**SGT University, Chandu-Budhera, Gurugram**

**Faculty of Engineering & Technology**

**Department of Computer Science &Engineering**

Bachelor of Computer Applications

Artificial Intelligence & Machine Learning

Scheme & Syllabus (2021-22 Onwards)

**Vision of SGT University**

"Driven by Research & Innovation, we aspire to be amongst the top ten Universities in the Country by 2022"

# Bachelor of Computer Application(AI/ML)

## Semester 1st

| S. No. | Subject Code | Subject Name | L | T | P | C | Internal | External | Total |
|---|---|---|---|---|---|---|---|---|---|
| 1 | | Discrete Mathematics | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 2 | | Computer Fundamental | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 3 | | Entrepreneurship | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 4 | | Object Oriented Programming | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 5 | | Artificial Intelligence-Present and Future | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 6 | | Computer Fundamental Lab | 0 | 0 | 2 | 1 | 60 | 40 | 100 |
| 7 | | Object Oriented Programming Lab | 0 | 0 | 2 | 1 | 60 | 40 | 100 |
| 8 | | Professional Communication Lab | 0 | 0 | 2 | 1 | 60 | 40 | 100 |
| 9 | | Mandatory Course- I | 2 | 0 | 0 | 2 | 40 | 60 | 100 |
| 10 | | Value Addition Courses-I | 2 | 0 | 0 | 2 | 40 | 60 | 100 |
| | | **Total** | **19** | **0** | **6** | **22** | 460 | 540 | 1000 |

| Score | Grade |
|---|---|
| 90 marks and above | O (Outstanding) |
| 80 marks and above but less than 90 marks | A+ (Excellent) |
| 70 marks and above but less than 80 marks | A (Very Good) |
| 60 marks and above but less than 70 marks | B+(Good) |
| 50 marks To 60 marks | B (Above Average) |
| Below Minimum Pass marks | F(Fail) |

# Bachelor of Computer Application (AI/ML)

## Semester 2nd

| S. No. | Subject Code | Subject Name | L | T | P | C | Internal | External | Total |
|---|---|---|---|---|---|---|---|---|---|
| 1 | | Introduction to Artificial Intelligence & Machine Learning | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 2 | | Java Programming | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 3 | | Basics of Data Structure | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 4 | | Web Development | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 5 | | Computer Architecture | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 6 | | Medical Measurement & Measuring Instruments | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 7 | | Java Programming Lab | 0 | 0 | 2 | 1 | 60 | 40 | 100 |
| 8 | | Basics of Data Structure Lab | 0 | 0 | 2 | 1 | 60 | 40 | 100 |
| 9 | | Web Development Lab | 0 | 0 | 2 | 1 | 60 | 40 | 100 |
| 10 | | Industrial Internship-I | 0 | 0 | 4w | 2 | 60 | 40 | 100 |
| | | **Total** | **18** | **0** | **6** | **23** | | | |

| Score | Grade |
|---|---|
| 90 marks and above | O (Outstanding) |
| 80 marks and above but less than 90 marks | A+ (Excellent) |
| 70 marks and above but less than 80 marks | A (Very Good) |
| 60 marks and above but less than 70 marks | B+(Good) |
| 50 marks To 60 marks | B (Above Average) |
| Below Minimum Pass marks | F(Fail) |

**Exit Point**

Certificate Course in Basics of Computer Application(AI/ML).

**Entry Point**

Three years Diploma or One year Basics of Computer Application(AIML).

# Bachelor of Computer Application (AI/ML)

| Semester 3rd | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **S. No.** | **Subject Code** | **Subject Name** | **L** | **T** | **P** | **C** | **Internal** | **External** | **Total** |
| 1 | | Database Management Systems | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 2 | | Software Engineering | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 3 | | Programming Language –Python | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 4 | | Department Electives-I | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 5 | | Open Elective-I | 4 | 0 | 0 | 4 | 40 | 60 | 100 |
| 6 | | Database Management Systems Lab | 0 | 0 | 2 | 1 | 60 | 40 | 100 |
| 7 | | Software Engineering Lab | 0 | 0 | 2 | 1 | 60 | 40 | 100 |
| 8 | | Programming Language –Python Lab | 0 | 0 | 2 | 1 | 60 | 40 | 100 |
| 9 | | Department Electives Lab-I | 0 | 0 | 2 | 1 | 60 | 40 | 100 |
| 10 | | Value Addition Course-II | 2 | 0 | 0 | 2 | 40 | 60 | 100 |
| | | **Total** | **18** | **0** | **8** | **22** | | | |

# Bachelor of Computer Application (AI/ML)

## Semester 4th

| S. No. | Subject Code | Subject Name | L | T | P | C | Internal | External | Total |
|---|---|---|---|---|---|---|---|---|---|
| 1 | | Operating System | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 2 | | Design and Analysis of Algorithm | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 3 | | Probabilistic modeling and reasoning with Python | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 4 | | Department Electives-II | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 5 | | Mandatory Course - II | 2 | 0 | 0 | 2 | 40 | 60 | 100 |
| 6 | | Medical imaging techniques | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 7 | | Operating System Lab | 0 | 0 | 2 | 1 | 60 | 40 | 100 |
| 8 | | Design and Analysis of Algorithm Lab | 0 | 0 | 2 | 1 | 60 | 40 | 100 |
| 9 | | Probabilistic modeling and reasoning with Python Lab | 0 | 0 | 2 | 1 | 60 | 40 | 100 |
| 10 | | Department Electives Lab-II | 0 | 0 | 2 | 1 | 60 | 40 | 100 |
| 11 | | Industrial Internship-II | 0 | 0 | 4w | 2 | 60 | 40 | 100 |
| | | **Total** | **17** | **0** | **8** | **23** | | | |

Note: -

1. Student can opt for any of the Open Elective subject outside from the Parent Institute leading to Holistic development of student. It may include Yoga, Dance, Fashion, Agriculture, Medicine, etc.
2. Hours for open elective may vary as per course but not credits.
3. The Department has liberty to vary Credits of Core Courses Lab but not for Department Electives Lab. The Department Elective Labs are significant. So, there hours not to be reduced.
4. Department Electives must be selected such that they should not have any year-wise dependency.

*2nd Year Core Courses along with 2 Department Elective Courses should make a capsule program with some specialization.

** Students entring directly in 2nd and 3rd year with Certifciate Course and Advanced Certification Course will be given Undergradute Diploma considering their credits of previous courses after successfully completion of 3rd year but the student need to submit his original previous certificate.

**Exit Point**

Advanced Certification Course in Bachelor of Computer Application(AI/ML) and with minor specialization in_____.

**Entry Point**

Undergraduate Diploma in Bachelor of Computer Application (AI/ML) Entry Point in 5th semester.

