

**Semester –VII (Final Year)**  
**Proposed Scheme w.e.f. July – 2023**

Course Category	Course Code	Course Title	Weekly Teaching Hrs			Evaluation Scheme				Credit
			L	T	P	CA	MSE	ESE	Total	
	BTCOC701	Artificial Intelligence	3	-	-	20	20	60	100	3
	BTCOC702	Cloud Computing	3	-	-	20	20	60	100	3
	BTCOE703	Elective – VI (A) Bioinformatics (B) Distributed System (C) Big Data Analytics	3	-	-	20	20	60	100	3
	BTCOE704	Open Elective – VII (A) Cryptography and Network Security (B) Business Intelligence (C) Block chain Technology	3	-	-	20	20	60	100	3
	BTCOE705	Open Elective – VIII (A) Virtual Reality (B) Deep Learning (C) Design Thinking	3	-	-	20	20	60	100	3
	BTHM706	Foreign Language Studies*	-	-	4	-	-	-	-	Audit
	BTCOL707	Artificial Intelligence & Cloud Computing Lab	-	-	4	60	-	40	100	2
	BTCOS708	Project Phase – I	-	-	-	60	-	40	100	2
	BTCOF608	Field Training / Internship / Industrial Training –III (Evaluation)	-	-	-	-	-	-	-	Audit
<b>TOTAL</b>			<b>15</b>	<b>-</b>	<b>8</b>	<b>220</b>	<b>100</b>	<b>380</b>	<b>700</b>	<b>19</b>

\*Any Foreign language can be opted by the students as per their need /demand conducted in online or offline mode by the institute.

**Semester –VIII (Final Year)**  
**Proposed Scheme w.e.f. January – 2024**

Course Category	Course Code	Course Title	Weakly Teaching Hrs			Evaluation Scheme				Credit
			L	T	P	CA	MSE	ESE	Total	
	BTCOF801	Project phase – II (In-house) / Internship and Project in Industry	-	-	24	60	-	40	100	12
<b>TOTAL</b>			<b>-</b>	<b>-</b>	<b>24</b>	<b>60</b>	<b>-</b>	<b>40</b>	<b>100</b>	<b>12</b>

## **BTCOC701: Artificial Intelligence**

### **[Unit1] Introduction**

**[7 Hours]**

What Is AI? The Foundations of Artificial Intelligence, the History of Artificial Intelligence, the State of the Art. Intelligent Agents: Agents and Environments Good Behavior: The Concept of Rationality, The Nature of Environments, The Structure of Agents.

### **[Unit2] Problem-solving**

**[7 Hours]**

Solving Problems by Searching, Problem-Solving Agents, Example Problems, Searching for Solutions, Uninformed Search Strategies, Informed (Heuristic) Search Strategies, Heuristic Functions, Defining Constraint Satisfaction Problems, Constraint Propagation: Inference in CSPs, Backtracking Search for CSPs, Local Search for CSPs, The Structure of Problems. Adversarial Search, Games, Optimal Decisions in Games, Alpha-Beta Pruning.

### **[Unit 3] Knowledge & Reasoning**

**[7 Hours]**

Knowledge representation issues, Representation & mapping, Approaches to knowledge representation, Issues in knowledge representation. Using predicate logic: Representing simple fact in logic, Representing instant & ISA relationship, Computable functions & predicates, Resolution, Natural deduction. Representing knowledge using rules: Procedural versus declarative knowledge, Logic programming, Forward versus backward reasoning, Matching, Control knowledge.

### **[Unit 4] Probabilistic Reasoning [7 Hours]**

Representing knowledge in an uncertain domain, The semantics of Bayesian networks, Dempster-Shafer theory, Fuzzy sets & fuzzy logics, Planning: Overview, Components of a planning system, Goal stack planning, Hierarchical planning and other planning techniques.

### **[Unit5] Natural Language processing: [7 Hours]**

Introduction, Syntactic processing, Semantic analysis, Discourse & pragmatic processing.

Learning: Forms of learning, Inductive learning, Learning decision trees, explanation based learning, Learning using relevance information, Neural net learning & genetic learning. Expert Systems: Representing and using domain knowledge, Expert system shells and knowledge acquisition.

