

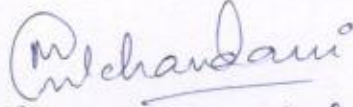
**RASHTRASANT TUKADOJI MAHARAJ NAGPUR UNIVERSITY, NAGPUR**  
**FOUR YEAR BACHELOR OF TECHNOLOGY (B.Tech) DEGREE COURSE**  
**SEMESTER: V (C.B.C.S.)**  
**BRANCH: COMPUTER SCIENCE AND ENGINEERING**


**Fifth Semester:-**

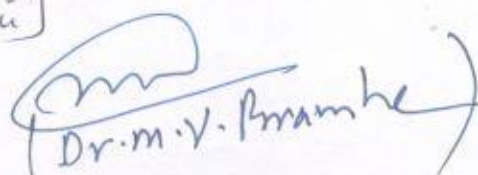
S. N.	Subject	Teaching Scheme			Evaluation Scheme			Credits	Category
		L	T	P	CA	UE	Total		
1	Artificial Intelligence	3	1	-	30	70	100	4	PCC-CS
2	Artificial Intelligence-Lab	-	-	2	25	25	50	1	PCC-CS
3	Design & Analysis of Algorithms	3	1	-	30	70	100	4	PCC-CS
4	Design & Analysis of Algorithms -Lab	-	-	2	25	25	50	1	PCC-CS
	Software Engineering & Project Management	3	-	-	30	70	100	3	PCC-CS
5	Elective-I	3	-	-	30	70	100	3	PEC-CS
6	Effective Technical Communication	2	-	-	15	35	50	2	HSMC
7	Professional Skills Lab I			2	25	25	50	1	ESC
8	Yoga and Meditation (Audit Course)	2	-	-	50	-	-	Audit	MC
	<b>Total</b>	<b>16</b>	<b>02</b>	<b>06</b>			<b>600</b>	<b>19</b>	


**Elective-I: 1. TCP/IP      2. Design Patterns      3. Data Warehousing and Mining**

  
 [Mrs. B. P. Chavaskar]

  
 [Mrs. Mona Mulchandani]

  
 [Dr. S. V. Sonelkar]

  
 [Dr. M. V. Bramhe]

  
 Dr. S. V. Sonelkar  
 Chairman

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**SEMESTER: V (C.B.C.S.)**  
**BRANCH: COMPUTER SCIENCE AND ENGINEERING**

Subject: Artificial Intelligence

Subject Code: BTECH\_CSE-501T

Load [Th+Tu]	Credits [Th+Tu]	College Assessme nt Marks	University Evaluation	Total Mark s
[36 + 12]=48 Hrs	3+1=4	30	70	100

**Aim:** To understand the basic principles and concepts of Artificial Intelligence.

**Prerequisite(s):** Student should have basic knowledge of computers and mathematics.

**Course Objectives:**

1	To create appreciation and understanding the achievements of AI and the theory underlying those achievements
2	To create an understanding of the basic issues of knowledge representation

**Course Outcomes:**

At the end of this course students are able to:

CO1	Demonstrate knowledge of the building blocks of AI as presented in terms of intelligent agents.
CO2	Analyze and formalize the problem as a state space, graph, design heuristics and select amongst different search or game based techniques to solve them.
CO3	To create an understanding of the basic issues of knowledge representation
CO4	Formulate and solve problems with uncertain information using Bayesian approaches.
CO5	Attain the capability to represent various real life problem domains using logic based techniques and



## **SYLLABUS:**

### **UNIT-I**

Introduction: What is AI? History & Applications, Artificial intelligence as representation & Search, Production system, Basics of problem solving: problem representation paradigms, defining problem as a state space representation, Characteristics.

### **UNIT-II**

Search Techniques: Uninformed Search techniques, Informed Heuristic Based Search, Generate and test, Hill-climbing, Best-First Search, Problem Reduction, and Constraint Satisfaction.

### **UNIT-III**

Knowledge representation: Knowledge representation Issues: First order logic, Predicate Logic, Structured Knowledge Representation: Backward Chaining, Backward Chaining, Resolution, Semantic Nets, Frames, and Scripts, Ontology.

### **UNIT-IV**

Uncertainty: Handling uncertain knowledge, rational decisions, basics of probability, axioms of probability, Baye's Rule and conditional independence, Bayesian networks, Exact and Approximate inference in Bayesian Networks, Fuzzy Logic.

Intelligent Agents: Introduction to Intelligent Agents, Rational Agent, their structure, reflex, model-based, goal-based, and utility-based agents, behavior and environment in which a particular agent operates.

### **UNIT-V**

Learning: What is learning?, Knowledge and learning, Learning in Problem Solving, Learning from example, learning probabilistic models

Expert Systems: Fundamental blocks, Knowledge Engineering, Knowledge Acquisition, Knowledge Based Systems, Basic understanding of Natural language

### **Text Books:**

1. E. Rich and K. Knight, Artificial Intelligence, Tata McGraw Hill, 2008.
2. S. Russell and P. Norvig, Artificial Intelligence: A Modern Approach, 3rd edition, Pearson Education, 2015.
3. Artificial intelligence and soft computing for beginners by Anandita Das Bhattachargee, Shroff Publishers
4. Artificial Intelligence – A Practical Approach : Patterson , Tata McGraw Hill, 3rd Edition

### **Reference Books:**

1. Introduction to Artificial Intelligence – Charniak (Pearson Education)



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**SEMESTER: V (C.B.C.S.)**  
**BRANCH: COMPUTER SCIENCE AND ENGINEERING**

**Subject: Artificial Intelligence LAB**  
**501P**

**Subject Code: BTECH\_CSE-**

Load	Credits	College Assessment Marks	University Evaluation	Total Marks
2 Hrs/Week	1	25	25	50

**Aim:** This lab is aimed to provide students a complete insight of the implementation of different Artificial Intelligence algorithms.

**Course Objectives:**

1	To create appreciation and understanding the achievements of AI and the theory underlying those achievements
2	To create an understanding of the basic issues of knowledge representation

**Course Outcomes:**

**Expected experiments to be performed (Not limited to):**

**Using the Python Libraries for Artificial Intelligence**

1. AIMA-Python
2. PyDatalog
3. Simple
4. Easy

**Write programs based on the following:**

1. Graph search algorithms
2. Adversarial search
3. Knowledge representation
4. Logical inference
5. Probability theory
6. Bayesian networks
7. Markov models
8. Constraint satisfaction
9. Machine learning
10. Reinforcement learning
11. Neural networks
12. Natural language processing



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**SEMESTER: V (C.B.C.S.)**  
**BRANCH: COMPUTER SCIENCE AND ENGINEERING**

**Subject: Design and Analysis of Algorithms**  
**502T**

**Subject Code: BTECH\_CSE-**

Load [Th+Tu]	Credits [Th+Tu]	College Assessment Marks	University Evaluation	Total Mark s
[36 + 12]=48 Hrs	3+1=4	30	70	100

**Course Objectives:**

1	Analyze the asymptotic performance of algorithm
2	Apply important algorithmic design paradigms and methods of analysis
3	Solve simple to moderately difficult algorithmic problems arising in applications.
4	Able to demonstrate the hardness of simple NP-complete problems

**Course Outcome:**

At the end of this course students are able to:

CO1	Illustrate different approaches for analysis and design of efficient algorithms and Analyze performance of various algorithms using asymptotic notations.
CO2	Determine and Apply various divide & conquer strategies and greedy approaches for solving a given computational problem
CO3	Demonstrate and Solve various realtime problems using the concepts of dynamic programming
CO4	Make use of backtracking and graph traversal techniques for solving real-world problems
CO5	Recall and Classify the NP-hard and NP-complete problems



## **SYLLABUS:**

### **UNIT-I**

Definition of algorithms and brief explanation about the basic properties of algorithms  
Recurrence relations, solutions of recurrence relations using technique of characteristic equation, master theorem, Asymptotic notations of analysis of algorithms, worst case, average case and best case analysis of insertion sort, selection sort and bubble sort, amortized analysis, application of amortized analysis, Biontonic sorting network.

### **UNIT-II**

**Divide and conquer strategies:** Binary search, quick sort, merge sort, heap sort, Strassen's matrix multiplication algorithm, min-max algorithm.

**Greedy Approach:** Application to job sequencing with deadlines problem, knapsack problem, optimal merge pattern, Huffman code.

### **UNIT-III**

**Dynamic Programming:** Basic Strategy, Multistage graph (forward and backward approach), Longest Common Subsequence, matrix chain multiplication, Optimal Binary Search Tree, 0/1 Knapsack problems, Travelling Salesman problem, single source shortest path using Bellman-Ford algorithm, all pair shortest path using Floyd-Warshall algorithm.

### **UNIT-IV**

**Basic Traversal and Search Techniques:** Breadth first search and depth first search, connected components.

Backtracking: Basic strategy, N-Queen Problem and their Analysis (4 & 8-Queen), graph coloring, Hamiltonian cycles.

### **UNIT-V**

NP-Hard and NP-complete problems, basic concepts, non-deterministic algorithms, NP Hard and NP-complete, Cook's theorem, decision and optimization problems, graph based problems on NP Principle.

### **Text Books:-**

1. "Introduction to Algorithms", Third Edition, Prentice Hall of India by Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein
2. "The Design and Analysis of Computer Algorithms", Pearson Education by Alfred V. Aho, John E. Hopcraft, Jeffrey D. Ullman.
3. "Fundamentals of Computer Algorithms", Second Edition, University Press By Horowitz, Sahani, Rajsekharam
4. "Fundamentals of Algorithms", Prentice Hall by Brassard, Bratley
5. "Design and Analysis of Algorithms", Pearson Education, II nd Edition, Parag Dave, Himanshu Dave

### **Reference Books:**

1. Computer Algorithms: Introduction to Design and analysis, 3rd Edition, By Sara Baase and Gelder Pearson Education.





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**SEMESTER: V (C.B.C.S.)**  
**BRANCH: COMPUTER SCIENCE AND ENGINEERING**

Subject: Design and Analysis of Algorithms LAB  
502P

Subject Code: BTECH\_CSE-

Load	Credits	College Assessment Marks	University Evaluation	Total Marks
2Hrs /Week (Practical)	1	25	25	50

**Course Objectives:**

1	To learn the importance of designing an algorithm in an effective way by considering space and time complexity
2	To learn graph search algorithms.
3	To study network flow and linear programming problems
4	To learn the dynamic programming design techniques.
5	To develop recursive backtracking algorithms.