# Bachelor of Computer Application (AI/ML)

## Semester 5th

| S. No. | Subject Code | Subject Name | L | T | P | C | Internal | External | Total |
|---|---|---|---|---|---|---|---|---|---|
| 1 | | Theory of Computation | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 2 | | Artificial Intelligence | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 3 | | Machine learning and Pattern recognition | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 4 | | Department Electives-III | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 5 | | Open Elective-II | 4 | 0 | 0 | 4 | 40 | 60 | 100 |
| 6 | | Medical informatics | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 7 | | Artificial Intelligence Lab | 0 | 0 | 4 | 2 | 60 | 40 | 100 |
| 8 | | Machine learning and Pattern recognition Lab | 0 | 0 | 2 | 1 | 60 | 40 | 100 |
| 9 | | Department Electives Lab-III | 0 | 0 | 2 | 1 | 60 | 40 | 100 |
| 11 | | Value Addition Course-III | 2 | 0 | 0 | 2 | 40 | 60 | 100 |
| | | **Total** | **21** | **0** | **8** | **25** | | | |

# Bachelor of Computer Application (AI/ML)

## Semester 6th

| S. No. | Subject Code | Subject Name | L | T | P | C | Internal | External | Total |
|---|---|---|---|---|---|---|---|---|---|
| 1 | | Compiler Design | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 2 | | Data Science tools & Techniques | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 3 | | Machine learning with Python, sclkit-learn, Matplotlib, Tensor Flow | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 4 | | Department Electives-IV | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 5 | | Open Elective-III | 4 | 0 | 0 | 4 | 40 | 60 | 100 |
| 6 | | Compiler Design Lab | 0 | 0 | 2 | 1 | 60 | 40 | 100 |
| 7 | | Data Science tools & Techniques Lab | 0 | 0 | 2 | 1 | 60 | 40 | 100 |
| 8 | | Machine learning with Python, sclkit-learn, Matplotlib,Tensor Flow Lab | 0 | 0 | 2 | 1 | 60 | 40 | 100 |
| 9 | | Mandatory Course - III | 2 | 0 | 0 | 2 | 40 | 60 | 100 |
| | | **Total** | **18** | **0** | **6** | **21** | | | |

**Note:-**

1. Student can opt for any of the Open Elective subject outside from the Parent Institute leading to Holistic Development of student. It may include Yoga, Dance, Fashion, Agriculture, Medicine, etc.
2. Hours for open elective may vary as per course but not credits.
3. The Department has liberty to vary Credits of Core Courses Lab but not for Department Electives Lab. The Department Elective Labs are significant. So, there hours not to be reduced.
4. Department Electives must be selected such that they should not have any year-wise dependency.

*3rd Year Core Courses along with 2 Department Elective Courses should make a capsule program with some specialization.

**Exit Point**

Undergraduate Diploma in Bachelor of Computer Application(AIML) with specialization in_____.

**Entry Point**

Degree in Bachelor of Computer Application(AI/ML).

**BCA (AIML)**

Semester I

| | | | | | | |
|---|---|---|---|---|---|---|
| **1. Name of the Department- Computer Science & Engineering** | | | | | | |
| **2. Course Name** | **Discrete Mathematics** | **L** | **T** | | **P** | |
| **3. Course Code** | | **3** | **0** | | **0** | |
| **4. Type of Course (use tick mark)** | | **Core (✓)** | **PE()** | | **OE ()** | |
| **5. Pre-requisite (if any)** | Basic math | **6. Frequency (use tick marks)** | Even () | Odd (✓) | Either Sem() | Every Sem () |
| **7. Total Number of Lectures, Tutorials, Practical (assuming 12 weeks of one semester)** | | | | | | |
| **Lectures = 36** | | **Tutorials = 0** | **Practical = 0** | | | |

**8. Course Description**

Introduction to discrete mathematics and their applications like logic, gate and set theory, recursive programming, digital logic and combinatorial circuits, real number representation and finite automata used in computer science.

**9. Learning Objectives:**

1. To provide basic and theoretical competencies that ismajorly used in Computer Science. To help students understand and appreciate the basic mathematical knowledge which is fundamental to Computer Science.
2. To aware students about computer,its functions and utilities.
3. To promote the development of computer-related skills for immediate application toother curricular areas.
4. To provide a foundation for post-secondaryeducation.
5. To facilitate the development and application of problem-solving skills instudents.

**10. Course Outcomes (COs):**

The students will be able to:-

1. Determination of the logical equivalence of propositions and the validity of formal arguments via truth tables.
2. Design and construction of a combinatorial circuit from a verbal description. Finite automata are able to construct a recognizer simple language.
3. Describe the usage of computers and why computers are essential components in business and society.
4. Identify categories of programs, system software and applications. Organize and workwith files andfolders.

**11. Unit wise detailed content**

| | | |
|---|---|---|
| **Unit-1** | **Number of lectures = 9** | Set Theory |

Set, Subset, Operations on set, Algebra of sets, Venn Diagrams, Multisets, Cartesian Product of sets, Relations: Representation, Compositions & properties of relations, closure properties of relations. Functions: Definition, Domain and Co-domain, Image, range, representation and Types of functions.

| | | |
|---|---|---|
| **Unit – 2** | **Number of lectures = 9** | Graph Theory |

Graph Theory – Definition of (undirected) Graphs, Isomorphic graph, Homeomorphic, Directed, Weighted, Weighted graphs, Representation, types of graph &their properties.
Trees: Types, representation, properties of trees. Algorithms,Binary, Spanning, Minimum spanning trees and Kruskal'sAlgorithm. Dijkstra's Algorithm.

| | | |
|---|---|---|
| **Unit – 3** | **Number of lectures = 9** | Propositional Calculus & probability theory |
| Propositional Calculus: properties, Tautologies, contradiction, contingency, Argument, Existential Quantifier, negation of quantified proposition, properties with multiple quantifier.<br>Probability: Definition, Addition & multiplication theorem, conditional probability. | | |
| **Unit – 4** | **Number of lectures = 9** | Recurrence relations, Generating function & PMI |
| Recurrence relations& Generating function: Particular solution and Total solution.<br>PMI: Principal of Mathematical Inductions, working rule and solutions of problems. | | |

**12. Brief Description of self-learning / E-learning component**

The students will be encouraged to learn using the SGT E-Learning portal and choose the relevant lectures delivered by subject experts of SGT University.

The link to the E-Learning portal.

https://elearning.sgtuniversity.ac.in/course-category/

www.youtube.com/watch?v=7k4Di5u-oUU&index=12&list=PL0862D1A947252D20

www.youtube.com/watch?v=_BIKq9Xo_5A&index=13&list=PL0862D1A947252D20

www.youtube.com/watch?v=RMLR2JHHeWo&list=PL0862D1A947252D20&index=14

www.youtube.com/watch?v=fZqfkJ-cb28&list=PL0862D1A947252D20&index=17

www.youtube.com/watch?v=Fk8nJjzohr8&index=22&list=PL0862D1A947252D20

**13. Books Recommended**

**Text Books**

- Baburam, Discrete Mathematics , Pearson Education 2010

**14. Reference Books**

- Discrete Mathematics , M.K. Venkataraman, The National Publishing Company
- Discrete Mathematical Structures with Applications to Computer Science J.P. Trembly and Manohar, Tata McGraw-Hill Publications.
- Elements of Discrete Mathematics, Liu, Tata Mac Graw Hills.
- Kolman B, Busby R.C. and Ross S., Discrete Mathematical Structures for Computer Science, Fifth Edition, Prentice Hall of India, New Delhi, 2006.

