Datasets
Week 3: Strength of Weak Ties
Week 4: Strong and Weak Relationships (Continued) & Homophily
Week 5: Homophily Continued and +Ve / -Ve Relationships
Week 6: Link Analysis
Week 7: Cascading Behavior in Networks
Week 8: Link Analysis (Continued)
Week 9: Power Laws and Rich-Get-Richer Phenomena
Week 10: Power law (contd..) and Epidemics
Week 11: Small World Phenomenon
Week 12: Pseudocode (How to go viral on web)

References:
1. https://onlinecourses.nptel.ac.in/noc23_cs19/preview
2. Networks, Crowds and Markets by David Easley and Jon Kleinberg, Cambridge University Press, 2010
3. Social and Economic Networks by Matthew O. Jackson, Princeton University Press, 2010.

(Dr. V. P. Mahatme) (Ashesh Shahare) (P. S. Prasad)

Subject: Reinforcement Learning **Subject Code: BTCME801.2T**

Load	Credit	Total Marks	Internal Marks	University Marks	Total
03Hrs (Theory)	03	100	30	70	100

Aim : The goal of the course is to introduce the basic mathematical foundations of reinforcement learning, as well as highlight some of the recent directions of research.

Prerequisite(s): Neural Networks

Course Objectives:

1	It aims to model the trial-and-error learning process that is needed in many problem situations where explicit instructive signals are not available.
2	It has roots in operations research, behavioral psychology and AI.
3	The goal of the course is to introduce the basic mathematical foundations of reinforcement learning.
4	It highlight some of the recent directions of research

Course Outcomes:

At the end of this course Student are able to:

CO1	Understand Bandit algorithm and its mathematical formulation.
CO2	Use dynamic programming for reinforcement learning
CO3	Perform function approximation and apply LSM
CO4	Fit Q, DQN & Policy Gradient for Full RL
CO5	Use combinatorial models for complex problems

Week 1 Introduction
Week 2 Bandit algorithms – UCB, PAC
Week 3 Bandit algorithms –Median Elimination, Policy Gradient
Week 4 Full RL & MDPs
Week 5 Bellman Optimality
Week 6 Dynamic Programming & TD Methods
Week 7 Eligibility Traces
Week 8 Function Approximation
Week 9 Least Squares Methods
Week 10 Fitted Q, DQN & Policy Gradient for Full RL
Week 11 Hierarchical RL
Week 12 POMDPs

References

1. https://archive.nptel.ac.in/courses/106/106/106106143/
2. R. S. Sutton and A. G. Barto. Reinforcement Learning - An Introduction. MIT Press. 1998.

Subject: GPU Architecture and Programming **Subject Code : BTCME801.3T**

Load	Credit	Total Marks	Internal Marks	University Marks	Total
03Hrs (Theory)	03	100	30	70	100

Aim : To understand GPU architecture basics in terms of functional units and then dive into the popular CUDA programming model commonly used for GPU programming.
Prerequisite(s): Programming and Data Structure, Digital Logic, Computer architecture

Course Objectives:

1	To introduce basics of conventional CPU architectures, their extensions for single instruction multiple data processing (SIMD)
2	To understand concept in the form of single instruction multiple thread processing (SIMT) as is done in modern GPUs.
3	To teach architecture specific details
4	To introduce different architecture-aware optimization techniques relevant to both CUDA and OpenCL

Course Outcome:
At the end of this course Student are able to:

CO1	Understand conventional CPU architectures, their extensions for single instruction multiple data processing (SIMD)
CO2	Program in CUDA about data space & synchronization
CO3	Apply optimization on kernals, treads etc
CO4	Learn basics of OpenCL
CO5	Design an application using neural networks

Week 1: Review of Traditional Computer Architecture – Basic five stage RISC Pipeline, Cache Memory, Register File, SIMD instructions
Week 2: GPU architectures - Streaming Multi Processors, Cache Hierarchy, The Graphics Pipeline
Week 3: Introduction to CUDA programming
Week 4: Multi-dimensional mapping of dataspace, Synchronization
Week 5: Warp Scheduling, Divergence
Week 6: Memory Access Coalescing
Week 7: Optimization examples: optimizing Reduction Kernels
Week 8: Optimization examples: Kernel Fusion, Thread and Block Coarsening
Week 9: OpenCL basics
Week 10: CPU GPU Program Partitioning
Week 11: Application Design: Efficient Neural Network Training/Inferencing
Week 12: Application Design: Efficient Neural Network Training/Inferencing,cont'd