**Course Outcome:**

At the end of this course students will be able to:

CO1	Calculate the time complexity of algorithm.
CO2	Sort the given numbers using various sorting algorithms.
CO3	Develop programs for the problems using Divide and Conquer and greedy methods.
CO4	Develop programs for the problems using Dynamic programming.
CO5	Students will be able to write programs for the problems using Backtracking.



**Expected experiments to be performed (Not limited to):**

1. To find Time complexity of an algorithm.
2. To find Space complexity of an algorithm.
3. To find HCF and LCM of two numbers
4. Code and analyses to find median element in an array of integers.
5. Code and analyse to find majority element in an array of integers.
6. Code and analyse to sort an array of integers using merge sort
7. Code and analyse to sort an array of integers using quick sort
8. To implement maximum and minimum problem using divide and conquer strategy
9. To implement binary search using divide and conquer strategy
10. To implement program of Heap Sort.
11. WAP of minimum spanning tree using Kruskal algorithm.
12. WAP of minimum spanning tree using Prim's algorithm.
13. WAP to implement matrix chain multiplication
14. Code to find the shortest path in graph using Dijkstra's algorithm.
15. Code to find the shortest path using Bellman-Ford algorithm.
16. To implement LCS problem using Dynamic Programming.
17. To implement matrix chain multiplication problem using dynamic programming.
18. Code and analyze to find the minimum spanning tree in a weighted, undirected graph.
19. Code and analyze to find all occurrences of a pattern P in a given string S.
20. Code and analyze to do a depth-first search (DFS) on an undirected graph. Implementing an application of DFS such as:
  - (i) to find the topological sort of a directed acyclic graph.
  - (ii) to find a path from source to goal in a maze.
21. Code and analyze to do a breadth-first search (BFS) on an undirected graph. Implementing an application of BFS such as
  - (i) to find connected components of an undirected graph.
  - (ii) to check whether a given graph is bipartite.





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**SEMESTER: V (C.B.C.S.)**

**BRANCH: COMPUTER SCIENCE AND ENGINEERING**

Subject: **Software Engineering and Project Management**      Subject Code: **BTECH\_CSE-503T**

Load	Lecture	Tutorial	Credits	College Assessment Marks	University Evaluation	Total Marks
36 Hrs	3	-	3	30	70	100

**Course Objectives:**

1	To understand general idea of software engineering
2	To develop skills to design various software process models
3	To develop skills required for software testing and various risk strategies

**Course Outcomes:**

At the end of this course students are able to:

CO1	Understand software engineering methods, practices, process models and application.
CO2	Analyse various software engineering life cycle models and apply methods for design and development of software projects.
CO3	Analyze and extract requirements for product and translate these into a documented design using different modeling techniques.
CO4	Understand and apply software testing methods and types, And to understand debugging concept with various testing methods.
CO5	Identify and apply the principles, processes and main knowledge areas for Software Project Management



## **SYLLABUS:**

### **UNIT-I**

Basics: Introduction to Software Engineering, Software Myths, Software Engineering-A Layered Technology. Software Process Models: The Waterfall Model, Incremental Process Models, Evolutionary Process Models, Specialized Process Models, Agile Process Models

### **UNIT-II**

Measures Metrics and Indicator, Metrics for process & projects: Software measurement, metrics for software quality.

System Engineering: Hierarchy, Business Process Engineering, Product Engineering, System Modeling, Requirements Engineering: Requirements Analysis, Analysis

Modeling Approaches, Data Modeling, Object-Oriented Analysis, Scenario-Based Modeling, Flow-Oriented Modeling, Class-based Modeling, Behavioral Model

### **UNIT-III**

Design Engineering Concepts, Design Model, Pattern-Based Software Design, Architectural Design, Mapping data flow into software architecture, Cohesion, Coupling, User interface analysis and Design.

### **UNIT-IV**

Debugging, Software Testing Fundamentals, Black-Box Testing, White-Box Testing, Metrics for Source Code

Risk Management: Risk strategies, Software risks, Risk identification, Risk refinement, RMMM

### **UNIT-V**

Quality Management: Quality Concepts, Software Quality Assurance, Software Reviews, Formal Technical Review, Software Reliability, Change Management: Software Configuration Management, SCM Repository, SCM Process, Reengineering: Software reengineering, Reverse Engineering, Restructuring, Forward Engineering

### **Text Books:**

1. Software Engineering-A Practitioner's Approach (Sixth Edition) by Roger Pressman (TMH)
2. Software Engineering (Ninth Edition)-Ian Sommerville (Pearson)
3. Software Engineering for students (4th Edition)- Douglas Bell(Pearson)

### **Reference Books:**

1. Schaum's Outline of Theory and Problems of Software Engineering by David Gustafson (TMH)
2. Software Engineering (Third Edition) by K. K. Aggarwal and Yogesh Singh (New age International Publishers)
3. Software Engineering, Theory and Practice(4th Edition)- Pfleeger, Atlee(Pearson)





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**SEMESTER: V (C.B.C.S.)**  
**BRANCH: COMPUTER SCIENCE AND ENGINEERING**

Subject: **Elective 1: TCP/IP**

Subject Code: **BTECH\_CSE-504.IT**

Load	Credits	College Assessment Marks	University Evaluation	Total Marks
36 Hrs.	3	30	70	100

**Aim:** The aim of the course is to provide students with an overview of the field of Internet technologies.

**Prerequisite(s):** Data Communication, Computer Networks




**Course Objectives:**

1	To, Create a comprehension of fundamental TCP / IP concepts, and how they function.
2	To, Build understanding of and functionality of TCP / IP protocol set.
3	To, Understand and evaluate various TCP / IP Interface protocols.
4	To, Introduce the student to basic definition of networking and train the students for advanced computer networking courses.

**Course Outcomes:**

At the end of this course Student are able to:

<b>CO1</b>	Enumerate the layers of the TCP/IP model.
<b>CO2</b>	Analyze the services of TCP/IP protocol and be able to deal with its layers. Also the concepts of IP addressing
<b>CO3</b>	Acquire the knowledge of routing protocols
<b>CO4</b>	Familiarize students with the basic computer network protocols, and how they can be used to help develop and execute networks.
<b>CO5</b>	Generate the solution for basic issues of Internet Mechanism and its security.

## **SYLLABUS:**

### **Unit I:**

Networking Basics, TCP/IP Model, Router, Broadband router, Internet, NAP, ISPs, RFCs and Internet Standards.

### **Unit II:**

IP addressig, Classful and Classless Internet address, CIDR-Subnetting and Supernetting, VLSM , IP Datagram, IP protocol. ARP, RARP, BOOTP, DHCP, VRRP vs HSRP.  
IP Routing & Packet Forwarding, RIP, OSPF, EIGRP, ICMP, IGMP.

### **Unit III:**

Protocol-Independent Multicast (PIM), Optical Time-Domain Reflectometer (OTDR).  
TCP header, Services, Connection establishment and termination, Interactive data flow, Bulk data flow, Flow control and Retransmission, TCP Timers, Urgent Data processing, Congestion control, Extension headers.

### **Unit IV:**

Switching technology, MPLS fundamentals, signaling protocols, **Carrier Ethernet**, LDP, IP traffic engineering, ECMP, SBR, Routing extensions for traffic engineering, Traffic engineering limitations and future developments.

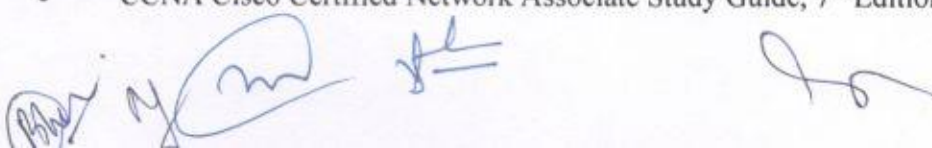
### **Unit V:**

IP security protocol, IPv6 addresses, Packet format, Multicast, Anycast, ICMPv6, Interoperation between IPv4 and IPv6-QoS, Auto configuration, Stateless address auto configuration (SLAAC), ACL.

### **Text books:**

- TCP/IP Network Administration, Craig Haut, 3<sup>rd</sup> Edition, Shroff Publications, 2002.
- Internetworking with TCP/IP - Principles, Protocols, and Architecture, Douglas E. Comer, 5th edition Volume-1, Prentice Hall, 2006.
- The Internet and its Protocols- A Comparative approach, Adrian Farrel, Morgan Kaufmann, 2004
- TCP/IP Illustrated - The Protocols, W. Richard Stevens, Volume-1, Pearson Education, 2003.
- TCP/IP Protocol Suite, Behrouz A. Forouzan, 3<sup>rd</sup> Edition, Tata McGraw Hill, 2006.

### **Reference books:**

- IPv6 Theory, Protocol and Practice, 2<sup>nd</sup> Edition By, Morgan Kaufmann, 2003.
  - Internetworking TCP/IP, Comer D.E and Stevens D.L, Volume 1, 4<sup>th</sup> Edition, Prentice Hall.
  - CCNA Cisco Certified Network Associate Study Guide, 7<sup>th</sup> Edition by Todd Lammle.
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**SEMESTER: V (C.B.C.S.)**

**BRANCH: COMPUTER SCIENCE AND ENGINEERING**

**Subject: Elective 1: Design Patterns**

**Subject Code: BTECH\_CSE-504.2T**

Load	Credits	College Assessment Marks	University Evaluation	Total Marks
36 Hrs.(Theory)	3	30	70	100

**Aim:** A design pattern offers a general comprehensive framework to particular challenges in software design to speed up the production process by offering a well-tested, validated development/design model.

**Prerequisite(s):** Intermediate knowledge of Object Oriented programming.

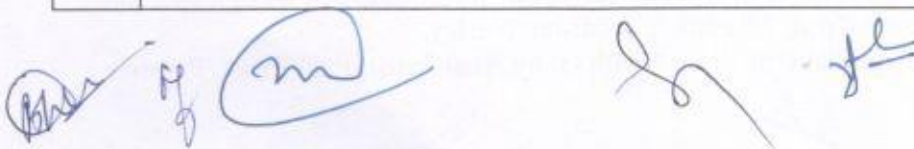
**Course Objectives:**

1	Understand the concept of Design patterns and its importance.
2	Be capable of applying knowledge to create an architecture for given application.
3	Apply the suitable design patterns to refine the basic design for given context.
4	Get perspectives that help render own design pattern more flexible, versatile, reusable and understandable.