**Semester I**

<table>
<tr><td colspan="8">1. Name of the Department- Computer Science & Engineering</td></tr>
<tr><td>2. Course Name</td><td colspan="2">Computer Fundamentals</td><td>L</td><td>T</td><td colspan="3">P</td></tr>
<tr><td>3. Course Code</td><td colspan="2"></td><td>3</td><td>0</td><td colspan="3">2</td></tr>
<tr><td colspan="2">4. Type of Course (use tick mark)</td><td>Core (✓)</td><td colspan="2">PE()</td><td colspan="2">OE ()</td></tr>
<tr><td>5. Pre-requisite (if any)</td><td colspan="2">Computer Basics</td><td>6. Frequency (use tick marks)</td><td>Even ()</td><td>Odd (✓)</td><td>Either Sem()</td><td>Every Sem ()</td></tr>
<tr><td colspan="8">7. Total Number of Lectures, Tutorials, Practical (assuming 12 weeks of one semester)</td></tr>
<tr><td colspan="3">Lectures = 36</td><td>Tutorials = 0</td><td colspan="4">Practical = 0</td></tr>
<tr><td colspan="8">8. Course Description</td></tr>
<tr><td colspan="8">Course introduces to fundamental concepts of computer; students will learn to use Microsoft office applications: word processing program (MS word), A spreadsheet program (MS Excel) and a presentation program (MS Power point). Course intended for students requiring hands on knowledge of computer applications.</td></tr>
<tr><td colspan="8">10. LearningObjectives:<br>1. To aware students about computer,its functions and utilities.<br>2. To promote the development of computer-related skills for immediate application toother curricularareas.<br>3. To provide a foundation for post-secondaryeducation.<br>4. To facilitate the development and application of problem-solving skills instudents.</td></tr>
<tr><td colspan="8">10. Course Outcomes (COs):</td></tr>
<tr><td colspan="8">The students will be able to:-<br>1. Describe the usage of computers and why computers are essential components in business and society.<br>2. Identify categories of programs, system software and applications. Organize and work with files andfolders.<br>3. Describe various types of networks network standards and communication software.</td></tr>
<tr><td colspan="8">11. Unit wise detailed content</td></tr>
<tr><td>Unit-1</td><td colspan="2">Number of lectures = 9</td><td colspan="5"></td></tr>
<tr><td colspan="8">Introduction to Computers: History of development of Computers , Computer system concepts , Characteristics Capabilities and limitations, Generations of Computers. Von Neumann Architecture, Classification of Computers , Instruction Execution Cycle , Basic Components of a computer system – Control Unit, ALU, I/ O Devices, Memory – RAM, ROM, EPROM, PROM, Flash Memory and other types of memory.<br>Types of Software – System software, Application software, Utility Software, Demoware, Shareware, Freeware, Firmware, Free Software. • Operating Systems – Functions, Types – Batch Processing, Single User, Multi User, Multiprogramming, Multi-Tasking. • Programming languages – Machine, Assembly, High Level, 4 GL. • Data representation in computers. Computer Viruses. Disk Operating System (DOS) • Introduction, History & Versions of DOS. DOS basics • Physical structure of disk, drive name, FAT, file & directory structure and naming rules, booting process</td></tr>
<tr><td>Unit – 2</td><td colspan="2">Number of lectures = 9</td><td colspan="5"></td></tr>
<tr><td colspan="8">PC Maintenance and Troubleshooting: Opening the PC and identification. Study of different blocks, Assembling and disassembling. Basic Device Configuration and Installation-Printers, Microphone, Monitor, Mother Board, Sound Card, Video Card, tips on Trouble Shooting.<br>IntroductiontoComputerHardware,ComponentsofMother-boards&itstypes,Ports,Slots,</td></tr>
</table>

Connectors, add on cards, Power supply units, and cabinet types. Storage devices:Primary & Secondary storage medium. Introduction to servers and network security Types of servers: Files servers, Email Servers, Proxy servers etc. Basics of Internet and Intranet: Types of Internet connections:Dialup,Broadband,LeasedLine,Wi-Fi,Wi-Max,2G,3G,4G,WWW,E-mails, Search Engines, Social Networking. Cloud application. Audio video conferencing, VOIP

| **Unit – 3** | **Number of lectures = 9** | |
|---|---|---|

**Windows:** features of windows — desktop, start menu, control panel, my computer, windows explorer, accessories. Managing multiple windows, arranging icons on the desktop, creating and managing folders, managing files and drives, logging off and shutting down windows. Entertainment – CD Player, DVD Player, Media Player, Sound Recorder, Volume Control..
**MS Word:** Introduction to Word processing, Names of some commonly used word processing software. Introduction to MS-Word: Feature, document creating, formatting, standard toolbar, drawing toolbar, tables and other features. Mail-merge, insertion of files, pictures, clipboard, graphs, print formatting, page numbering and printing documents. Spell Check, Thesaurus, Find & Replace, Inserting Header, Footer, page number & pictures. Working with Tables.

| **Unit – 4** | **Number of lectures = 9** | |
|---|---|---|

**MS-Excel**: Definition And Advantages of Electronic Worksheet, Working On Spreadsheets: Cell Referencing, Range & Related Operations, Setting, Saving And Retrieving Worksheet File, Inserting, Deleting, Copying And Moving of Data Cells, Inserting And Deleting Rows & Columns, Copying, inserting, Renaming the sheet of workbook. General Short-cut commands, Entering text and numeric data, Entering date and time different functions, formatting text and numeric data. Functions and Other Features: Classification and Usage of Various Built-In-Functions In Worksheet, Passwords, Protecting A Worksheet Printing of the worksheet, page margin setting and adding header and footer, Transferring Data to and From Non Worksheet Files, Database handling, Creating names and executing macros, creating graphs
**MS Power Point**:- Auto -wizard, creating a presentation using Auto content wizard, Blank presentation, creating, saving and printing a presentation, adding slide to a presentation, slide view, outline view, slide sorter view, notes view and slide show view. Changing text font and size, selecting text style and color, to set header and footer. Using, bullets, clipart and word art gallery. Applying design template creating graph. Adding transitions and Animation effects, setting timings for slide show preparing note pages, preparing audience handouts

**12. Brief Description of self-learning / E-learning component**
The students will be encouraged to learn using the SGT E-Learning portal and choose the relevant lectures delivered by subject experts of SGT University.
The link to the E-Learning portal.
https://elearning.sgtuniversity.ac.in/course-category/

**13. Books Recommended**

**Text Books**

- P .K. Sinha, Fundamentals of Computers, BPBPublications

**14. Reference Books**


- V. Rajaraman, Fundamentals of Computers, 3rd Edition , PHIPublications
- Anita Goel, Computer Fundamentals, PearsonEducation.
- Computers Today, D. H. Sanders, Fourth Edition, McGraw Hill,1988
- Marmel, Elauue, MS Office Projects 2007, WileyIndia