References:

1. https://onlinecourses.nptel.ac.in/noc23_cs61/preview
2. "Computer Architecture -- A Quantitative Approach" - John L. Hennessy and David A. Patterson
"Programming Massively Parallel Processors" - David Kirk and Wen-mei Hwu

3. Heterogeneous Computing with OpenCL" -- Benedict Gaster, Lee Howes, David R. Kaeli

Subject : Predictive Analytics - Regression and Classification Subject Code : BTCME802.1T

Load	Credit	Total Marks	Internal Marks	University Marks	Total
03Hrs (Theory)	03	100	30	70	100

Aim : The course will provide an overview of fundamental ideas in statistical **predictive** models.
Prerequisite(s): Probability and Statistics

Course Objectives:

1	The course will provide an overview of fundamental ideas in statistical predictive models
2	. The objective is to understand how statistical models handle prediction problems.
3	The stress will be on understanding the construction of the models and implementation.
4	It is a core course if students aspire to be Data Scientists.

Course Outcomes:
At the end of this course Student are able to:

CO1	To understand predictive models, LSM, Normal equations and GMT
CO2	Understand regression models and infer its statistical inference
CO3	Check model assumptions and bias variance tradeoff.
CO4	Perform regression analysis in various programming languages
CO5	Apply regression models and classification for predictive analysis

Week 1:
- Landscape of the predictive models.
- Least Squares method

Week 2:
- Normal Equations:
- Gauss Markov theorem

Week 3:
- The geometry of Regression Model and Feature Engineering
- Statistical Inference of Regression Coefficient

Week 4:
- Checking Model Assumptions
- Model Comparison with R-squared, RMSE, AIC or BIC

Week 5:
- Model Complexity and Bias-Variance tradeoff
- Feature selection and Dimension Reduction

Week 6:
- Multicollinearity and Variance Inflation Factor
- Regularization with LASSO, Ridge and Elastic Net
- Ridge Regression with Python

Week 7:
- Regression Analysis with Python
- Regression Analysis with R
- Regression Analysis with Julia

Week 8: Major Applications of Regression Models
- Capital Asset Pricing Model
- Bootstrap Regression
- Time Series Forecasting with Regression Model
- Granger Causal model.

Week 9:
- Logistic Regression
- MLE of coefficient of Logistic Regression

Week 10:
- Fit Logistic Regression with optim function in R
- Fit Logistic Regression with glm function in R
- Fit Logistic Regression with sklearn in Python
- Fit Logistic Regression in Julia

Week 11:
- Logistic Regression and Inference
- Discriminant Analysis

Week 12:
- Multinomial Logit Regression
- Generalised Linear Regression
- Poisson Regression
- Negative Binomial Regression

References:

1. https://onlinecourses.nptel.ac.in/noc23_ma46/preview
2. An Introduction to Statistical Learning by James, Witten, Hastie, and Tibshirani, Springer (https://www.statlearning.com/)
3. The Elements of Statistical Learning by Hastie, Tibshirani, and Friedman, Springer (https://hastie.su.domains/Papers/ESLII.pd)
4. Regression and Other Stories by Gelman, Hill, and Vehtari, by Cambridge University Press (https://avehtari.github.io/ROS-Examples/)

Subject : Data Analytics using Python **Subject Code: BTCME802.2T**

Load	Credit	Total Marks	Internal Marks	University Marks	Total
03 Hrs (Theory)	03	100	30	70	100

Aim : To give hands-on experience using python for creating analytics models

Prerequisite(s): Nil

Course Objectives:

1	To learn analytics using python programming language
2	Learn hypothesis testing and ANOVA model
3	Regression models and its implementation
4	*Learn clustering and classification*

Course Outcomes:

At the end of this course student are able to:

CO1	Understand data analytics and Python fundamentals
CO2	Perform sampling using various methods and perform hypothesis test or ANOVA test
CO3	Fit linear regression model and calculate various errors
CO4	Apply ROC
CO5	Apply clustering and classification using python programming