**Course Outcomes:**

At the end of this course Student are able to:

CO1	Understand common design patterns in the context of incremental/iterative development.
CO2	Exploit well-known Creational design patterns.
CO3	Distinguish between different types of structural design patterns..
CO4	Remember the appropriate design patterns, purpose and methods and use of Behavioural Design Pattern to solve object oriented design problems.
CO5	Demonstrate an understanding of Behavioural and other useful design patterns.



## **SYLLABUS:**

### **Unit I:**

**Introduction to Design Patterns:** Software design principles, Object oriented design principles, Overview of design pattern, benefits of design patterns, Description of design patterns, Catalog and organization of catalog, design patterns to solve design problems, selection of design pattern, Use of design patterns.

### **Unit II:**

**Creational Patterns:** Abstract Factory, Builder, Factory Method, prototype, Singleton, Creational Patterns.

### **Unit III:**

**Structural Pattern:** Adapter, Bridge, Composite, Decorator, Façade, Flyweight, Proxy, Discussion of Structural Patterns.

### **Unit IV:**

**Behavioral Patterns Part I:** Chain of Responsibility, Command, Interpreter, Iterator Mediator, Memento, Observer, Discussion of Behavioral Patterns.

### **Unit V:**


**Behavioral Patterns Part III:** State, Strategy, Template Method, Visitor, Discussion of Behavioral Patterns. Expectations from Design Patterns.

**Other useful Design Patterns:** Model View Controller, Data Access Object and Transfer Object Design Pattern.

### **Text books:**

1. Head First Design Patterns, by Eric Freeman and Elisabeth Freeman, Oreilly Media.
2. Design Patterns Elements of Reusable Object Oriented Software, by Erich Gamma, Addison-Wesley.
3. Applying UML and Patterns: An Introduction to Object-Oriented Analysis and Design and Iterative Development, by Craig Larman, 3rd Edition, Pearson.

### **Reference books:**

1. Pattern-Oriented Software Architecture: A System of Pattern by Frank Buschmann, Regine Meunier, Hans Rohnert, Peter Sommerlad, Michael Stal, John Wiley & Sons, 1996.
  2. Design Patterns Explained: A New Perspective on Object Oriented Design by Alan Shalloway and James Trott, 2<sup>nd</sup> edition, Addison-Wesley.
  3. Introduction to design Patterns in C++ with Qt by Alan Ezust, Paul Ezust, Prentice Hall, 2011.
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**SEMESTER: V (C.B.C.S.)**

**BRANCH: COMPUTER SCIENCE AND ENGINEERING**

Subject: **Elective 1: Data Warehousing and Mining**  
**504.3T**

Subject Code: **BTECH\_CSE-**

Load	Credits	College Assessment Marks	University Evaluation	Total Marks
<b>36 Hrs.(Theory)</b>	<b>3</b>	<b>30</b>	<b>70</b>	<b>100</b>

**Aim:** To understand the overall architecture of a data warehouse and methods for data gathering and data pre-processing. The different data mining models and techniques will be discussed in this course.

**Prerequisite(s):** Intermediate knowledge of Object Oriented programming.

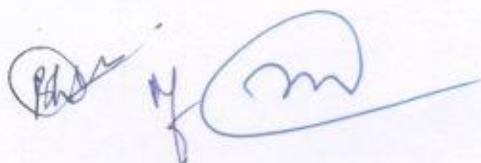
**Course Objectives:**

<b>1</b>	To understand the basic concepts of Data Warehouse and Data Mining techniques.
<b>2</b>	Capable to create a data warehouse and to process raw data .
<b>3</b>	Able to apply basic classification, clustering on a set of data.
<b>4</b>	Able to identify frequent data items and to apply association rule on a set of data.
<b>5</b>	To learn recent trends of data mining such as web mining.

**Course Outcomes:**

At the end of this course Student are able to:

<b>CO1</b>	To understand the basic concepts of Data Warehouse and Data Mining techniques.
<b>CO2</b>	Capable to create a data warehouse and to process raw data .
<b>CO3</b>	Able to apply basic classification, clustering on a set of data.
<b>CO4</b>	Able to identify frequent data items and to apply association rule on a set of data.
<b>CO5</b>	To learn recent trends of data mining such as web mining.



## SYLLABUS:

### UNIT I

**Introduction:** Characteristics, Operational database systems and data warehouse (OLTP & OLAP), Multidimensional data models, Data warehouse architecture, OLAP Operations, Design and construction of data warehouses.

### UNIT II

**Fundamentals of data mining:** Data mining functionalities, Classification of data mining systems, Data mining task primitives, Major issues and challenges in data mining, Data preprocessing- need for processing, data cleaning, integration, transformation, data reduction, data mining application areas.

### UNIT III

**Classification:** Introduction, Decision tree, Building decision tree- tree induction algorithm, Split algorithm based on information theory, Split algorithm based on gini index, Decision tree rules, Naive based methods.

**Clustering:** Cluster analysis, Desired features, Types of data in cluster analysis, Computing distance. Categorizations of major clustering methods – Partitioning methods (K-means, EM), Hierarchical methods (agglomerative, divisive).

### UNIT IV

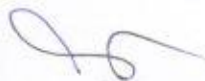
**Mining frequent patterns and Association Rules:** Market basket analysis, Frequent item sets and association rules, Apriori algorithm, FP growth algorithm, Improving efficiency of Apriori and FP growth algorithms.

### UNIT V

**Web Data Mining:** Introduction, Graph properties of web, Web content mining, Web structure mining, Web usage mining, Text mining, Visual web data mining, Temporal and Spatial data mining.

## TEXT BOOKS:

1. Jiawei Han and Micheline Kamber, "Data Mining Concepts and Techniques", Second Edition, Elsevier, Reprinted 2008.
2. A. K. Pujari, "Data Mining Techniques", Second Edition, University press, 2013.
3. Jason Bell, "Machine Learning for Big Data: Hands-on for Developers and Technical Professionals, Wiley India Publications, 2013.





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**SEMESTER: V (C.B.C.S.)**

**BRANCH: COMPUTER SCIENCE AND ENGINEERING**

**Subject: Professional Skills Lab I**

**Subject Code: BTECH\_CSE-505P**

Load	Credits	College Assessment Marks	University Evaluation	Total Marks
2 Hrs/Week	1	25	25	50

**Aim:** The aim of this lab is to develop an ability to design and implement static and dynamic websites.

**Prerequisite(s):** Internet Programming ,Fundamental of Computing and Programming

**Course Objectives:**

1	To understand the basic concepts of Web designing
2	Design and implement dynamic websites with good aesthetic sense of designing and latest technical know-how's.
3	Have a Good grounding of Web Application Terminologies, Internet Tools, E-Commerce and other web services.

**Course Outcomes:**

At the end of this course Student are able to:

CO1	List various tags in HTML , DHTML and use these, apply Cascaded style sheet to create web page.
CO2	Understand and evaluate web application architecture, technologies and frameworks
CO3	Apply the knowledge of web technology in developing web applications
CO4	Develop an interactive web applications using ASP.NET.
CO5	Evaluate different solutions in field of web application development



**Expected experiments to be performed (Not limited to):**

● **Client Side Scripting / Coding -**

1. HTML (HyperText Markup Language)
2. CSS (Cascading Style Sheets)
3. JavaScript
4. Ajax (Asynchronous JavaScript and XML)
5. jQuery (JavaScript Framework Library - commonly used in Ajax development)
6. MooTools (JavaScript Framework Library - commonly used in Ajax development)
7. Dojo Toolkit (JavaScript Framework Library - commonly used in Ajax development)

● **Server Side Scripting / Coding -**

1. PHP (very common Server Side Scripting language - Linux / Unix based Open Source - free redistribution, usually combines with MySQL database)
2. Zend Framework (PHP's Object Oriented Web Application Framework)
3. ASP (Microsoft Web Server (IIS) Scripting language)
4. ASP.NET (Microsoft's Web Application Framework - successor of ASP)
5. ColdFusion (Adobe's Web Application Framework)
6. Ruby on Rails (Ruby programming's Web Application Framework - free redistribution)
7. Perl (general purpose high-level programming language and Server Side Scripting Language - free redistribution - lost its popularity to PHP)
8. Python (general purpose high-level programming language and Server Side Scripting language - free redistribution)

● **Use of Program Libraries and Web Application Frameworks**

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**RASHTRASANT TUKADOJI MAHARAJ NAGPUR UNIVERSITY, NAGPUR**  
**FOUR YEAR BACHELOR OF TECHNOLOGY (B.Tech.) DEGREE COURSE**

**SEMESTER: V (C.B.C.S.)**

**BRANCH: COMPUTER SCIENCE AND ENGINEERING**

**Subject: Effective Technical Communication**

**Subject Code: BTECH\_CSE-506T**

Load	Credits	College Assessment Marks	University Evaluation	Total Marks
2 Hrs/Week	2	15	35	50

**Course Objective:** At the end of the semester, students will have enough confidence to face competitive examinations (IELTES/ TOEFL/CAT/ MAT/ XAT/SNAP/GMAT/GATE etc.) to pursue masters degree. They will also acquire language skills required to write their Reviews/Projects/Reports. They will be able to organize their thoughts in English and hence face job interviews more confidently.

**Course Outcomes:** After completing the course, students will

1. Acquire knowledge of structure of language.
2. Be able to face competitive exams and the interview process and can become employable.
3. Develop business writing skills.
4. Become familiar with technology enabled communication and can develop technical and scientific writing skills.

**Unit I. Functional Grammar:**

Common errors, Transformation of Sentences- Change the Voice, Change the Narration, Simple, Compound Complex sentences, Use of Phrases, Idioms & Proverbs.

**Unit II. English for Competitive Exams & Interview Techniques:**

Word building, **English** words /phrases derived from other languages, Prefixes and Suffixes, Synonyms/Antonyms, Technical Jargons, Verbal Analogies, Give one word for, Types & Techniques of Interview.