**Semester I**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **1. Name of the Department- Computer Science & Engineering** | | | | | | | |
| **2. Course Name** | **Entrepreneurship Development** | **L**<br>**3** | | **T**<br>**0** | | **P**<br>**0** | |
| **3. Course Code** | | | | | | | |
| **4. Type of Course (use tick mark)** | | **Core ()** | **EAS(✓)** | **BSC ()** | | | |
| **5. Pre-requisite (if any)** | **Basic Business Studies knowledge** | **6. Frequency (use tick marks)** | | Even () | Odd (✓) | Either Sem () | Every Sem () |
| **7. Total Number of Lectures, Tutorials, Practical (assuming ….. weeks of one semester)** | | | | | | | |
| **Lectures = 36** | | **Tutorials = 0** | | | | | |

**8. Brief Syllabus**

Entrepreneurship Development is a challenging, applicable degree program that integrates management concepts in a technical and innovative setting as required by today's dynamic business environment. It develops graduates with relevant skills preparing students for entry into management careers in business, government, public, or social service organizations. Industry-trained faculty translates theory to practice; advising students through the diversity of the curriculum, project-based learning, and internships.

**9. Learning objectives:**

The objective of the course is to

1. To make the students aware of the importance of entrepreneurship opportunities available in the society for the entrepreneur.
2. Acquaint them with the challenges faced by the entrepreneur.

**10. Course Outcomes (COs):**

Upon completion of this course, graduates will be able to:

1. Explain the major concepts in the functional areas of accounting, marketing, finance, and management.
2. Evaluate the legal, social, and economic environments of business.
3. Describe the global environment of business.
4. Describe and explain the ethical obligations and responsibilities of business.
5. Apply decision-support tools to business decision making.

**11. Unit wise detailed content**

| | | |
|---|---|---|
| **Unit-1** | **Number of lectures = 10** | **Title of the unit: Introduction: Entrepreneur** |
| Evolution, Characteristics, Types, Functions of Entrepreneur - Distinction between an Entrepreneur and a Manager, Concept, Growth of Entrepreneurship in India, Role of Entrepreneurship in Economic Development. Rural Entrepreneurship: Concept, Need, Problems, Rural Industrialization in Retrospect, How to Develop Rural Entrepreneurship, NGOs and Rural Entrepreneurship | | |
| **Unit – 2** | **Number of lectures = 8** | **Title of the unit: Women Entrepreneurship** |
| Concept, functions, Growth of Women Entrepreneurs, Problems, Development of Women Entrepreneurs Small Enterprises: Definition, Characteristics, Relationship between Small and Large Units, Rationale, Objectives, Scope, Opportunities for an Entrepreneurial Career, Role of small Enterprise in Economic development | | |
| **Unit - 3** | **Number of lectures = 8** | **Title of the unit: Project Identification And Selection (PIS)** |
| Meaning of Project, Project Identification, Project Selection, Project Formulation: Meaning, Significance, Contents, Formulation, Project Report, Specimen of a Project Report, | | |
| **Unit - 4** | **Number of lectures = 10** | **Title of the unit: Financing of Enterprises** |
| Need for Financial Planning, Sources of finance, Capital Structure, Term-loan, Sources of Short-Term Finance, | | |

Capitalization, Financial Institutional, Commercial Banks, Other financial institutions

**12. Brief Description of self-learning / E-learning component**

The students will be encouraged to learn using the SGT ELearning portal and choose the relevant lectures delivered by subject experts of SGT University.

The link to the E-Learning portal.

https://elearning.sgtuniversity.ac.in/course-category/Journal papers; Patents in the respective field.

**13. Books Recommended**

**Text Books**

1. Roy Rajeev, Entrepreneurship Oxford Latest Edition
2. E. Gordon & K. Natarajan Entrepreneurship Development Himalaya 2008
3. Coulter Entrepreneurship in Action PHI 2nd Edition

**Reference Books**

1. P. C. Jain Handbook For New Entrepreneur Oxford Latest Edition
2. S. S. Khanka Entrepreneurial Development S. Chand Latest Edition
3. Thomas W. Zimmerer & Norman M. Scarborough Essentials of Entrepreneurship and small business management PHI 4th Edition
4. Dr. Vidya Hattangadi Entrepreneurship Himalaya 2007
5. Vasant Desai Small Scale Industries and Entrepreneurship Himalaya 2008
6. Dr. v. B. Angadi, Dr. H. S. Cheema & Dr. M. R. Das Entrepreneurship, Growth, and Economic IntegrationA linkage Himalaya 2009

**Semester I**

<table>
<tr><td colspan="8">1. Name of the Department:- Computer Science Engineering</td></tr>
<tr><td>2. Course Name</td><td colspan="2">Object Oriented Programming</td><td>L</td><td>T</td><td colspan="2">P</td></tr>
<tr><td>3. Course Code</td><td colspan="2"></td><td>3</td><td>0</td><td colspan="2">2</td></tr>
<tr><td colspan="2">4. Type of Course (use tick mark)</td><td>Core ((✓)</td><td colspan="2">PE()</td><td colspan="2">OE ()</td></tr>
<tr><td>5. Pre-requisite (if any)</td><td>C</td><td>6. Frequency (use tick marks)</td><td>Even ()</td><td>Odd (✓)</td><td>Either Sem()</td><td>Every Sem ()</td></tr>
<tr><td colspan="8">7. Total Number of Lectures, Tutorials, Practical (assuming 14 weeks of one semester)</td></tr>
<tr><td colspan="2">Lectures = 36</td><td>Tutorials = 0</td><td colspan="5">Practical = 0</td></tr>
<tr><td colspan="8">8. Course Description</td></tr>
<tr><td colspan="8">Students learn how to write programs in an object-oriented high level programming language. Topics covered include problem solving, programming concepts, classes and methods, control structures, arrays, and strings.</td></tr>
<tr><td colspan="8">9. Learning Objectives:<br>1. To Know the Basics OfProgramming<br>2. To understand how to use programming in day to dayApplications.</td></tr>
<tr><td colspan="8">10. Course Outcomes (COs):</td></tr>
<tr><td colspan="8">1. Knowledge of programming language.<br>2. Be aware about OOP‘s concept.<br>3. Basic understanding on programming.</td></tr>
<tr><td colspan="8">11. Unit wise detailed content</td></tr>
<tr><td>Unit-1</td><td colspan="2">Number of lectures = 9</td><td colspan="5"></td></tr>
<tr><td colspan="8">Introduction: Object oriented programming, characteristics of object orientated languages, classes, C++ basics: Program Statements, Variables and constants, Loops and Decisions.</td></tr>
<tr><td>Unit – 2</td><td colspan="2">Number of lectures = 9</td><td colspan="5"></td></tr>
<tr><td colspan="8">Functions: Defining a function, function arguments & passing by value, arrays & pointers, function & strings, functions & structures.<br>Classes & Objects: Defining class, class constructors and destructors, operator overloading.</td></tr>
<tr><td>Unit – 3</td><td colspan="2">Number of lectures = 9</td><td colspan="5"></td></tr>
<tr><td colspan="8">Class Inheritance: Derived class & base class; Virtual, Friends and Static functions; Inheritance and its types, Polymorphism.<br>Exception Handling: Try Throw, Catch, Throwing an Exception, Catching an Exception.</td></tr>
<tr><td>Unit – 4</td><td colspan="2">Number of lectures = 9</td><td colspan="5"></td></tr>
<tr><td colspan="8">Function Templates, Overloading Template Functions, Class Template, Class Templates and Non-Type Parameters, Templates and Inheritance, Templates and Friends, Templates and Static Members.<br>Input/output files: Streams, buffers & iostreams, header files, redirection, file input and output</td></tr>
<tr><td colspan="8">12. Brief Description of self-learning / E-learning component<br>The students will be encouraged to learn using the SGT E-Learning portal and choose the relevant lectures delivered by subject experts of SGT University.<br>The link to the E-Learning portal.<br>https://elearning.sgtuniversity.ac.in/course-category/Journal papers; Patents in the respective field.</td></tr>
</table>