### **Text Book:**

1. Rich, E. and Knight K.: Artificial Intelligence, Tata McGraw- Hill

### **Reference Books:**

1. Peter Norvig, Artificial Intelligence: A Modern Approach, Third Edition.
2. Ivan Bratko, Prolog Programming for Artificial Intelligence, Addison-Wesley.

## BTCOE702 Cloud Computing

[Lecture: 3 Periods/Week

End Semester Examination: 60 Marks

CA: 20 Marks

MSE: 20 Marks

Prerequisites: Discrete Mathematics, Computer Networks

### Course Objectives:

1. To understand the concepts of Cloud Computing.
2. To learn Taxonomy of Virtualization Techniques.
3. To learn Cloud Computing Architecture.
4. To acquire knowledge on Aneka Cloud Application Platform.
5. To learn Industry Cloud Platforms.

### Course Outcomes:

At the end of this course student will:

- CO1) Understand the concept of virtualization and how this has enabled the development of Cloud Computing
- CO2) Know the fundamentals of cloud, cloud Architectures and types of services in cloud
- CO3) Understand scaling, cloud security and disaster management
- CO4) Design different Applications in cloud
- CO5) Explore some important cloud computing driven commercial systems

### UNIT 1

**Introduction to Cloud:** Cloud Computing at a Glance, the Vision of Cloud Computing, Defining a Cloud, a Closer Look, Cloud Computing Reference Model. Characteristics and Benefits, Challenges Ahead, Historical Developments. **Virtualization:** Introduction, Characteristics of Virtualized Environment, Taxonomy of Virtualization Techniques, Virtualization and Cloud computing, Pros and Cons of Virtualization, Technology Examples- VMware and Microsoft Hyper-V.

### UNIT 2

**Cloud Computing Architecture:** Introduction, Cloud Reference Model, Architecture, Infrastructure / Hardware as a Service, Platform as a Service, Software as a Service, Types of Clouds, Public Clouds, Private Clouds, Hybrid Clouds, Community Clouds, Economics of the Cloud, Open Challenges, Cloud Interoperability and Standards, Scalability and Fault Tolerance.

### UNIT 3

**Defining the Clouds for Enterprise:** Storage as a service, Database as a service, Process as a service, Information as a service, Integration as a service and Testing as a service. Scaling a cloud infrastructure -Capacity Planning, Cloud Scale.

### UNIT 4

**Aneka: Cloud Application Platform** Framework Overview, Anatomy of the Aneka Container, From the Ground Up: Platform Abstraction Layer, Fabric Services, Foundation Services, Application Services, Building Aneka Clouds, Infrastructure Organization, Logical Organization, Private Cloud Deployment Mode, Public Cloud Deployment Mode, Hybrid Cloud Deployment Mode, Cloud Programming and Management, Aneka SDK, Management Tools.

### UNIT 5

**Cloud Applications:** Scientific Applications – Health care, Geoscience and Biology. Business and Consumer Applications- CRM and ERP, Social Networking, Media Applications and Multiplayer Online Gaming.

**Cloud Platforms in Industry:** Amazon Web Services- Compute Services, Storage Services, Communication Services and Additional Services. Google AppEngine-Architecture and Core Concepts, Application Life-Cycle, cost model. Microsoft Azure- Azure Core Concepts.

## Learning Resource

### Text Books

1. Mastering Cloud Computing by Raj Kumar Buyya, Christian Vecchiola, and S.Thamarai Selvi from TMH 2013.
2. George Reese Cloud Application Architectures, First Edition, O'Reilly Media 2009.

### References

1. Cloud Computing and SOA Convergence in Your Enterprise *A Step-by-Step Guide* by
2. David S. Linthicum from Pearson 2010.
3. Cloud Computing 2nd Edition by Dr. Kumar Saurabh from Wiley India 2012.
4. Cloud Computing – web based Applications that change the way you work and collaborate Online – Micheal Miller. Pearson Education.