**Unit III. Formal Correspondence**

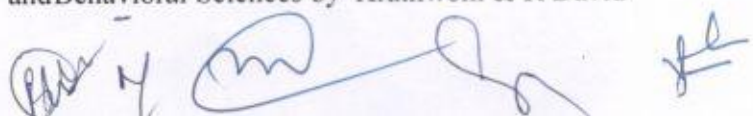
Business Letters, (Enquiry, Quotation, Order, Complaint), Job applications and Resume Writing, e-mail etiquette, Writing Memorandum, Circulars, notices, Analytical comprehension

**Unit IV. Technical & Scientific Writing:**

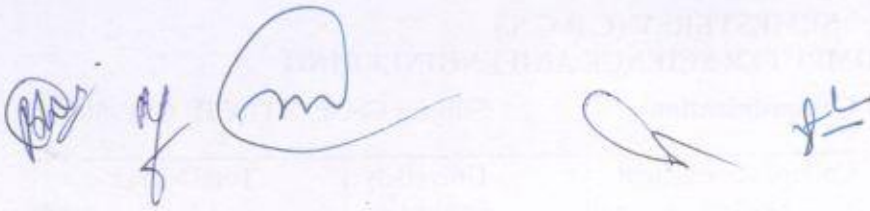
Features of Technical Writing, Technical Report writing (Accident, Feasibility, Trouble, Progress), Writing Scientific Projects, Writing Manuals, Writing Project Proposals, Writing Research papers.

**Reference Books:**

1. Effective technical Communication by Barun K. Mitra, Oxford University Press,
2. *Technical Communication-Principles and Practice* by Meenakshi Raman & Sharma, Oxford University Press, 2011,
3. *Functional English for Technical Students* by Dr. Pratibha Mahato and Dr. Dora Thompson, Himalaya Publishing House
4. *How to Prepare a Research Proposal: Guidelines for Funding and Dissertations in the Social and Behavioral Sciences* by Krathwohl & R David



5. *Technical Writing- Process and Product* by Sharon J. Gerson & Steven M. Gerson, 3<sup>rd</sup> edition, Pearson Education Asia, 2000
6. *Developing Communication skills* by Krishna Mohan & Meera Banerjee



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**FOUR YEAR BACHELOR OF TECHNOLOGY (B.Tech.) DEGREE COURSE**  
**SEMESTER: V (C.B.C.S.)**  
**BRANCH: COMPUTER SCIENCE AND ENGINEERING**

Subject: **Audit Course: Yoga & Meditation**

Subject Code: **BTECH\_CSE-507T**

Load	Credits	College Assessment Marks	University Evaluation	Total Marks
2 Hrs/Week	-	50 (Grade)	-	Grade

**Aim:**

The purpose of this course is to learn the specific skills and/or the techniques of the activity. By actively participating in an activity class, the student may gain health benefits such as improved body composition, increased flexibility, increased muscular endurance and increased muscular strength. Participating in activity classes leads to a healthier lifestyle.

**Course Objectives:**

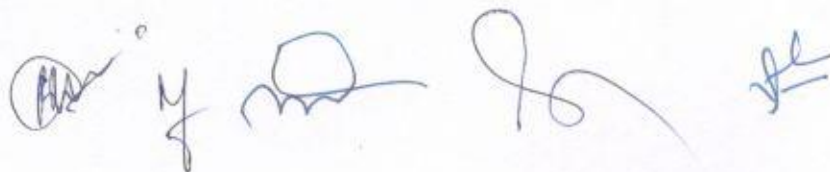
1. Learn the rules, fundamentals, skills & strategies of yoga.
2. Teach various asanas (postures) using hatha yoga & the Iyengar method.
3. Learn breathing techniques.
4. Improve strength, flexibility and the sense of well-being.
5. Increase relaxation of body and soul.

**Instructional Methodology:**

This class is an activity and participation course; the specific task/exercise(s) for students to complete will be demonstrated. Students will then complete the task/exercise(s) to the best of their ability.

**Curriculum:**

1. Two: Basic yoga asanas, breathing techniques and relaxation exercises.
2. Continuation of learning asanas, breathing techniques, and relaxation exercises.
3. Instructions for final yoga routine will be distributed to students.
4. Continuation of learning more advanced asanas, breathing techniques, relaxation exercises and meditation.



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**SEMESTER: V (C.B.C.S.)**

**BRANCH: COMPUTER SCIENCE AND ENGINEERING**

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**FOUR YEAR BACHELOR OF TECHNOLOGY (B. Tech.) DEGREE COURSE**  
**SEMESTER: VI (C.B.C.S.)**

**BRANCH: COMPUTER SCIENCE AND ENGINEERING**

**Examination Scheme and Syllabus**

**Sixth Semester:-**

S. N.	Subject	Teaching Scheme			Evaluation Scheme			Credits	Category
		L	T	P	CA	UE	Total		
1	Compiler Design	4	-	-	30	70	100	4	PCC-CS
2	Compiler Design -Lab	-	-	2	25	25	50	1	PCC-CS
3	Elective-II	3	-	-	30	70	100	3	PEC-CS
4	Elective-III	3	-	-	30	70	100	3	PEC-CS
5	Open Elective-I	3	-	-	30	70	100	3	OEC
6	Professional Skills Lab II	-	-	2	25	25	50	1	PCC-CS
7	Hardware Lab	-	-	2	25	25	50	1	ESC
8	Mini Project	-	-	6	50	50	100	3	PROJ-CS
9	Economics of IT Industry	2	-	-	15	35	50	2	HSMC
10	Intellectual Property Rights (Audit Course)	2	-	-	50	-	-	Audit	PCC
	<b>Total</b>	<b>17</b>	<b>-</b>	<b>12</b>			<b>700</b>	<b>21</b>	

**Elective-II:** - 1. Machine Learning 2. Internet of Things 3. Cluster and Cloud Computing

**Elective-III:** - 1. Data Science 2. Distributed Operating Systems 3. Human Computer Interaction

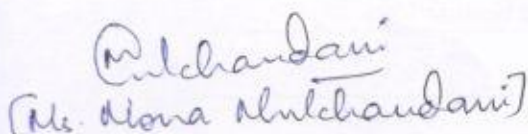
**Open Elective I:-** 1. Linux Fundamentals 2. Android Application Development 3. Blockchain Technologies



[Mrs. B. P. Dharaskar]



Dr. S. V. Sonelkar  
Chairman

  
[Mrs. Mona Mulchandani]

  
Dr. M. V. Bramhe

**RASHTRASANT TUKADOJI MAHARAJ NAGPUR UNIVERSITY, NAGPUR**  
**FOUR YEAR BACHELOR OF TECHNOLOGY (B. Tech..) DEGREE COURSE**  
**SEMESTER: VI (C.B.C.S.)**  
**BRANCH: COMPUTER SCIENCE AND ENGINEERING**

Subject: **Compiler Design**

Subject Code: **BTECH\_CSE-601T**

Load	Credits	College Assessment Marks	University Evaluation	Total Marks
48 Hrs	4	30	70	100

**Aim:** To understand the principles and concepts of Compiler Design

**Prerequisite(s):** Student should have basic knowledge of computers and mathematics.

**Course Objectives:**

1	Understand the phases of the Compiler and utilities of Automata.
2	Give the implementation details of Top-Down and Bottom-up Parsers and its types.
3	Describe the importance of the Semantic Phase and Symbol Table in Compiler.
4	Give the descriptions for the Synthesis Model of the Compiler w.r.t Analysis Model.
5	Understand the Architecture of the Computer and few advanced topics for a Compiler.

**Course Outcomes:**

At the end of this course students will be able to:

CO1	Define the Compiler along with phases and basic programs in LEX.
CO2	Develop programs for various kinds of the Parsers.
CO3	Write simple programs related to Type Checking, Parameter Passing and Overloading.
CO4	Implement the concepts of Code Optimizations and Code Generations.
CO5	Provide the Case Studies of Object-Oriented Compilers.





## **SYLLABUS:**

### **UNIT-I:**

Introduction: Phases of compilation and overview. Lexical Analysis (scanner): Regular languages, finite automata, regular expressions, relating regular expressions and finite automata, scanner generator (lex, flex).

### **UNIT-II:**

Syntax Analysis (Parser): Context-free languages and grammars, push-down automata, LL(1) grammars and top-down parsing, operator grammars, LR(O), SLR(1), LR(1), LALR(1) grammars and bottom-up parsing, ambiguity and LR parsing, LALR(1) parser generator (yacc, bison)

### **UNIT-III:**

Semantic Analysis: Attribute grammars, syntax directed definition, evaluation and flow of attribute in a syntax tree. Symbol Table: Basic structure, symbol attributes and management. Runtime environment: Procedure activation, parameter passing, value return, memory allocation,

### **UNIT-IV:**

Intermediate Code Generation: Translation of different language features, different types of intermediate forms. Code Improvement (optimization): control-flow, data-flow dependence etc.; local optimization, global optimization, loop optimization, peep-hole optimization etc.


**UNIT-V:** Architecture dependent code improvement: instruction scheduling (for pipeline), loop optimization (for cache memory) etc. Register allocation and target code generation. Advanced topics: Type systems, data abstraction, compilation of Object Oriented features and non-imperative programming languages.

### **TEXT BOOKS:**

1. Compilers: Principles, Techniques and Tools, V. Aho, R. Sethi and J. Ullman.
2. Lex&Yacc, Levine R. John, Tony Mason and Doug Brown

### **REFERENCES:**

1. The Design and Evolution of C++, Bjarne Stroustrup.


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**SEMESTER: VI (C.B.C.S.)**  
**BRANCH: COMPUTER SCIENCE AND ENGINEERING**

Subject: **Compiler Design Lab**

Subject Code: **BTECH\_CSE-601P**

Load	Credits	College Assessment Marks	University Evaluation	Total Marks
2 Hrs/Week	1	25	25	50

**Course Objectives:**

1	To learn usage of tools LEX, YACC
2	To develop a code generator
3	To implement different code optimization schemes

**Course Outcomes:**

At the end of this course students will be able to:

CO1	Generate scanner and parser from formal specification.
CO2	Generate top down and bottom up parsing tables using Predictive parsing, SLR and LR Parsing techniques.
CO3	Apply the knowledge of YACC to syntax directed translations for generating intermediate code – 3 address code.
CO4	Build a code generator using different intermediate codes and optimize the target code.
CO5	Generate scanner and parser from formal specification.