**13. Books Recommended**

**Text books:**

1. Object Oriented Programming with C++ by E Balagurusamy, 2001, Tata McGraw-Hill, New Delhi.

**Reference books:**

1. Object Oriented Programming in Turbo C+ + by Robert Lafore, PearsonEducation, NewDelhi.
2. The Complete Reference in C++ by Herbert Schildt, 2002, TMH, NewDelhi.
3. Object Oriented Programming Using C++ by Kamthane, Pearson Education,New Delhi.
4. C + + How to Program by H M Deitel and P J Deitel, 1998, Prentice Hall, India,New Delhi.

**Semester I**

| | | | | | | |
|---|---|---|---|---|---|---|
| **1. Name of the Department:- Computer Science Engineering** | | | | | | |
| **2. Course Name** | **Artificial Intelligence- Present & Future** | **L** | **T** | | **P** | |
| **3. Course Code** | | **3** | **0** | | **0** | |
| **4. Type of Course (use tick mark)** | | **Core ((✓)** | **PE()** | | **OE ()** | |
| **5. Pre-requisite (if any)** | | **6. Frequency (use tick marks)** | Even () | Odd (✓) | Either Sem() | Every Sem () |
| **7. Total Number of Lectures, Tutorials, Practical (assuming 14 weeks of one semester)** | | | | | | |
| **Lectures = 36** | | **Tutorials = 0** | **Practical = 0** | | | |

**8. Course Description**

The course begins with the theoretical understanding of AIML and usage, Ethics present and future.

**10. Learning Objectives:**

1. Learn concepts of current main conceptual frameworks at use in AI
2. Learn the concept of machine learning
3. Learn the various applications of AI

**10. Course Outcomes (COs):**

On completion of this course, the students are expected to learn
1. Uses of AI, Ethics present and future
2. Introduction to Machine Learning
3. Application of AI by domain, Role of AI insociety.

**11. Unit wise detailed content**

| | | |
|---|---|---|
| **Unit-1** | **Number of lectures = 9** | |

Introduction to AI: What is AI, Turing test, cognitive modelling approach, law of thoughts, the relational agent approach, the underlying assumptions about intelligence, techniques required to solve AI problems, level of details required to model human intelligence, successfully building an intelligent problem, history of AI

| | | |
|---|---|---|
| **Unit – 2** | **Number of lectures = 9** | |

**Introduction to Machine Learning:** What is Machine Learning, Learning from Data, History of Machine Learning, Big Data for Machine Learning, Leveraging Machine Learning, Descriptive vs Predictive Analytics, Machine Learning and Statistics, Artificial Intelligence and Machine Learning, Types of Machine Learning – Supervised, Unsupervised, Semi-supervised, Reinforcement Learning, Types of Machine Learning Algorithms, Classification vs Regression Problem, Bayesian,Clustering, Decision Tree, Dimensionality Reduction, Neural Network and Deep Learning, Training machine learningsystems

| | | |
|---|---|---|
| **Unit – 3** | **Number of lectures = 9** | |

**Applications of AI by domain:** Transportation, home/service robots, healthcare, education, low-resource communities, public safety and security, employment and workplace, entertainment, finance, baking and insurance

**AI Research Trends:** Research trends in machine learning, deep learning, reinforcement learning, robotics, computer vision, natural language processing, collaborative systems, algorithmic game theory, internet of things (IoT), neuromorphic computing

| Unit – 4 | Number of lectures = 9 | |
|---|---|---|

**Role of Artificial Intelligence in Society:** Societal challenges AI presents, Ethical and Societal implications, policy and law for AI, fostering dialogue, sharing of best practices

**Malicious Use of AI: Prevention and Mitigation:** Security relevant properties of AI, Security domains and scenarios: digital security, physical security, pollical security, factors affecting the equilibrium of AI and security

**Explainable AI:** Introduction to explainable AI, why explainable AI, interpretability and explain ability, methods of interpretability and explain ability

**Introduction to Data Analytics:** Working with Formula and Functions, Introduction to Charts, Logical functions using Excel, Analyzing Data with Excel.

**12. Brief Description of self-learning / E-learning component**

The students will be encouraged to learn using the SGT E-Learning portal and choose the relevant lectures delivered by subject experts of SGT University.
The link to the E-Learning portal.
https://elearning.sgtuniversity.ac.in/course-category/Journal papers; Patents in the respective field.

**13. Books Recommended**

**Text books:**


1. ArtificialIntelligence3e:A Modern Approach Paperback By Stuart J Russel & Peter Norvig Publisher–Pearson
2. Artificial Intelligence Third Edition By Kevin Knight, Elaine Rich ,B.Nair–McGraw Hill
3. Artificial Intelligence Third Edition By Patrick Henry Winston–Addison-Wesley Publishing Company