### NPTEL Course:

1. Cloud Computing, Prof. Soumya Kanti Ghosh, Department of Computer Science and Engineering, IIT Kharagpur

## **BTCOE703 (A): Bioinformatics**

### **[Unit 1] Introduction to Bioinformatics**

**[6 Hours]**

The Brain of Biotechnology Evolutionary Biology Origin & History of Bioinformatics Origin of Bioinformatics/Biological Databases Importance of Bioinformatics Use of Bioinformatics Basics of Molecular Biology Definitions of Fields Related to Bioinformatics Applications. Biological Databases: Introduction Categories of Biological Databases The Database Industry Classification of Biological Databases The Creation of Sequence Databases Bioinformatics Programs and Tools Bioinformatics Tools Application of Programmes in Bioinformatics.

### **[Unit 2] Genomics & Proteomics**

**[7 Hours]**

DNA, Genes and Genomes DNA Sequencing Genome Mapping Implications of Genomics for Medical Science Proteomic Application of Proteomics to Medicine Difference between Proteomics and Genomics Protein Modeling. Sequence Alignment: Introduction Pairwise Sequence Alignment Sequence Alignment (MSA) Substitution Matrices Two Sample Applications.

### **[Unit 3] Phylogenetic Analysis**

**[7 Hours]**

Introduction Fundamental Elements of Phylogenetic Models Tree Interpretation Importance of Identifying Paralogs and Orthologs Phylogenetic Data Analysis Alignment Building the Data Model Determining the Substitution Model Tree-Building Methods Tree Evaluation. Microarray Technology: A Boon to Biological Sciences Introduction to Microarray Microarray Technique Potential of Microarray Analysis Microarray Products Microarray Identifying Interactions Applications of Microarrays.

### **[Unit 4] Bioinformatics in Drug Discovery**

**[6 Hours]**

A Brief Overview Introduction Drug Discovery Informatics and Medical Sciences Bioinformatics and Medical Sciences Bioinformatics in Computer-Aided Drug Design Bioinformatics Tools.

### **[Unit 5] Human Genome Project**

**[6 Hours]**

Human Genome Project: Introduction Human Genome Project Genome Sequenced in the Public (HGP) and Private Project Funding for Human Genome Sequencing DNA Sequencing Bioinformatics Analysis: Finding Functions Insights Learned from the Human DNA Sequence Future Challenges.

#### **Text Book:**

1. S. C. Rastorgi et al, Bioinformatics Concepts Skills and Applications; 2nd Edition, CBS Publishers & Distributors.

#### **NPTEL Course:**

1. Prof. M. Michael Gromiha, Algorithms and Applications.

## **BTCOE703 (B): Distributed Systems**

### **[Unit1]Introduction**

**[7 Hours]**

Introduction to Distributed Computing System, Evolution of Distributed Computing System, Distributed Computing System models, Distributed Computing System Gaining Popularity, Distributed Operating System, Introduction to Distributed Computing Environment (DCE), Desirable Features of a Good Message- Passing System, Issues in IPC by Message-Passing, Synchronization, Buffering, Multidatagram message, Encoding and Decoding of message data, Process addressing, Failure Handling, Group Communication, Case Study: BSD UNIX IPC Mechanism.

### **[Unit 2] Remote Procedure Calls**

**[7 Hours]**

RPC model, Transparency of RPC, Implementing RPC Mechanism, Stub Generation, RPC messages, Marshaling arguments and Results, Server Management, Parameter Passing Semantics, Call Semantics, Communication Protocols for RPCs, Complicated RPCs, Client- Server Binding, Exception Handling, Security, Some Special Types of RPCs, Case studies: Sun RPC, DCE, RPC.

### **[Unit 3] Distributed Shared Memory**

**[6 Hours]**

General Architecture of DSM Systems, Design and Implementation Issues of DSM, Granularity, Structure of Shared Memory Space, Consistency Models, Replacement Strategy, Thrashing, Other Approaches to DSM, Heterogeneous DSM, Advantages of Synchronization: Clock Synchronization, Event Ordering, Mutual Exclusion, Deadlock, Election Algorithms.

### **[Unit 4] Resource Management And Process Management**

**[6 Hours]**

Desirable Features of a Good Global Scheduling Algorithm, Task assignment Approach, Load-Balancing Approach, load Sharing Approach, Process Migration, Threads.

### **[Unit 5] Distributed File System**

**[6 Hours]**

Desirable Features of a Good Distributed File System, File Models, File Accessing Models, File Sharing Semantics, File Caching Schemes, File Replication, Fault Tolerance, Atomic Transactions, Design Principles, Case Study: DCE Distributed File Service.