**Expected experiments to be performed (Not limited to):**

1. Sample programs using LEX.
2. Scanner Generation using LEX.
3. Elimination of Left Recursion in a grammar.
4. Left Factoring a grammar.
5. Top down parsers.
6. Bottom up parsers.
7. Parser Generation using YACC.
8. Intermediate Code Generation.
9. Target Code Generation.
10. Code optimization



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**FOUR YEAR BACHELOR OF TECHNOLOGY (B. Tech..) DEGREE COURSE**  
**SEMESTER: VI (C.B.C.S.)**  
**BRANCH: COMPUTER SCIENCE AND ENGINEERING**

Subject: **Elective 2: Machine Learning**

Subject Code: **BTECH\_CSE-602.1T**

Load	Credits	College Assessment Marks	University Evaluation	Total Marks
36 Hrs.	3	30	70	100

**Aim:** The use of data and algorithms to imitate the way that humans learn, gradually improving its accuracy.

**Prerequisite(s):** Statistics, Calculus, Linear Algebra and Probability & Programming Knowledge.

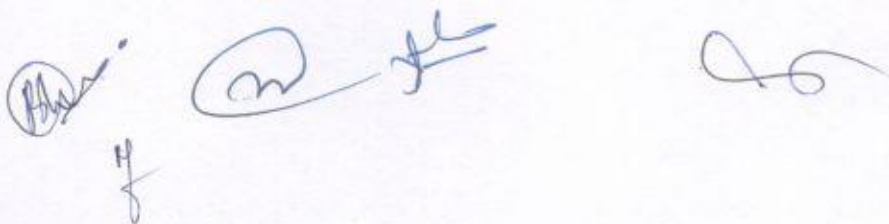
**Course Objectives:**

1.	To enable the Students with basic knowledge on Machine Learning Techniques.
2.	To develop skills of applying Machine Learning Techniques for solving real world problems.

**Course Outcomes:**

At the end of this course students will be able to:

CO1.	Understand basics of Machine Learning Techniques.
CO2.	Understand different types of Regression Techniques.
CO3.	Be capable of applying classification techniques.
CO4.	Apply unsupervised machine learning techniques.
CO5.	Apply & evaluate the machine learning techniques to real world problems.





## **SYLLABUS:**

### **UNIT I: Introduction to Machine Learning**

Human learning & it's types, Machine learning and it's types (Supervised ,unsupervised reinforcement),well-posed learning problems, Applications of Machine learning, issues in machine learning.

Types of data: Numerical and categorical data, data issues and remediation.

### **UNIT II: Supervised Learning: Regression**

Data pre-processing: Dimensionally reduction, feature subset selection Types of regression: Multiple linear regression, Polynomial regression model.

### **UNIT III: Supervised Learning: Classification**

Logistic regression, K-nearest neighbour (KNN),Naive Bayes Decision trees, Support vector machine, Recommendation Systems : Content based and collaborative techniques.

### **UNIT IV: Unsupervised Learning: Introduction**

Clustering, K-means clustering, Apriori algorithm and association rule, anomaly detection algorithm, Hierarchical clustering , K-Medoids.

### **UNIT V: Trends and applications in Machine learning**

Ensemble learning, Bagging, randomization, Boosting, Applications of Machine learning: Image recognition, speech recognition, Prediction recommendation: email spam and malware filtering, virtual personal assistant, online fraud detection.

### **Textbooks:**

1. Machine Learning by Subramanian Chandramouli, Saikat Dutt, Amit Kumar Das
2. Introduction to Machine Learning by Dr. Nilesh Shelke, Dr. Narendra. V. Choudhary, Dr. Gopal Sakarkar, Das Ganu Publications, ISBN-978-93-84336-63-9
3. Machine Learning by Tom Mitchell, Mc.Graw Publications

### **Reference books:**

1. Python Machine Learning Dr Randal S. Olson

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**RASHTRASANT TUKADOJI MAHARAJ NAGPUR UNIVERSITY,  
NAGPUR  
FOUR YEAR BACHELOR OF TECHNOLOGY (B. Tech..) DEGREE  
COURSE**

**SEMESTER: VI (C.B.C.S.)**

**BRANCH: COMPUTER SCIENCE AND ENGINEERING**

**Subject: Elective 2: Internet of Things**

**Subject Code: BTECH\_CSE-602.2T**

Load	Credits	College Assessment Marks	University Evaluation	Total Marks
36 Hrs.	3	30	70	100

**Aim:** This course provides a way to understand the concepts and the basics of Internet of things, IoT applications and examples overview (building automation, transportation, healthcare, industry, etc.) with a focus on wearable electronics.

**Prerequisite(s):** Introductory knowledge in programming, Networking.

**Course Objectives:**

1	To learn the concepts about Internet of things.
2	To understand and implement smart systems.
3	To understand the Network & Communication aspects.
4	Ability to understand the Security requirements in IoT.

**Course Outcomes:**

At the end of this course Student will be able to:

CO1	Understand the vision of IoT from a global context.
CO2	Understand M2M to IoT – A Basic Perspective
CO3	Use of Devices, Gateways and Data Management in IoT.
CO4	Understand the Internet of Things Privacy, Security and Governance
CO5	Implement basic IoT applications on embedded platform



## **SYLLABUS:**

### **Unit I:**

#### **Introduction to IoT**

Defining IoT, Characteristics of IoT, Physical design of IoT, Logical design of IoT, Functional blocks of IoT, Communication models & APIs

### **Unit II:**

**M2M to IoT – A Basic Perspective**– Introduction, Some Definitions, M2M Value Chains, IoT Value Chains, An emerging industrial structure for IoT, The international driven global value chain and global information monopolies.

**M2M to IoT-An Architectural Overview**– Building an architecture, Main design principles and needed capabilities, An IoT architecture outline, standards considerations.

### **Unit III:**

#### **Network & Communication aspects**

Wireless medium access issues, MAC protocol survey, Survey routing protocols, Sensor deployment & Node discovery, Data aggregation & dissemination

### **Unit IV:**

#### **Internet of Things Privacy, Security and Governance**

Introduction, Overview of Governance, Privacy and Security Issues, Contribution from FP7 Projects, Security, Privacy and Trust in IoT-Data-Platforms for Smart Cities, First Steps Towards a Secure Platform, Smartie Approach. Data Aggregation for the IoT in Smart Cities, Security

### **Unit V:**

#### **Developing IoTs**

Introduction to Python, Introduction to different IoT tools, Developing applications through IoT tools, Developing sensor based application through embedded system platform, Implementing IoT concepts with python

### **Text books:**

1. Vijay Madiseti and Arshdeep Bahga, "Internet of Things (A Hands-on-Approach)", 1<sup>st</sup> Edition, VPT, 2014 .

### **Reference books:**

1. Francis daCosta, "Rethinking the Internet of Things: A Scalable Approach to Connecting Everything", 1<sup>st</sup> Edition, Apress Publications, 2013.
2. Cuno Pfister, Getting Started with the Internet of Things, O'Reilly Media, 2011, ISBN: 978-1-4493- 9357-1
3. Waltenegus Dargie, Christian Poellabauer, "Fundamentals of Wireless Sensor Networks: Theory and Practice".



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**FOUR YEAR BACHELOR OF TECHNOLOGY (B. Tech..) DEGREE COURSE**  
**SEMESTER: VI (C.B.C.S.)**

**BRANCH: COMPUTER SCIENCE AND ENGINEERING**

**Subject: Elective 2: Cloud Computing**

**Subject Code: BTECH\_CSE-602.3T**

Load	Credits	College Assessment Marks	University Evaluation	Total Marks
36 Hrs.	3	30	70	100

**Aim:** The aim of this course is to make students understand the concepts, characteristics, models and benefits of cloud computing.

**Prerequisite(s):** Database Management System, Data Structures, Operating Systems, Computer Networks

**Course Objectives:**

1	To study fundamental concepts of cloud computing
2	To understand the implementation of Virtualization in Cloud Computing
3	To learn the application and security on cloud computing

**Course Outcomes:**

At the end of this course students will be able to:

CO1	Understand the different Cloud Computing environment
CO2	Analyze virtualization technology and install virtualization software
CO3	Use appropriate data storage technique on Cloud, based on Cloud application
CO4	Apply security in cloud applications
CO5	Use advance techniques in Cloud Computing





## **SYLLABUS:**

### **UNIT 1:**

Introduction: Importance of Cloud Computing, Characteristics, Pros and Cons of Cloud Computing, Migrating into the Cloud, Seven-step model of migration into a Cloud, Trends in Computing. Cloud Service Models: SaaS, PaaS, IaaS, Storage. Cloud Architecture: Cloud Computing Logical Architecture, Developing Holistic Cloud Computing Reference Model, Cloud System Architecture, Cloud Deployment Models.

### **UNIT 2:**

Introduction to Virtualizations: Definition of Virtualization, Adopting Virtualization, Types of Virtualizations, Virtualization Architecture and Software, Virtual Clustering, Virtualization Application, Pitfalls of Virtualization. Grid, Cloud and Virtualization: Virtualization in Grid, Virtualization in Cloud, Virtualization and Cloud Security. Virtualization and Cloud Computing: Anatomy of Cloud Infrastructure, Virtual infrastructures, CPU Virtualization, Network and Storage Virtualization.

### **UNIT 3:**

Cloud Storage: Data Management, Provisioning Cloud storage, Data Intensive Technologies for Cloud Computing. Cloud Storage from LANs to WANs: Cloud Characteristics, Distributed Data Storage.

### **UNIT 4:**

Risks in Cloud Computing: Risk Management, Enterprise-Wide Risk Management, Types of Risks in Cloud Computing. Data Security in Cloud: Security Issues, Challenges, advantages, Disadvantages, Cloud Digital persona and Data security, Content Level Security. Cloud Security Services: Confidentiality, Integrity and Availability, Security Authorization Challenges in the Cloud, Secure Cloud Software Requirements, Secure Cloud Software Testing.

