**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**

**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 (AuditCourse) | 2 | - | - | 50 | - | - | Audit | PCC |
| | **Total** | **17** | **-** | **12** | | | **700** | **21** | |

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

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**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** |

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**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** |

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**Course Objectives:**

| | |
|---|---|
| **1** | To learn usage of tools LEX, YAAC |
| **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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**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, Hierarchial 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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**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 Madisetti and Arshdeep Bahga, "Internet of Things (A Hands-on-Approach)", 1st Edition, VPT, 2014 .

**Reference books:**

1. Francis daCosta, "Rethinking the Internet of Things: A Scalable Approach to Connecting Everything", 1 st 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 ofWireless Sensor Networks: Theory and Practice".

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**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 CloudComputing, 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 Tends 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 andImplementation”, Pearson, ISBN: 978-81-317-7651-3
2. Rajkumar Buyya, Christian Vecchiola, S. Thamarai Selvi, “Mastering CloudComputing”, McGraw Hill Education, ISBN-13:978-1-25-902995-0
3. Anthony T. Velte Toby J. Velte, Robert Elsenpeter, “Cloud Computing: A PracticalApproach” 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”, WileyPublications, ISBN: 978-0-470-97389-9

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**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** |

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**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, 2nd 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.

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**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-Intiated algorithm, Symmetrically Initiated Algorithm, Adaptive Algorithm.

**Text books:**
1. Advanced Concepts in Operating Systems, Shivaratri, Tata McGraw Hill, 2001. Mukesh Singhal and Niranjan
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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**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-604.1T**

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

**Aim: T**o 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 scripta 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 faiIure 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 Dist ribution 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- Ill**

Users and Group management- Creation, Updating, Deletion of user and group, Commands - password, Shadow, user add, user mod , user deI, 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 f disk 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

**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: **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 - Merkley 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; 1stedition, 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/
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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**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 (AuditCourse)**

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

**Reference Journal:**

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