### **Text Book:**

1. P. K. Sinha, Distributed Operating System, PHI Publication

### **Reference Books:**

1. Colorouis, Distributed Systems, Addison Wesley Publication.
2. M. L. Liu, Distributed Computing: Principles and Applications, Addison-Wesley, 2004.

### **NPTEL Course:**

1. Distributed Systems, Prof. Rajiv Mishra, IIT Patna.

## **BTCOE703 (C): Big Data Analytics**

### **[Unit 1] Introduction to Big Data**

**[6 Hours]**

Why Big Data and Where did it come from?, Characteristics of Big, Challenges and applications of Big Data, Enabling Technologies for Big Data, Big Data Stack, Big Data distribution packages.

### **[Unit 2] Big Data Platforms**

**[7 Hours]**

Overview of Apache Spark, HDFS, YARN, MapReduce, MapReduce Programming Model with Spark, MapReduce Example: Word Count, Page Rank etc, CAP Theorem, Eventual Consistency, Consistency Trade-O-s, ACID and BASE, Zookeeper and Paxos, Cassandra, Cassandra Internals, HBase, HBase Internals.

### **[Unit 3] Big Data Streaming Platforms**

**[6 Hours]**

Big Data Streaming Platforms for Fast Data, Streaming Systems, Big Data Pipelines for Real-Time computing, Spark Streaming, Kafka, Streaming Ecosystem.

### **[Unit 4] Big Data Applications**

**[6 Hours]**

Overview of Big Data Machine Learning, Mahout, Big Data Machine learning Algorithms in Mahout-kmeans, Naive Bayes etc. Machine learning with Spark, Machine Learning Algorithms in Spark, SparkMLlib, Deep Learning for Big Data, Graph Processing: Pregel, Giraph, Spark GraphX.

### **[Unit 5] Database for the Modern Web**

**[7 Hours]**

Introduction to mongoDB key features, Core server tools, MongoDB through the JavaScript‘ sshell, Creating and querying through Indexes, Document-oriented, principles of schema design, Constructing queries on databases, collections and documents, MongoDB query language.

#### **Text Book:**

1. Bart Baesens –Analytics in a Big Data World: The Essential Guide to Data Science and its Applications, Wiley and SAS Business Series.

#### **Reference Books:**

1. Rajkumar Buyya, Rodrigo N. Calheiros, Amir M Vahid Dastjerdi, Morgan Kaufmann, –Big Data Principals and Paradiagram, Elsevier, ISBN: 978-0-12-805394-2
2. Kyle Banker, Peter Bakum and Shaun Verch, –MongoDB in Action, 2nd Edition Dream tech Press, ISBN: 978-9351199359.
3. Anand Rajaraman, Jeffrey D. Ullman, –Mining of Massive Datasets, 3rd edition, Cambridge University Press
4. Sima Acharya, Subhashini Chhellappan, –BIG Data and Analytics, Willey publication, ISBN: 978-8126554782.

#### **NPTEL COURSE:**

1. Big Data Computing by Prof. Rajiv Misra, Dept. of Computer Science and Engineering, IIT Patna



## BTCE704 (A): Cryptography & Network Security

### [Unit 1]

[6 Hours]

Introduction and Mathematical Foundations: Introduction, Overview on Modern Cryptography, Number Theory, Probability and Information Theory. Classical Cryptosystems: Classical Cryptosystems, Crypt-analysis of Classical Cryptosystems, Shannon's Theory.

### [Unit 2]

[6 Hours]

Symmetric Key Ciphers: Symmetric Key Ciphers, Modern Block Ciphers (DES), Modern Block Cipher (AES). Crypt-analysis of Symmetric Key Ciphers: Linear Crypt-analysis, Differential Crypt-analysis, other Crypt-analytic Techniques, Overview on S-Box Design Principles, Modes of operation of Block Ciphers.

### [Unit 3]

[6 Hours]

Stream Ciphers and Pseudo-randomness: Stream Ciphers, Pseudo-random functions. Hash Functions and MACs: Hash functions: The Merkle Damgard Construction, Message Authentication Codes (MACs).