### **UNIT 5:**

Future Trends in Cloud Computing, Mobile Cloud, Automatic Cloud Computing: Comet Cloud. Multimedia Cloud: IPTV, Energy Aware Cloud Computing, Jungle Computing, Distributed Cloud Computing Vs Edge Computing, Containers, Docker, and Kubernetes, Introduction to DevOps. IOT and Cloud Convergence: The Cloud and IoT in your Home, The IOT and cloud in your Automobile, PERSONAL: IoT in Healthcare.

### **Text/Reference Books**

1. A.Srinivasan, J. Suresh, "Cloud Computing: A Practical Approach for Learning and Implementation", Pearson, ISBN: 978-81-317-7651-3
2. Rajkumar Buyya, Christian Vecchiola, S. Thamarai Selvi, "Mastering Cloud Computing", McGraw Hill Education, ISBN-13: 978-1-25-902995-0
3. Anthony T. Velte Toby J. Velte, Robert Elsenpeter, "Cloud Computing: A Practical Approach" McGraw Hill Tim Mather, Subra K, Shahid L., "Cloud Security and Privacy", Oreilly, ISBN-13 978-81-8404-815-5



4. Dr. Kris Jamsa, "Cloud Computing: SaaS, PaaS, IaaS, Virtualization and more", Wiley Publications, ISBN: 978-0-470-97389-9

Four handwritten signatures in blue ink are arranged horizontally. From left to right: the first is a circular signature with 'B' and 'J' inside; the second is a simple 'f' or 'y' shape; the third is a signature starting with a large 'm' and ending in a horizontal stroke; the fourth is a signature starting with a large 'L' and ending in a horizontal stroke.



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**FOUR YEAR BACHELOR OF TECHNOLOGY (B. Tech..) DEGREE COURSE**  
**SEMESTER: VI (C.B.C.S.)**

**BRANCH: COMPUTER SCIENCE & ENGINEERING**

Subject: Elective 3: **Data Science**

Subject Code : **BTECH\_CSE-603.1T**

Load	Credits	College Assessment Marks	University Evaluation	Total Marks
36 Hrs.	03	30	70	100

**Aim:** To apply data science concepts and methods to solve problems in real-world contexts and to communicate these solutions effectively.

**Prerequisite(s):** Preliminary Linear Algebra

**Course Objectives:**

1	To understand the basic concepts of Data science.
2	Demonstrate an understanding of statistics and classification concepts that are vital for data science.
3	Demonstrate the implementation of Data Science experiments through Python or R Language.

**Course Outcomes:**

At the end of this course Student will be able to:

1	Understanding the significance of exploratory data analysis in Data Science.
2	Demonstrate the usage of Random Sampling and bias in a given dataset.
3	Analysis of various Statistical Experiments through various types popular Testing methods.
4	Design and analysis of regression techniques to estimate outcomes and detect anomalies.
5	Ability to implement classification Techniques.



## **SYLLABUS:**

### **UNIT I**

#### **Exploratory Data Analysis**

Elements of Structured Data, Rectangular Data, Estimates of Location, Estimates of Variability, Exploring the Data Distribution, Exploring Binary and Categorical Data, Correlation, Exploring Two or More Variables

### **UNIT 2**

#### **Data and Sampling Distributions**

Random Sampling and Sample Bias, Selection Bias, Sampling Distribution of a Statistic, The Bootstrap, Confidence Intervals, Normal Distribution, Long-Tailed Distribution, Student's t-Distribution. Binomial Distribution, Chi-Square Distribution, F-Distribution

### **UNIT 3**

#### **Statistical Experiments and Significance Testing**

A/B Testing, Hypothesis Tests, Resampling, Statistical Significance and p-Values, Multiple Testing, Degrees of Freedom, ANOVA, Chi-Square Test, Multi-Arm Bandit Algorithm. Power and Sample Size

### **UNIT 4:**

#### **Regression and Prediction**

Simple Linear Regression, Multiple Linear Regression, Prediction Using Regression, Factor Variables in Regression, Interpreting the Regression Equation, Regression Diagnostics, Polynomial and Spline Regression

### **UNIT 5:**

#### **Classification**

Naive Bayes, Discriminant Analysis, Logistic Regression, Evaluating Classification Models, Strategies for Imbalanced Data

#### **Text books:**

1. Peter Bruce, Andrew Bruce and Peter Gedeck, Practical Statistics for Data Scientists, 2<sup>nd</sup> Edition, Oreilly.
2. R Programming for Data Science – Roger D.Peng, Learn Pub Book, Learn Publishing.
3. Sanjivranjan Das, Data Science: Theories, Models, Algorithms and Analytics.
4. Cathy O'Neil and Rachel Schutt, Doing Data Science, Straight Talk.

#### **Reference books:**

1. Allen B. Downey, Think Python: How to Think Like a Computer Scientist, (2nd Edition), O'Reilly, 2015. ISBN-978-1-491-93936-9.
2. R for dummies – Andrie de vries and Joris Meys, A John Wiley sons, Ltd. Publication.





**RASHTRASANT TUKADOJI MAHARAJ NAGPUR UNIVERSITY, NAGPUR**  
**FOUR YEAR BACHELOR OF TECHNOLOGY (B. Tech..) DEGREE COURSE**  
**SEMESTER: VI (C.B.C.S.)**  
**BRANCH: COMPUTER SCIENCE AND ENGINEERING**

**Subject: Elective 3: Distributed Operating Systems**

**Subject Code: BTECH-CSE-603.2T**

Load	Credits	College Assessment Marks	University Evaluation	Total Marks
36 Hrs.	3	30	70	100

**Aim:** A distributed operating system is a software over a collection of independent, networked, communicating and physically separate computational nodes. They handle jobs which are serviced by multiple CPUs. Each individual node holds a specific software subset of the global aggregate operating system.

**Prerequisite(s):** Distributed Operating systems holds concepts such as threads, processes, mutual exclusion, deadlock. It also works on Computer networking concepts such as Internet, protocols, sockets, network application programming.

**Course Objectives:**

1	To understand the principles and techniques behind the design of distributed systems, such as locking, concurrency, scheduling, and communication across networks.
2	To get knowledge in distributed architecture, naming, synchronization, consistency and replication, fault tolerance, security, and distributed file systems.

**Course Outcomes:**

At the end of this course Student will be able to:

1	Learn the principles, architectures, algorithms and programming models used in distributed systems.
2	Understand the core concepts of distributed systems.
3	Design and implement sample distributed systems, using different algorithm.
4	Understand the Distributed File System, Architecture, and Mechanism.
5	Analyze the Distributed Scheduling, Issues in Load Distributing, components of a Load Distributing Algorithm, Load Distributing Algorithms.



## **SYLLABUS:**

### **Unit I:**

Fundamentals: Introduction, Models and Features, Concept of Distributed Operating system, Issues in Design of a Distributed Operating System. Foundations of Distributed System: Limitations of Distributed Systems.

### **Unit II:**

Broadcast Algorithm, Distributed Mutual Exclusion: Requirement of Mutual Exclusion Non Token Based Algorithms: Lamport's Algorithm, Ricard-Agrawala Maekawa's Algorithm.

### **Unit III:**

Distributed Deadlock Detection: Introduction, Deadlock Handling strategies in Distributed System, Centralized and Distributed Deadlock Detection Algorithms.

### **Unit IV:**

Distributed File system, Architecture, and Mechanism for Building Distributed File System. General Architecture of DSM systems, Algorithm for Implementing DSM, Memory coherence and Coherence Protocols.

### **Unit V:**

Distributed Scheduling, Issues in Load Distributing, Load Distributing Algorithms, Sender-Initiated Algorithm, Receiver-Initiated algorithm, Symmetrically Initiated Algorithm, Adaptive Algorithm.

### **Text books:**

1. Advanced Concepts in Operating Systems, Shivaratri, Tata McGraw Hill, 2001. Mukesh Singhal and Niranjana
2. Distributed Systems - Concepts and Design, Coulouris, Dollimore and Kindberg, 5th Edition, Addison-Wesley, 2012.

### **Reference books:**

1. Distributed Operating System, Andrew S. Tanenbaum, Pearson Education, 2003.





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**SEMESTER: VI (C.B.C.S.)**

**BRANCH: COMPUTER SCIENCE AND ENGINEERING**

Subject: **Elective 3: Human Computer Interaction**

Subject Code: **BTECH-CSE-603.3T**

Load	Credits	College Assessment Marks	University Evaluation	Total Marks
36 Hrs.	3	30	70	100

**Aim:** The course focuses on human-computer interaction and interface design.

**Prerequisites:** Fundamental knowledge of programming.

**Course Objectives:**

Students should be able to:

1	Describe what interaction design is and how it relates to human computer interaction and other fields.
2	Use, adapt and extend classic design standards, guidelines, and patterns.
3	Apply core theories, models and methodologies from the field of HCI
4	Types of Mobile Application along with Designing
5	Learn the guidelines in designing user interfaces

**Course Outcomes**

Students would be able to:

CO1	Understand the Importance of user Interface
CO2	Design effective dialog for HCI
CO3	Develop navigation panes in windows
CO4	Understand HCI using software tools, prototypes and golden rules
CO5	Analyse and apply various evaluation techniques.



## **SYLLABUS:**

### **UNIT - I**

Introduction: Importance of user Interface – definition, importance of good design. Benefits of good design. A brief history of Screen design. The graphical user interface – popularity of graphics, the concept of direct manipulation, graphical system, Characteristics, Web user – Interface popularity, characteristics- Principles of user interface.

### **UNIT - II**

Design process – Human interaction with computers, importance of human characteristics human consideration, Human interaction speeds, understanding business junctions. Screen Designing: Design goals: Screen planning and purpose, organizing screen elements, ordering of screen data and content, screen navigation and flow, Visually pleasing composition, amount of information, focus and emphasis, presentation information simply and meaningfully, information retrieval on web, statistical graphics

### **UNIT - III**

Windows – New and Navigation schemes selection of window, selection of devices based and screen based controls. Components – text and messages, Icons and increases – Multimedia, colors, uses problems, choosing colors.

### **UNIT - IV**

HCI in the software process, The software life cycle Usability engineering Iterative design and prototyping Design Focus: Prototyping in practice Design rationale Design rules Principles to support usability Standards Golden rules and heuristics HCI patterns.