**Semester I**

<table>
<tr><td colspan="8">1. Name of the Department- Computer Science & Engineering</td></tr>
<tr><td colspan="2">2. Course Name</td><td>Computer Fundamentals Lab</td><td>L</td><td colspan="2">T</td><td colspan="2">P</td></tr>
<tr><td colspan="2">3. Course Code</td><td></td><td>3</td><td colspan="2">0</td><td colspan="2">2</td></tr>
<tr><td colspan="3">4. Type of Course (use tick mark)</td><td>Core (✓)</td><td colspan="2">PE()</td><td colspan="2">OE ()</td></tr>
<tr><td colspan="2">5. Pre-requisite (if any)</td><td></td><td>6. Frequency (use tick marks)</td><td>Even ()</td><td>Odd (✓)</td><td>Either Sem()</td><td>Every Sem ()</td></tr>
<tr><td colspan="8">7. Total Number of Lectures, Tutorials, Practical (assuming 12 weeks of one semester)</td></tr>
<tr><td colspan="3">Lectures = 0</td><td>Tutorials = 0</td><td colspan="4">Practical = 36</td></tr>
<tr><td colspan="8">8. Course Description: Course introduce to use of Microsoft office applications: word processing program (MS word), A spreadsheet program (MS Excel) and a presentation program (MS Power point). Course intended for students requiring hands on knowledge of computer applications.</td></tr>
<tr><td colspan="8">9. Learningobjectives:<br>1. To aware students about computer,its functions and utilities.<br>2. To promote the development of computer-related skills for immediate application toother curriculararеas.<br>3. To provide a foundation for post-secondaryeducation.<br>4. To facilitate the development and application of problem-solving skills instudents.</td></tr>
<tr><td colspan="8">10. Course Outcomes (COs):</td></tr>
<tr><td colspan="8">The students will be able to<br>1. Describe the usage of computers and why computers are essential components in business and society.<br>2. Identify categories of programs, system software and applications. Organize and workwith files and folders.<br>3. Describe various types of networks network standards and communicationsoftware.</td></tr>
<tr><td colspan="8">11. List of Experiments</td></tr>
<tr><td colspan="8">1. Assembly and disassembly of a Desktop Computer withconnections.<br>2. Operating System Installation-Formatting, Partitioning<br>3. Additional Hardware Installation like printer, mobile, scanner.<br>4. Application Software Installation-MS Office and CD/DVD Writing<br>5. To connect two PC‘s using the interconnecting devices and transfer the data between them.<br>6. To study various connections and ports used in computer communication. PS/2 port and its specification, VGA Port and its specification, Serial port and its specification and applications, Parallel Ports and its specification, USB Port and its specification, RJ45 connector, DVI Monitor port.<br>7. To study various cards used in a Computer System. (Ethernet Card, Sound Card, Video/Graphics Card, Network Interface card ,TV Tuner Card, Accelerator card)<br>8. MS WORD<br>9. Adding text, editing text, finding and replacing text, formatting text, character/line/paragraph spacing, working with styles and text in dentation.<br>10. Saving document with and without password.<br>11. Workingwithpagelayout,pagesetupi.e.settingmargins,changingpagesize,changingpage</td></tr>
</table>

12. orientation and applying page background.
13. Printing a document.
14. Inserting page numbers, headers and footers, footnote, endnote, date and time, pictures, objects, shapesetc.
15. Creating bulleted and numbered lists.
16. Working with tables, paragraphs and columns.
17. Reviewing (track changes, adding comments etc.) and proof reading a document i.e. spell check, grammar etc.
18. Creating and working with table of content.
19. Mail merge.

**MSEXCEL**

1. Entering data, formatting data i.e. applying borders, various formats (currency formats, number formats etc.), fontsetc.
2. Creating custom lists, using auto fill, find and replace and editing text (cut, copy, paste and pastespecial).
3. Working with formulae andfunctions.
4. Applying conditional formatting todata.
5. Sorting and filtering data (auto and advancedfilter).
6. PerformingSubtotals.
7. Working with charts (2D and3D).
8. Adding comments, applying password protection to theworkbook.
9. Working with page layout and printingoptions.

**MSPOWERPOINT**

1. Creating and formatting slides in apresentation.
2. Create a master slide with a logo, footer, andfont.
3. Add notes to eachslide.
4. Insert a graphic orpicture.
5. Implement a background.
6. Place a text box in the title slide with yourname.
7. Insert transitions for each slide.
8. Applying various effects (custom animation and transitional effects) in apresentation.
9. Adjust text alignment in the title slide so it iscentered.
10. Printing the slides of apresentation

**12. Brief Description of self-learning / E-learning**

https://office.live.com/start/Word.aspx

https://office.live.com/start/Excel.aspx

https://office.live.com/start/PowerPoint.aspx

**Semester I**

| | | | | | | |
|---|---|---|---|---|---|---|
| **1. Name of the Department- Computer Science & Engineering** | | | | | | |
| **2. Course Name** | **Object Oriented Programming Lab** | **L** | **T** | | **P** | |
| **3. Course Code** | | **3** | **0** | | **2** | |
| **4. Type of Course (use tick mark)** | | **Core (✓)** | **PE()** | | **OE ()** | |
| **5. Pre-requisite (if any)** | | **6. Frequency (use tick marks)** | Even | Odd (✓) | Either Sem() | Every Sem () |
| **7. Total Number of Lectures, Tutorials, Practical (assuming 14 weeks of one semester)** | | | | | | |
| **Lectures = 0** | | **Tutorials = 0** | **Practical = 36** | | | |
| **8. Course Description** | | | | | | |
| **9. Learning objectives:**<br>1. To understand fundamentals of programming such as variables, conditional and iterative execution, methods etc.<br>2. To understand fundamentals of object-oriented programming in Java, including defining classes, invoking methods, using class libraries etc<br>3. To have the ability to write a computer program to solve specified problems | | | | | | |
| **10. Course Outcomes (COs):**<br>1. Understand the features of C++ supporting object oriented programming<br>2. Understand the relative merits of C++ as an object oriented programming language<br>3. Understand th features of C++ supporting object oriented programmimng<br>4. Understand the relatives merits of C++ as an object oriented programmimg language | | | | | | |
| **11. List of Experiments**<br>1. Simple C++ programs to implement various control structures.<br>a. if statement<br>b. switch case statement and do while loop<br>c. for loop<br>d. while loop<br>2. Programs to understand structure &unions.<br>a. structure<br>b. union<br>3. Programs to understand pointer arithmetic.<br>4. Functions &Recursion.<br>a. recursion<br>b. function<br>5. Inline functions.<br>6. Programs to understand different function call mechanism.<br>a. call by reference<br>b. call by value<br>7. Programs to understand storage specifiers.<br>8. Constructors &destructors.<br>9. Use of –this pointer using class<br>10. Programs to implement inheritance and function overriding.<br>a. multiple inheritance –access specifiers<br>b. hierarchical inheritance – function overriding /virtual Function<br>11. Programs to overload unary & binary operators as member function &non member function.<br>a. unary operator as member function | | | | | | |

b. binary operator as non member f unction

11. Programs to understand friend function & friend Class.
    a. friend Function
    b. friend class
13. Programs on classtemplates
14. Using a C++ program check whether a student passed the exam or not based on total mark which shall be above40%
12. Create a C++ program which takes two distances in inch-feet system and stores in data members of two structure variables. Then, this program calculates the sum of two distances and displaysit.

**12. Brief Description of self-learning / E-learning component**

http://vlabs.iitb.ac.in/vlabs-dev/labs/oops/index.php

**13. Books Recommended**

**Text books:**

1. Object Oriented Programming with C++ by E Balagurusamy, 2001, Tata McGraw-Hill, New Delhi.

**Reference books:**

5. Object Oriented Programming in Turbo C+ + by Robert Lafore, PearsonEducation, NewDelhi.
6. The Complete Reference in C++ by Herbert Schildt, 2002, TMH, NewDelhi.
7. Object Oriented Programming Using C++ by Kamthane, Pearson Education,New Delhi.
8. C + + How to Program by H M Deitel and P J Deitel, 1998, Prentice Hall, India,New Delhi.