### [Unit 4]

[6 Hours]

Asymmetric Key Ciphers: Construction and Crypt-analysis: More Number Theoretic Results, The RSA Cryptosystem, Primality Testing, Factoring Algorithms, Other attacks on RSA and Semantic Security of RSA, The Discrete Logarithm Problem (DLP) and the Diffie-Hellman Key Exchange algorithm, The ElGamal Encryption Algorithm, Crypt-analysis of DLP.

### [Unit -5]

[6 Hours]

Digital Signatures: Signature schemes: I, Signature schemes: II. Modern Trends in Asymmetric Key Cryptography: Elliptic curve based cryptography: I, Elliptic curve based cryptography: II. Network Security: Secret Sharing Schemes, A Tutorial on Network Protocols, Kerberos, Pretty Good Privacy (PGP), Secure Socket Layer (SSL), Intruders and Viruses, Firewalls.

### Text Book:

1. Douglas Stinson, *"Cryptography Theory and Practice"*, 2nd Edition, Chapman & Hall/CRC.

### Reference Books:

1. B. A. Forouzan, *"Cryptography & Network Security"*, McGraw Hill Publication.
2. William Stallings, *"Cryptography and Network Security"*, Pearson Education.
3. Dr. B. B. Meshram, *TCP/IP & Network Security*, SPD Publication.
4. Wenbo Mao, *"Modern Cryptography, Theory & Practice"*, Pearson Education.
5. Hoffstein, Pipher, Silverman, *"An Introduction to Mathematical Cryptography"*, Springer.
6. Alang.Konheim, *Computer Security and Cryptography*, Wiley Publication.
7. A. Joux, *"Algorithmic Crypt-analysis"*, CRC Press.
8. S. G. Telang, *"Number Theory"*, McGraw Hill.
9. Matt Bishop, *"Computer Security"*, Pearson Education.

## **BTCOE704 (B): Business Intelligence**

### **[Unit 1] Business Intelligence Introduction**

**[6 Hours]**

Definition, History of Business intelligence, Leveraging Data and Knowledge for BI, BI Components, Business Intelligence and Business Analytics, BI Life Cycle, Business intelligence architectures, Effective and timely decisions.

### **[Unit 2] BI Planning for success**

**[6 Hours]**

The role of mathematical models, Enabling factors in business intelligence projects, Development of a business intelligence system, Ethics and business intelligence, Planning for Success Initiating a Program, Business/Information Technology Partnership, Business Intelligence Success Factors, Team Building, Strategic versus Tactical Planning.

### **[Unit 3] Decision support system**

**[6 Hours]**

Definition of system, Representation of the decision-making process, Rationality and problem solving, The decision-making process, Types of decisions, Approaches to the decision-making process, Evolution of information systems, Definition of decision support system, Development of a decision support system

### **[Unit 4] Data Warehousing**

**[6 Hours]**

Definition of data warehouse, Data marts, Data quality, Data warehouse architecture, ETL tools , Metadata, Schemas Used in Data Warehouses: Star, Snowflake and fact constellation , Cubes and multidimensional analysis ,Hierarchies of concepts and OLAP operations ,OLAP vs OLTP Materialization of cubes of data

### **[Unit 5] Data Mining and Application of BI**

**[6 Hours]**

Data mining, Definition of data mining, Models and methods for data mining, Data mining, classical statistics and OLAP, Applications of data mining, Representation of input data, Data mining process, Applications of BI:Data Warehousing Helps MultiCare Save More Lives ,Smarter Insurance: Infinity P&C Improves Customer Service and Combats Fraud with Predictive Analytics.

### **Text Book:**

1. Efraim Turban, Ramesh Sharda, Jay Aronson, David King, Decision Support and Business Intelligence Systems, 9th Edition, Pearson Education, 2009
- 2 Ramesh Sharda, Dursun Delen, Efraim Turban BUSINESS INTELLIGENCE AND ANALYTICS: SYSTEMS FOR DECISION SUPPORT, 10th Edition, Pearson Education, 2009

### **Reference Books:**

1. David Loshin, Business Intelligence – The Savy Manager's Guide Getting Onboard with Emerging IT, Morgan Kaufmann Publishers, 200BI
- 2 Carlo Vercellis Business Intelligence: Data Mining and Optimization for Decision Making, John Wiley & Sons Ltd