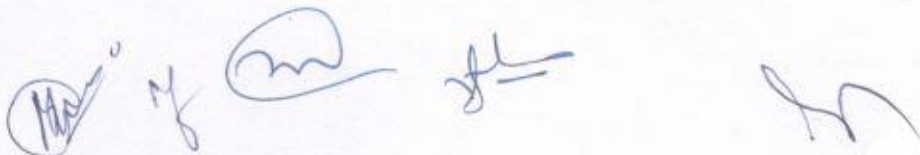
**UNIT - V** Evaluation techniques, Goals of evaluation, Evaluation through expert analysis, Evaluation through user participation, Choosing an evaluation method. Universal design, Universal design principles Multi-modal interaction Cognitive models Goal and task hierarchies Design Focus: GOMS saves money Linguistic models The challenge of display-based systems Physical and device models Cognitive architectures Ubiquitous computing and augmented realities

### **Text Books:**

1. The essential guide to user interface design, Wilbert O Galitz, Wiley Dream Tech. Units 1, 2, 3
2. Human – Computer Interaction. Alan Dix, Janet Fincay, Gre Goryd, Abowd, Russell Bealg, Pearson Education Units 4,5

### **Reference Books:**

1. Designing the user interface. 3rd Edition Ben Shneidermann, Pearson Education Asia.
2. Interaction Design Prece, Rogers, Sharps. Wiley Dreamtech.
3. User Interface Design, Soren Lauesen , Pearson Education.
4. Human –Computer Interaction, D. R. Olsen, Cengage Learning.
5. Human –Computer Interaction, Smith - Atakan, Cengage Learning.





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**SEMESTER: VI (C.B.C.S.)**

**BRANCH: COMPUTER SCIENCE AND ENGINEERING**

**Subject: Open Elective 1: Linux Fundamentals    Subject Code: BTECH-CSE-604.IT**

Load	Credits	College Assessment Marks	University Evaluation	Total Marks
36 Hrs.	3	30	70	100

**Aim:** To provide knowledge of Linux including the directory structure, basic commands, the shell, and using the command line.

**Prerequisites:** Basic knowledge of networks, and computer skills.

**Course Objectives:**

Students should be able to:

1	Understand basic terminology of Linux.
2	Conduct basic activities such as installation, troubleshooting, and navigation.
3	Understand and write shell scripts and management of Failure recovery.

**Course Outcomes**

Students would be able to:

1	Understand Linux Architecture, different Linux installation and Linux commands.
2	Effectively use Linux Environment using shell, file system, scripts, filters and program development tools
3	Perform user, group management , package management through commands
4	Perform storage management and failure recovery through commands.
5	Automate tasks and write simple programs using shell scripts.



## **SYLLABUS:**

### **UNIT-I**

History of Linux OS, Architecture of Linux OS, Linux Distribution s, Installation of Linux OS

### **UNIT- II**

Introduction to terminal, Basic commands, File system, File handling commands, process and process management commands, VI editor.

### **UNIT- III**

Users and Group management- Creation, Updating, Deletion of user and group, Commands - password, Shadow, user add, user mod , user del, group add, group mod, group del.

### **UNIT-IV**

Package Management - Introduction to package manager, function of package manager, Package management commands - rpm, yum. Storage management- Types of storages, creating partitions using fdisk command.

### **UNIT-V**

Logical volume management (LVM), Creating file system, mounting file system. Shell and Shell script.

### **Text Book**

1. Unix and Shell Programming-B. M. Harwani, OXFORD University Press.

### **Reference Books**

1. Linux Administration: A Beginner's Guide-Wale Soyinka, McGraw Hill Publication
2. Unix Concepts and Applications-Sumitabha Das, McGraw Hill Publication





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**SEMESTER: VI (C.B.C.S.)**

**BRANCH: COMPUTER SCIENCE AND ENGINEERING**

Subject: **Open Elective 1: Android Application Development**      Subject Code: **BTECH-CSE-604.2T**

Load	Credits	College Assessment Marks	University Evaluation	Total Marks
36 Hrs.	3	30	70	100

**Aim:** Introduction to Android development framework and programming.

**Prerequisites:** 1.Oops through java 2.XML

**Course Objectives:**

Students should be able to:

1	Demonstrate their understanding of the fundamentals of Android operating systems.
2	Demonstrate their skills of using Android software development tools.
3	Develop software with reasonable complexity on mobile platform.
4	Deploy software to mobile devices.
5	Debug programs running on mobile devices

**Course Outcomes**

Students would be able to:

1	Describe the components and structure of a mobile development framework
2	Understand the specific requirements, possibilities and challenges when developing for a mobile context.
3	Apply Java programming concepts to Android application development
4	Design and develop user Interfaces for the Android platform
5	Publish an application to the Android Market



## **SYLLABUS:**

### **UNIT- I:**

Introduction to Android Operating System: Android OS design and Features – Android development framework, SDK features, Installing and running applications on Eclipse platform, Creating AVDs, Types of Android applications, Best practices in Android programming, Android tools Android application components – Android Manifest file, Externalizing resources like values, themes, layouts, Menus etc, Resources for different devices and languages, Runtime Configuration Changes Android Application Lifecycle – Activities, Activity lifecycle, activity states, monitoring state changes

### **UNIT-II:**

Android User Interface: Measurements – Device and pixel density independent measuring units. Layouts – Linear, Relative, Grid and Table Layouts. User Interface (UI) Components – Editable and non-editable Text Views, Buttons, Radio and Toggle Buttons, Checkboxes, Spinners, Dialog and pickers. Event Handling – Handling clicks or changes of various UI components.

Fragments – Creating fragments, Lifecycle of fragments, Fragment states, Adding fragments to Activity, adding, removing and replacing fragments with fragment transactions, interfacing between fragments and Activities, Multi-screen Activities.

### **UNIT- III:**

Intents and Broadcasts: Intent – Using intents to launch Activities, Explicitly starting new Activity, Implicit Intents, Passing data to Intents, Getting results from Activities, Native Actions, using Intent to dial a number or to send SMS Broadcast Receivers – Using Intent filters to service implicit Intents, Resolving Intent filters, finding and using Intents received within an Activity Notifications – Creating and Displaying notifications, Displaying Toasts

### **UNIT- IV:**

Persistent Storage: Files – Using application specific folders and files, creating files, reading data from files, listing contents of a directory Shared Preferences – Creating shared preferences, saving and retrieving data using Shared Preference Database – Introduction to SQLite database, creating and opening a database, creating tables, inserting retrieving and deleting data, Registering Content Providers, Using content Providers (insert, delete, retrieve and update)

### **UNIT- V:**

Advanced Topics: Alarms – Creating and using alarms. Using Internet Resources – Connecting to internet resource, using download manager Location Based Services – Finding Current Location and showing location on the Map, updating location

### **Text Books:**

1. Professional Android 4 Application Development, Reto Meier, Wiley India, (Wrox) , 2012
2. Android Application Development for Java Programmers, James C Sheusi, Cengage Learning, 2013

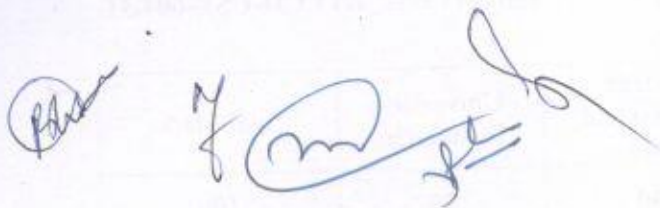
### **Reference Books:**

- Beginning Android 4 Application Development, Wei-Meng Lee, Wiley India (Wrox), 2013



**Web Course:**

1. <https://www.nptel.ac.in/courses/106106156/>

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**SEMESTER: Sixth (C.B.C.S.)**

**BRANCH: COMPUTER SCIENCE & ENGINEERING**

**Subject: Open Elective 1: Block-chain  
Technologies**

**Subject Code: BTECH-CSE-604.3T**

Load	Credits	College Assessment Marks	University Evaluation	Total Marks
36 Hrs.	3	30	70	100

**Aim:** To make students aware of Block Chain Technology and how it works. T

**Prerequisites:** Data Structures and algorithms and basic knowledge of Cryptography.

**Course Objectives:**

1	To teach the concepts of blockchain technologies.
2	To cover the technical aspects of crypto currencies, block chain technologies, and distributed consensus.
3	To familiarize potential applications for Bit coin-like crypto currencies
4	To learn, how these systems work and how to engineer secure software that interacts with the Bit coin network and other crypto currencies.

**Course Outcomes:**

Students would be able to:

1	Understand emerging abstract models for Block chain Technology
2	Analyse the concept of cryptocurrency and mathematical background behind it
3	Apply the tools for understanding the background of bitcoins
4	Identify major research challenges and technical gaps existing between theory and practice in crypto currency domain
5	Understanding of latest advances and its applications in Block Chain Technology





## **SYLLABUS:**

### **UNIT- I:**

**Introduction** Basic of Blockchain Architecture – Challenges – Applications – Block chain Design Principles -The Blockchain Ecosystem - The consensus problem - Asynchronous Byzantine Agreement - AAP protocol and its analysis, Abstract Models for BLOCKCHAIN - GARAY model - RLA Model - Proof of Work ( PoW) as random oracle - formal treatment of consistency, liveness and fairness - Proof of Stake ( PoS) based Chains - Hybrid models ( PoW + PoS)

### **UNIT-II:**

**Cryptographic Fundamentals** Cryptographic basics for crypto currency - a short overview of Hashing, cryptographic algorithm – SHA 256, signature schemes, encryption schemes and elliptic curve cryptography- Introduction to Hyperledger- Hyperledger framework - Public and Private Ledgers.

### **UNIT- III:**

**Bit Coin** Bit coin - Wallet - Blocks - Merkle Tree - hardness of mining - transaction verifiability - anonymity - forks - double spending - mathematical analysis of properties of Bit coin. Bitcoin blockchain, the challenges, and solutions, proof of work, Proof of stake, alternatives to Bitcoin consensus, Bitcoin scripting language and their uses.