**Semester I**

<table>
<tr><td colspan="8">1. Name of the Department : Computer Science & Engineering</td></tr>
<tr><td colspan="2">2. Course Name</td><td colspan="2">Professional Communication Lab</td><td colspan="2">L</td><td>T</td><td>P</td></tr>
<tr><td colspan="2">3. Course Code</td><td colspan="2"></td><td colspan="2">0</td><td>0</td><td>2</td></tr>
<tr><td colspan="3">4. Type of Course (use tick mark)</td><td colspan="2">Core (√)</td><td>PE()</td><td>OE ()</td></tr>
<tr><td colspan="2">5. Pre-requisite (if any)</td><td colspan="2">English at +2 level</td><td colspan="2">6. Frequency (use tick marks)</td><td>Even ()<br>Odd (√)</td><td>Either Sem()<br>Every Sem()</td></tr>
<tr><td colspan="8">7.Total Number of Lectures, Tutorials, Practical (assuming 14 weeks of one semester)</td></tr>
<tr><td colspan="3">Lectures = 36</td><td colspan="2">Tutorials = 0</td><td colspan="3">Practical =</td></tr>
<tr><td colspan="8">8. Course Description<br>The course helps to learn about formal and informal communication, strategies for communication and how to be an advocate for yourself using communications</td></tr>
<tr><td colspan="8">9. Learningobjectives:<br>1. To enhance the communication skills in a effective manner<br>2. To develop communication skills as well as presentation traits<br>3. To emphasizing the Important Words in Context<br>4. To make students competent in professional and technical communication</td></tr>
<tr><td colspan="8">10.Course Outcomes (COs):</td></tr>
<tr><td colspan="8">1. Able to communicate and expand the knowledge of communication.<br>2. Able to communicate in English confidently<br>3. Able to improve pronunciation andaccent<br>4. Able to improve reading and writingskills</td></tr>
<tr><td colspan="8">11.Unit wise course details:</td></tr>
<tr><td>Unit-1</td><td colspan="3">Number of lectures = 09</td><td colspan="4">Title of the unit: Business Communication Skills:</td></tr>
<tr><td colspan="8">Introduction to Communication: Types of Communication, Process of Communication, Functions of Communication, Barriers to Communication and ways to overcome the barriers to communication.</td></tr>
<tr><td>Unit - 2</td><td colspan="3">Number of Lectures= 09</td><td colspan="4">Title of the unit: Conversation Skills & Presentational Skills</td></tr>
<tr><td colspan="8">Strategies for effective presentation, Importance of Body Language in Presentation, Visual Aids, Podium Panic, Pronunciation: Emphasizing the Important Words in Context. Greetings and introducing oneself, Framing questions and answers, Role play, Buying: asking details etc. Word formation strategies, vocabulary building, One word substitution, Antonyms, Synonyms, Homophones, Homonyms.</td></tr>
<tr><td>Unit - 3</td><td colspan="3">Number of lectures = 09</td><td colspan="4">Title of the unit: Reading Comprehension and Pronunciation</td></tr>
<tr><td colspan="8">Simple Passages and Stories, Newspaper and articles clippings, Pronunciation: Syllable and Stress. Sentences: Types , Tenses, Phrases and Clauses, Parts of speech. Formal grammatical categories, Articles, Prepositional phrases, Phrasal verbs</td></tr>
<tr><td>Unit - 4</td><td colspan="3">Number of lectures =09</td><td colspan="4">Title of the unit: Writing Skills</td></tr>
<tr><td colspan="8">Correct the sentences, Letter Writing, Brief introduction to Types of Letter, Format of Letter, Précis Writing, Paragraph Writing, Report Writing, Difference between Report and Proposal</td></tr>
</table>

**12. Brief Description of self learning / E-learning component**

The students will be encouraged to learn using the SGT E-Learning portal and choose the relevant lectures delivered by subject experts of SGT University.

The link to the E-Learning portal:

https://elearning.sgtuniversity.ac.in/course-category/general/

**13. Books Recommended (3 Text Books + 2-3 Reference Books)**


1. ImproveyourWriting,PeopleSkillsForBusiness:EssentialToolstoImproveYour Communication Skills and Relationships at Work. Kindle Edition, Melissa Contreras
2. Fluency In English II, Promodini Varma, Mukti Sanyal, OUP India2006
3. Communication Skills in English, D. G. Saxena and Kuntal Tamang, Top Quark,2011
4. Complete Course in English, Robert J. Dixson PHI Private Limited2009
5. Effective Technical Communication M Asharaf Rizvi Tata McGraw Hill EducationPrivateLimited 2005
6. English Grammar in Context, R K Agnihotri and A L Khanna Ratna Sagar1996
7. Professional Communication, Malti Agrawal Krishna Educational Publishers2013

**SEMESTER-II**

| | | | | | | |
|---|---|---|---|---|---|---|
| **1. Name of the Department- Computer Science & Engineering** | | | | | | |
| **2. Course Name** | **Introduction to Artificial Intelligence & Machine Learning** | **L** | **T** | | **P** | |
| **3. Course Code** | | **3** | **0** | | **0** | |
| **4. Type of Course (use tick mark)** | | **Core (✓))** | **PE()** | | **OE ()** | |
| **5. Pre-requisite (if any)** | | **6. Frequency (use tick marks)** | Even (✓) | Odd () | Either Sem() | Every Sem (2) |
| **7. Total Number of Lectures, Tutorials, Practical (assuming 12 weeks of one semester)** | | | | | | |
| **Lectures = 36** | | **Tutorials = 0** | **Practical = 0** | | | |

**8. Course Description**

This course introduces several fundamental concepts and methods for machine learning. The objective is to familiarize the audience with some basic learning algorithms and techniques and their applications, as well as general questions related to analyzing and handling large data sets.

**9. Learningobjectives:**

1. Ability to identify the characteristics of datasets and compare the trivial data and big data for various applications.
2. Ability to select and implement machine learning techniques and computing environment that are suitable for the applications under consideration.
3. Ability to solve problems associated with batch learning and online learning, and the big data characteristics such as high dimensionality, dynamically growing data and in particular scalability issues.

**10. Course Outcomes (COs):**

1. Understand a wide variety of learning algorithms.
2. Understand how to evaluate models generated from data.
3. Apply the algorithms to a real problem, optimize the models learned and report on the expected accuracy that can be achieved by applying the models.

**11. Unit wise detailed content**

| | | |
|---|---|---|
| **Unit-1** | **Number of lectures = 09** | |

**Introduction:** Basic concepts: Definition of learning systems, Goals and applications of machine learning. Aspects of developing a learning system: training data, concept representation, function approximation.
**Types of Learning:** Supervised learning and unsupervised learning. Overview of classification: setup, training, test, validation dataset, over fitting.
**Classification Families:** linear discriminative, non-linear discriminative, decision trees, probabilistic (conditional and generative), nearest neighbor.

| | | |
|---|---|---|
| **Unit – 2** | **Number of lectures = 09** | |

Logistic regression, Perceptron, Exponential family, Generative learning algorithms, Gaussian discriminant analysis, Naive Bayes, Support vector machines: Optimal hyper plane, Kernels. Model selection and feature selection. Combining classifiers: Bagging, boosting (The Ada boost algorithm), Evaluating and debugging learning algorithms, Classification errors.

| | | |
|---|---|---|
| **Unit – 3** | **Number of lectures = 09** | |

**Unsupervised learning:** Clustering. K-means. EM Algorithm. Mixture of Gaussians. Factor analysis. PCA (Principal components analysis), ICA (Independent components analysis), latent semantic indexing. Spectral clustering, Markov models Hidden Markov models (HMMs).

| **Unit – 4** | **Number of lectures = 09** | |
|---|---|---|

**Reinforcement Learning and Control:** MDPs. Bellman equations, Value iteration and policy iteration, Linear quadratic regulation (LQR). LQG. Q-learning. Value function approximation, Policy search. Reinforce. POMDPs.