**BTCOE704 (C): Blockchain Technology****[Unit 1] Introduction****[6 Hours]**

Overview of Blockchain, Public Ledgers, Bitcoin, Smart Contracts, Block in a Blockchain, Transactions, Distributed Consensus, Public vs. Private Blockchain, Understanding Crypto currency to Blockchain, Permissioned Model of Blockchain, Overview of Security aspects of Blockchain. Basic Crypto Primitives: Cryptographic Hash Function, Properties of a hash function, Hash pointer and Merkle tree, Digital Signature, Public Key Cryptography, A basic crypto currency.

**[Unit 2] Bitcoin and Blockchain****[7 Hours]**

Creation of coins, Payments and double spending, Bitcoin Scripts, Bitcoin P2P Network, Transaction in Bitcoin Network, Block Mining, Block propagation and block relay. Working with Consensus in Bitcoin: Distributed consensus in open environments, Consensus in a Bitcoin network, Proof of Work (PoW) – Hashcash PoW, Bitcoin PoW, Attacks on PoW and the monopoly problem, Proof of Stake, Proof of Burn and Proof of Elapsed Time, The life of a Bitcoin Miner, Mining Difficulty, Mining Pool.

**[Unit 3] Permissioned Blockchain****[7 Hours]**

Permissioned model and use cases, Design issues for Permissioned blockchains, Execute contracts, State machine replication, Overview of Consensus models for permissioned blockchain-Distributed consensus in closed environment, Paxos, RAFT Consensus, Byzantine general problem, Byzantine fault tolerant system, Lamport-Shostak-Pease BFT Algorithm, BFT over Asynchronous systems.

**[Unit 4] Enterprise application of Blockchain****[6 Hours]**

Cross border payments, Know Your Customer (KYC), Food Security, Mortgage over Blockchain, Blockchain enabled Trade, We Trade – Trade Finance Network, Supply Chain Financing, Identity on Blockchain.

**[Unit 5] Blockchain Application Development****[6 Hours]**

Hyperledger Fabric- Architecture, Identities and Policies, Membership and Access Control, Channels, Transaction Validation, Writing smart contract using Hyperledger Fabric, Writing smart contract using Ethereum, Overview of Ripple and Corda.

**Text Book:**

1. Melanie Swan, –Blockchain: Blueprint for a New Economy, O'Reilly, 2015.

**Reference Books:**

1. Josh Thompsons, –Blockchain: The Blockchain for Beginners-Guide to Blockchain Technology and Leveraging Blockchain Programming.
2. Daniel Drescher, –Blockchain Basics, Apress; 1st Edition, 2017.
3. Anshul Kaushik, –Blockchain and Crypto Currencies, Khanna Publishing House, Delhi.
4. Imran Bashir, –Mastering Blockchain: Distributed Ledger Technology, Decentralization and Smart Contracts Explained, Packt Publishing.
5. Ritesh Modi, –Solidity Programming Essentials: A Beginner's Guide to Build Smart Contracts for Ethereum and Blockchain, Packt Publishing.
6. Salman Baset, Luc Desrosiers, Nitin Gaur, Petr Novotny, Anthony O'Dowd, Venkatraman Ramakrishna, –Hands-On Block Chain with Hyperledger: Building Decentralized Applications with Hyperledger Fabric and Composer, Import, 2018.

**NPTEL Course:**

1. Prof. Sandip Chakraborty, Department of Computer Science and Engineering, IIT Kharagpur and Dr. Praveen Jayachandran, Research Staff Member, IBM.

## **BTCOE705 (A): Virtual Reality**

### **[Unit 1] Introduction to Virtual Reality**

**[6 Hours]**

Virtual Reality and Virtual Environment: Computer graphics, Real time computer graphics, Flight Simulation, Virtual environment requirement, benefits of virtual reality, Historical development of VR, Scientific Landmark 3D Computer Graphics: The Virtual world space, positioning the virtual observer, the perspective projection, human vision, stereo perspective projection, 3D clipping, Colour theory, Simple 3D modelling, Illumination models, Reflection models, Shading algorithms, Radiosity, Hidden Surface Removal, Realism- Stereographic image.