Week 1: Introduction to data analytics and Python fundamentals

Week 2: Introduction to probability

Week 3: Sampling and sampling distributions

Week 4: Hypothesis testing

Week 5: Two sample testing and introduction to ANOVA

Week 6: Two way ANOVA and linear regression

Week 7: Linear regression and multiple regressions

Week 8: Concepts of MLE and Logistic regression

Week 9: ROC and Regression Analysis Model Building

Week 10: c^2 Test and introduction to cluster analysis

Week 11: Clustering analysis

Week 12: Classification and Regression Trees (CART)

References:

- **https://archive.nptel.ac.in/courses/106/107/106107220/**
- McKinney, W. (2012). Python for data analysis: Data wrangling with Pandas, NumPy, and IPython. " O'Reilly Media, Inc.".
- Swaroop, C. H. (2003). A Byte of Python. Python Tutorial.
- Ken Black, sixth Editing. Business Statistics for Contemporary Decision Making. "John Wiley & Sons, Inc".
- Anderson Sweeney Williams (2011). Statistics for Business and Economics. "Cengage Learning".
- Douglas C. Montgomery, George C. Runger (2002). Applied Statistics & Probability for Engineering. "John Wiley & Sons, Inc"
- Jay L. Devore (2011). Probability and Statistics for Engineering and the Sciences. "Cengage Learning".
- David W. Hosmer, Stanley Lemeshow (2000). Applied logistic regression (Wiley Series in probability and statistics). "Wiley-Interscience Publication".
- Jiawei Han and Micheline Kamber (2006). Data Mining: Concepts and Techniques. "
- Leonard Kaufman, Peter J. Rousseeuw (1990). Finding Groups in Data: An Introduction to Cluster Analysis. "John Wiley & Sons, Inc".

Subject: Cloud Computing **Subject Code : BTCME802.3T**

Load	Credit	Total Marks	Internal Marks	University Marks	Total
03 Hrs (Theory)	03	100	30	70	100

Aim : This will help students to use and explore the cloud computing platforms.

Prerequisite(s): Basics of Computer Architecture and Organization, Networking

Course Objectives:

1	This course will introduce various aspects of cloud computing.
2	Learn cloud fundamentals, management issues, security challenges and future research trends.
3	VM resource management and cloud fog edge enabled analytics
4	Teach case studies and advanced research areas

Course Outcomes:
At the end of this course Student are able to:

CO1	Understand on-demand computing service for shared pool of resources, namely servers, storage, networking, software, database, applications etc.,
CO2	Understand cloud model for enabling ubiquitous, on-demand access to a shared pool of configurable computing resources, which can be rapidly provisioned and released with minimal management effort.
CO3	Create a cloud and use cloud simulator softwares
CO4	PerformVM resource management and cloud fog edge enabled analytics.
CO5	Practice case studies and understand advanced research areas

Week 1: Introduction to Cloud Computing

Week 2: Cloud Computing Architecture

Week 3: Service Management in Cloud Computing

Week 4: Data Management in Cloud Computing

Week 5: Resource Management in Cloud

Week 6: Cloud Security

Week 7: Open Source and Commercial Clouds, Cloud Simulator

Week 8: Research trend in Cloud Computing, Fog Computing

Week 9: VM Resource Allocation, Management and Monitoring

Week 10: Cloud-Fog-Edge enabled Analytics

Week 11: Serverless Computing and FaaS Model

Week 12: Case Studies and Recent Advancements

References

1. Cloud Computing: Principles and Paradigms, Editors: Rajkumar Buyya, James Broberg, Andrzej M. Goscinski, Wiley,2011

2. Enterprise Cloud Computing - Technology, Architecture, Applications, Gautam Shroff, Cambridge University Press, 2010

3. Cloud Computing Bible, Barrie Sosinsky, Wiley-India, 2010

4. Cloud Security: A Comprehensive Guide to Secure Cloud Computing, Ronald L. Krutz, Russell Dean Vines, Wiley- India,2010

5. https://archive.nptel.ac.in/courses/106/105/106105167/

Subject : Project Work/Industry Project (Phase II) **Subject Code: BTCME803P**

Load	Credit	Total Marks	Internal Marks	University Marks	Total
12 Hrs (Practical)	08	200	100	100	200