### **UNIT- IV:**

**Ethereum** Ethereum - Ethereum Virtual Machine (EVM) - Wallets for Ethereum - Solidity - Smart Contracts - some attacks on smart contracts. Ethereum and Smart Contracts- The Turing Completeness of Smart Contract Languages and verification challenges- comparing Bitcoin scripting vs. Ethereum Smart Contracts

### **UNIT- V:**

**Block Chain-Recent Trend** Blockchain Implementation Challenges- Zero Knowledge proofs and protocols in Block chain - Succinct non interactive argument for Knowledge (SNARK) - pairing on Elliptic curves – Zcash - attacks on Blockchains

### **Text Books:**

1. Melanie Swan, "Block Chain: Blueprint for a New Economy", O'Reilly, first edition 2015.
2. Daniel Drescher, "Block Chain Basics", Apress; 1st edition, 2017
3. Anshul Kaushik, "Block Chain and Crypto Currencies", Khanna Publishing House, Delhi.
4. Imran Bashir, "Mastering Block Chain: Distributed Ledger Technology, Decentralization and Smart Contracts Explained", Packt Publishing, first edition – 2012.

### **Reference Book:**

Ritesh Modi, "Solidity Programming Essentials: A Beginner's Guide to Build Smart Contracts for Ethereum and Block Chain", Packt Publishing.



**Websites:**

1. [https://developer.ibm.com/patterns/create-and-deploy-block chain-network-usingfabric-sdk-java/](https://developer.ibm.com/patterns/create-and-deploy-block-chain-network-usingfabric-sdk-java/)
2. <https://docs.docker.com/get-started/>
3. <https://console.ng.bluemix.net/docs/services/block%2520chain/index.html>

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**SEMESTER: VI (C.B.C.S.)**  
**BRANCH: COMPUTER SCIENCE AND ENGINEERING**

Subject: **Professional Skills Lab II**

Subject Code: **BTECH\_CSE-605P**

Load	Credits	College Assessment Marks	University Evaluation	Total Marks
2 Hrs/Week	1	25	25	50

**Aim:**

This lab has focus on hands-on project and assignment-based learning space where students will gain strong practical and technical skills in various programming languages and advanced tools.

**Course Objectives:**

The interactive experiments in this lab will give the students an opportunity for learning and better understanding of the basic concepts and constructs of computer programming as well as advanced methodology concepts

**Expected experiments to be performed Based on the Electives and Open Electives opted by students (Not limited to):**

Android Application Development

Or

Block Chain Technology

Or

Machine Learning

Or

Data science

Or

Human Computer Interface

Or

Linux Fundamentals



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**SEMESTER: VI (C.B.C.S.)**  
**BRANCH: COMPUTER SCIENCE AND ENGINEERING**

Subject: **Hardware Lab**

Subject Code: **BTECH\_CSE-606P**

Load	Credits	College Assessment Marks	University Evaluation	Total Marks
2 Hrs/Week	1	25	25	50

**Course Objectives:**

To skill the students in the H/W field.

To enhance research activities in different application areas of IoT, Robotics and Embedded systems.

**Expected experiments to be performed Based on the Electives and Open Electives opted by students (Not limited to):**

**Internet of Things**

**Or**

**Microprocessors and Micro-controllers**

**Or**

**Components of ROBOTS**

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**SEMESTER: VI (C.B.C.S.)**  
**BRANCH: COMPUTER SCIENCE AND ENGINEERING**

Subject: **Mini Project**

Subject Code: **BTECH\_CSE-607P**

Load	Credits	College Assessment Marks	University Evaluation	Total Marks
6 Hrs/Week	3	50	50	100

**Aim:**

The mini project is designed to help students develop practical ability and knowledge about practical tools/techniques in order to solve real life problems related to the industry, academic institutions and computer science research. The course Mini Project is one that involves practical work for understanding and solving problems in the field of computing.

**Course Objectives:**

Mini-Project is intended develop investigative, research and report writing skills and will provide an opportunity to investigate a chosen topic in considerable depth so as to demonstrate the application of their programming and research skills, and to apply their knowledge to complex computing problems.

**Course Outcomes:**

**At completion of mini-project:**

Students will get knowledge of all the necessary details required for the development of a software project and its documentation using software engineering approach.



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**SEMESTER: VI (C.B.C.S.)**

**BRANCH: COMPUTER SCIENCE & ENGINEERING**

**Subject: Economics of IT industry**

**Subject Code: BTECH-CSE-608T**

Load	Credits	College Assessment Marks	University Evaluation	Total Marks
2 Hrs /Week	2	15	35	50

**Course Objective:**

Objective of the course is to make learners aware about the impact of Information Communication technology (ICT) and Information Technology (IT) revolution on Indian Economy and their seamless interaction.

1. The learners will be able to distinguish between Micro and Macro economics
2. The learners will be able to relate economics concept with IT industry
3. The learners will be able to identify key trends in IT industry
4. The learners will be able to understand the key economic drivers of IT industry.

**SYLLABUS:**

**UNIT 1:**

Difference between Micro and Macroeconomics, law of demand and supply, concept and types of elasticity of demand, deflation and recession.

**UNIT 2:**

Role of Information and technology industry in economic growth of the country, labour intensive verses capital intensive industry, the concept of digital economy and digital age, digital divide, various phases of business cycle.

**UNIT 3:**

Merger and acquisition, types of merger, advantages of merger, hostile takeover, concept of top line and bottom line growth, Contribution of E-Commerce in economic growth, information technology and environment- the challenge of E - waste.

**UNIT 4:**

Venture and angel funding as sources of finance, organic verses inorganic growth model, 5 level capability maturity model of IT industry, Concept of agile organization

**List of Reference Books:**

1. Modern economic theory by K.K.Dewett,
2. Information and economic development by Yutuka Khurana, IGI Global publisher.
3. The economics of information technology by Paul Jowett, Margaret Rothwell. St Martin Press New York.
4. Industrial Economics. By, Ranjana Seth, Ane Book Pvt Ltd.





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**SEMESTER: VI (C.B.C.S.)**

**BRANCH: COMPUTER SCIENCE AND ENGINEERING**

**Subject: Intellectual Property  
Rights (Audit Course)**

**Subject Code: BTECH\_CSE-609T**

Load	Credits	College Assessment Marks	University Evaluation	Total Marks
2 Hrs./Week	-	50 (Will be converted to grade)	-	-

**Aim:** To introduce the basics of Intellectual Property Rights, Copy Right Laws Trade Marks and Issues related to Patents. The overall idea of the course is to help and encourage the student for startups and innovations.

**Prerequisite(s):** Nil

**Course Objectives:**

1.	To introduce fundamental aspects of Intellectual property Rights
2.	To disseminate knowledge on patents, patent regime in India and abroad and registration aspects
3.	To disseminate knowledge on copyrights and its related rights and registration aspects
4.	To disseminate knowledge on trademarks and registration aspects
5.	To disseminate knowledge on Design, Geographical Indication (GI), Plant Variety and Layout Design Protection and their registration aspects

**Course Outcomes:**

At the end of this course students will be able to:

CO1.	Understand fundamental aspects of Intellectual property Rights
CO2.	Apply knowledge on patents, patent regime in India and abroad and registration aspects
CO3.	Be capable of getting copyrights and its related rights and registration aspects
CO4.	Be capable of getting trademarks and registration aspects
CO5.	Apply knowledge on Design, Geographical Indication (GI), Plant Variety and Layout Design Protection and their registration aspects



## **SYLLABUS:**

### **UNIT 1:**

**Overview of Intellectual Property:** Introduction and the need for intellectual property right (IPR) - Kinds of Intellectual Property Rights: Patent, Copyright, Trade Mark, Design, Geographical Indication, Plant Varieties and Layout Design - Genetic Resources and Traditional Knowledge - Trade Secret - IPR in India : Genesis and development - IPR in abroad - Major International Instruments concerning Intellectual Property Rights: Paris Convention, 1883, the Berne Convention, 1886, the Universal Copyright Convention, 1952, the WIPO Convention, 1967, the Patent Co-operation Treaty, 1970, the TRIPS Agreement, 1994

### **UNIT 2:**

**Patents** - Elements of Patentability: Novelty , Non Obviousness (Inventive Steps), Industrial Application - Non - Patentable Subject Matter - Registration Procedure, Rights and Duties of Patentee, Assignment and licence , Restoration of lapsed Patents, Surrender and Revocation of Patents, Infringement, Remedies & Penalties - Patent office and Appellate Board

### **UNIT 3:**

**Copyrights** - Nature of Copyright - Subject matter of copyright: original literary, dramatic, musical, artistic works; cinematograph films and sound recordings - Registration Procedure, Term of protection, Ownership of copyright, Assignment and licence of copyright - Infringement, Remedies & Penalties - Related Rights - Distinction between related rights and copyrights

### **UNIT 4:**

**Trademarks** - Concept of Trademarks - Different kinds of marks (brand names, logos, signatures, symbols, well known marks, certification marks and service marks) - Non Registrable Trademarks - Registration of Trademarks - Rights of holder and assignment and licensing of marks - Infringement, Remedies & Penalties - Trademarks registry and appellate board

### **UNIT 5:**

#### **Other forms of IP -**

**Design:** Design meaning and concept of novel and original - Procedure for registration, effect of registration and term of protection **Geographical Indication (GI):** Geographical indication meaning, and difference between GI and trademarks - Procedure for registration, effect of registration and term of protection

**Plant Variety Protection:** Plant variety protection meaning and benefit sharing and farmers' rights - Procedure for registration, effect of registration and term of protection

**Layout Design Protection** Layout Design protection meaning - Procedure for registration, effect of registration and term of protection





**Text books:**

1. Nithyananda, K V. (2019). Intellectual Property Rights: Protection and Management. India, IN: Cengage Learning India Private Limited.
2. Neeraj, P., & Khusdeep, D. (2014). Intellectual Property Rights. India, IN: PHI learning Private Limited.

**Reference books:**

1. Ahuja, V K. (2017). Law relating to Intellectual Property Rights. India, IN: Lexis Nexis.

**E-resources:**

1. Subramanian, N., & Sundararaman, M. (2018). Intellectual Property Rights – An Overview. Retrieved from <http://www.bdu.ac.in/cells/ipr/docs/ipr-eng-ebook.pdf>
2. World Intellectual Property Organisation. (2004). WIPO Intellectual property Handbook. Retrieved from [https://www.wipo.int/edocs/pubdocs/en/intproperty/489/wipo\\_pub\\_489.pdf](https://www.wipo.int/edocs/pubdocs/en/intproperty/489/wipo_pub_489.pdf)

**Reference Journal:**

1. Journal of Intellectual Property Rights (JIPR): NISCAIR

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