### **[Unit 2] Geometric Modelling**

**[6 Hours]**

From 2D to 3D, 3D space curves, 3D boundary representation Geometrical Transformations: Frames of reference, Modelling transformations, Instances, Picking, Flying, Scaling the VE, Collision detection Generic VR system: Virtual environment, Computer environment, VR technology, Model of interaction, VR Systems.

### **[Unit 3] Virtual Environment**

**[6 Hours]**

Animating the Virtual Environment: The dynamics of numbers, Linear and Nonlinear interpolation, the animation of objects, linear and non-linear translation, shape & object in between, free from deformation, particle system.

### **[Unit 4] Physical Simulation**

**[4 Hours]**

Objects falling in a gravitational field, Rotating wheels, Elastic collisions, projectiles, simple pendulum, springs, Flight dynamics of an aircraft.

### **[Unit 5] VR Hardware and Software**

**[6 Hours]**

Human factors: The eye, the ear, the somatic senses. VR Hardware: Sensor hardware, Head-coupled displays, Acoustic hardware, Integrated VR systems. VR Software: Modelling virtual world, Physical simulation, VR toolkits, Introduction to VRML.

VR Applications: Engineering, Entertainment, Science, Training. The Future: Virtual environment, modes of interaction

### **Text Book:**

1. John Vince, –Virtual Reality Systems –, Pearson Education Asia, 2007.

### **Reference Books:**

1. Anand R., –Augmented and Virtual Reality, Khanna Publishing House, Delhi.
2. Adams, —Visualizations of Virtual Reality, Tata McGraw Hill, 2000.
3. Grigore C. Burdea, Philippe Coiffet, –Virtual Reality Technology, Wiley Inter Science, 2nd Edition, 2006.
4. William R. Sherman, Alan B. Craig, —Understanding Virtual Reality: Interface, Application and Design, Morgan Kaufmann, 2008.
5. [www.vresources.org](http://www.vresources.org)
6. [www.vrac.iastate.edu](http://www.vrac.iastate.edu)
7. [www.w3.org/MarkUp/VRML](http://www.w3.org/MarkUp/VRML)

## **BTCOE705 (B): Deep Learning**

### **[Unit 1]**

**[6 Hours]**

History of Deep Learning, Deep Learning Success Stories, McCulloch Pitts Neuron, Thresholding Logic, Perceptrons, Perceptron Learning Algorithm, Multilayer Perceptrons (MLPs), Representation Power of MLPs, Sigmoid Neurons, Gradient Descent, Feed forward Neural Networks.

### **[Unit 2]**

**[6 Hours]**

FeedForward Neural Networks, Backpropagation. Gradient Descent (GD), Momentum Based GD, Nesterov Accelerated GD, Stochastic GD, AdaGrad, RMSProp. Principal Component Analysis and its interpretations, Singular Value Decomposition.

### **[Unit 3]**

**[6 Hours]**

Auto encoders and relation to PCA, Regularization in auto encoders, Denoising auto encoders, Sparse auto encoders, Contractive auto encoders. Regularization: Bias Variance Tradeoff, L2 regularization, Early stopping, Dataset augmentation, Parameter sharing and tying. Greedy Layer wise Pre-training, Better activation functions, Better weight initialization methods, Batch Normalization.

### **[Unit 4]**

**[6 Hours]**

Convolutional Neural Networks, LeNet, AlexNet, ZF-Net, VGGNet, GoogLeNet, ResNet, Learning Vectorial Representations of Words,

### **[Unit 5]**

**[6 Hours]**

Recurrent Neural Networks, Back propagation through time, Encoder Decoder Models, Attention Mechanism, Attention over images.

### **Text Book:**

1. Ian Goodfellow and Yoshua Bengio and Aaron Courville, "Deep Learning", 1st Edition, MIT Press

### **Reference Books:**

1. Raúl Rojas, Neural Networks: A Systematic Introduction, 1996.
2. Christopher Bishop, Pattern Recognition and Machine Learning, 2007.

### **NPTEL Courses:**

1. Prof. Prof. Mitesh M. Khapra, Prof. Sudarshan Iyengar, Dept. of Computer Science and Engineering, IIT Madras & IIT Ropar, NPTEL Course on Deep Learning (Part-I).

## **BTCOE705 (C): Design Thinking**

### **[Unit 1] Overview of Design Thinking Process**

**[6 Hours]**

Design Thinking Process: Business context of innovation for applying design thinking, two models of design thinking, phases of design thinking, correlation with other philosophies. Introduction to design thinking: Definition, Origin of design thinking, Importance of design thinking, Design vs. Design thinking, Problem solving, Understanding design thinking and its process model, Design thinking tools. Human-Centered Design (HCD) process - Empathize, Define, Ideate, Prototype and Test and Iterate or Empathize, Analyze, Solve and Test.

### **[Unit 2] Empathize**

**[5 Hours]**

Design thinking phases, How to emphasize, Role of empathy in design thinking, purpose of empathy maps, Things to be done prior to empathy mapping, creation of user personas, customer journey mapping, How might we questions.

### **[Unit 3] Analyze or Define**

**[5 Hours]**

Root cause analysis, conflict of interest, perspective analysis, big picture thinking through system operator, big picture thinking through function modeling Silent brainstorming, metaphors for ideation, CREATE and What-If tool for ideation, introduction to TRIZ, Inventive principles and their applications.

### **[Unit 4] Test (Prototyping and Validation)**

**[5 Hours]**

Prototyping, Assumptions during the design thinking process, Validation in the market, best practices of presentation.

### **[Unit 5] Design Innovation**

**[5 Hours]**

Benefits of iteration in the design thinking process, taking the idea to the market, introduction to innovation management in a company.

#### **Text Book:**

1. Bala Ramadurai, –Karmic Design Thinking, First Edition, 2020.

#### **Reference Books:**

1. Vijay Kumar, 101 Design Methods: A Structured Approach for Driving Innovation in Your Organization –.
2. Human-Centered Design Toolkit: An Open-Source Toolkit to Inspire New Solutions in the Developing World by IDEO.
3. This is Service Design Thinking: Basics, Tools, Cases by Marc Stickdorn and Jakob Schneider.
4. Ulrich, Karl T. Design: Creation of artifacts in society, 2011.

## **BTCOL707 Artificial Intelligence**

### **List of Experiments:**

1. Study of PROLOG. Write the following programs using PROLOG.
2. Write a program to solve 8 queens problem.
3. Solve any problem using depth first search.
4. Solve any problem using best first search.
5. Solve 8-puzzle problem using best first search.
6. Solve Robot (traversal) problem using means End Analysis.
7. Solve traveling salesman problem.

## **BTCOL707 Cloud Computing**

### **List of Experiments:**

(Pl. Note: List of Experiments should be as per theory covered in the class based on Cloud Environments.

Following list can be used as a reference.)

1. Sketch out and analyze architecture of Moodle cloud portal and moodle cloud site and create different entities dynamically.
2. Create a scenario in wordpress for Social Marketing, Search engine and Sharing Tools.
3. Working in Cloud9 to demonstrate different language.
4. Working in Codenvy to demonstrate Provisioning and Scaling of a website.
5. Implement and configure Google App Engine to deploy Python Program application.
6. Installation and configuration of virtual machine with guest OS.
7. Demonstrate the use of map and reduce tasks.
8. Implementation of SOAP Web services in C#/JAVA Applications.
9. Categorize Amazon Web Service (AWS) and implement its various cloud entities using its Cloud Toolbox support.
10. Implement and use sample cloud services with the help of Microsoft Azure.
11. Design and analyze architecture of Aneka / Eucalyptus / KVM identify different entities to understand the structure of it.
12. Make and perform scenario to pause and resume the simulation in Aneka / Eucalyptus entity, and create simulation entities dynamically.
13. Organize a case in Aneka / Eucalyptus for simulation entities in run-time using a its toolkit support and manage virtual cloud.



### **BTCOS708: Project phase - I**

### **BTCOF801: Project phase – II (In-house) / Internship and Project in the Industry**

In this course, it is expected that students will go to industry for internship for one semester and do industry based project in that period. Student will be assigned one dept. one Industry guide to monitor progress of the student. After, completion of the Internship student will submit project report to the dept. and project examination will be conducted in consultation with the Industry guide.

In case, if student not opting / not doing Internship in the Industry, such students can do project work in the dept.