**12. Brief Description of self-learning / E-learning component**

The students will be encouraged to learn using the SGT E-Learning portal and choose the relevant lectures delivered by subject experts of SGT University.

**13. Books Recommended**

**Text Books**


1. Tom M Mitchell, Machine Learning, McGraw Hill Education
2. Bishop, C. (2006). Pattern Recognition and Machine Learning. Berlin: Springer-Verlag.
3. Duda, Richard, Peter Hart, and David Stork. Pattern Classification. 2nd ed. New York, NY: WileyInterscience, 2000. ISBN: 9780471056690.
4. Tom M. Mitchell, Machine Learning .ISBN – 9781259096952, McGraw-Hill Series, Edition – First


**Reference Books**


1. Bishop, Christopher. Neural Networks for Pattern Recognition. New York, NY: Oxford University Press, 1995. ISBN: 9780198538646.
2. Introduction to Machine Learning - Ethem Alpaydin, MIT Press, Prentice hall of India.

**SEMESTER-II**

<table>
<tr><td colspan="8">1. Name of the Department- Computer Science & Engineering</td></tr>
<tr><td>2. Course Name</td><td colspan="2">Java Programming</td><td colspan="2">L</td><td colspan="2">T</td><td>P</td></tr>
<tr><td>3. Course Code</td><td colspan="2"></td><td colspan="2">3</td><td colspan="2">0</td><td>2</td></tr>
<tr><td colspan="3">4. Type of Course (use tick mark)</td><td colspan="2">Core (✓))</td><td colspan="2">PE()</td><td>OE ()</td></tr>
<tr><td>5. Pre-requisite (if any)</td><td colspan="2"></td><td colspan="2">6. Frequency (use tick marks)</td><td>Even (✓)</td><td>Odd ()</td><td>Either Sem()</td><td>Every Sem (2)</td></tr>
<tr><td colspan="8">7. Total Number of Lectures, Tutorials, Practical (assuming 12 weeks of one semester)</td></tr>
<tr><td colspan="3">Lectures = 36</td><td colspan="2">Tutorials = 0</td><td colspan="3">Practical = 0</td></tr>
<tr><td colspan="8">8. Course Description<br>This course of study builds on the skills gained by students in Java programming Students will design object-oriented applications with Java and will create Java programs using hands-on,engaging activities</td></tr>
<tr><td colspan="8">10. Learningobjectives:<br>1. This module gives students the skills and knowledge to understand javaprogramming.<br>2. How to write Java code according to Object-Oriented Programmingprinciples<br>3. How to design GUI applications and Applets usingAWT</td></tr>
<tr><td colspan="8">10. Course Outcomes (COs):</td></tr>
<tr><td colspan="8">1. Describe Java concepts<br>2. Identify various datat ypes<br>3. Evaluate various java concept using programs</td></tr>
<tr><td colspan="8">11. Unit wise detailed content</td></tr>
<tr><td colspan="2">Unit-1</td><td colspan="2">Number of lectures = 09</td><td colspan="4"></td></tr>
<tr><td colspan="8">Importance and features of Java: Introduction to JVM ,Language Construct of java including Keywords, constants, variables and looping and decision making construct, Classes and their implementation, Introduction to JVM and its architecture including set of instructions.<br>Introducing classes, objects and methods: defining a class, adding variables and methods, creating objects, constructors, class inheritance.<br>Arrays and String: Creating an array, one and two dimensional arrays, string array and methods</td></tr>
<tr><td colspan="2">Unit – 2</td><td colspan="2">Number of lectures = 09</td><td colspan="4"></td></tr>
<tr><td colspan="8">Exception Handling: Fundamentals exception types, uncaught exceptions, throw, throw, final, built in exception, creating your own exceptions,<br>Multithreaded Programming: Fundamentals, Java thread model: priorities, synchronization, messaging, thread classes, Runnable interface, inter thread Communication, suspending, resuming and stopping threads.</td></tr>
<tr><td colspan="2">Unit – 3</td><td colspan="2">Number of lectures = 09</td><td colspan="4"></td></tr>
<tr><td colspan="8">Input/Output Programming: Basics, Streams, Byte and Character Stream, predefined streams, Reading and writing from console and files. Networking: Basics, networking classes and interfaces, using java.net package, doing TCP/IP and Data-gram Programming, RMI (Remote Method Invocation).</td></tr>
<tr><td colspan="2">Unit – 4</td><td colspan="2">Number of lectures = 09</td><td colspan="4"></td></tr>
<tr><td colspan="8">Event Handling: Different Mechanism, the Delegation Event Model, Event Classes, Event</td></tr>
</table>

Listener Interfaces, Adapter and Inner Classes, Working with windows, Graphics and Text, using AWT controls, Layout managers and menus, handling Image, animation, sound and video, Java Applet.
**The Collection Framework:** The Collection Interface, Collection Classes, Working with Maps & Sets.

**12. Brief Description of self-learning / E-learning component**

The students will be encouraged to learn using the SGT E-Learning portal and choose the relevant lectures delivered by subject experts of SGT University.
The link to the E-Learning portal.
https://elearning.sgtuniversity.ac.in/course-category/

**13. Books Recommended**

**Text Books**

1. Patrick Naughton and Herbertz Schildt, ―Java-2: The Complete Reference‖, TMH, Tenth edition

**Reference Books**

1. E. Balaguruswamy, ‒Programming withJava: APrimer‖,McGraw-Hill; Sixth edition, 2019.
2. Core Java: An Integrated Approach, New: Includes All Versions upto Java 8, R. Nageswara Rao, DreamTech Press, 2016.

**SEMESTER-II**

| | | | | | | |
|---|---|---|---|---|---|---|
| **1. Name of the Department: - Computer Science Engineering** | | | | | | |
| **2. Course Name** | **Basics of Data Structure** | **L** | **T** | | **P** | |
| **3. Course Code** | | **3** | **0** | | **2** | |
| **4. Type of Course (use tick mark)** | | **Core (✓)** | **PE()** | | **OE ()** | |
| **5. Pre-requisite (if any)** | **C Language** | **6. Frequency (use tick marks)** | Even (✓) | Odd () | Either Sem() | Every Sem (2) |
| **7. Total Number of Lectures, Tutorials, Practical (assuming 12 weeks of one semester)** | | | | | | |
| **Lectures = 36** | | **Tutorials = 0** | **Practical = 0** | | | |

**8. Course Description**

The course focuses on basic and essential topics in data structures, including array-based lists, linked lists, hash tables, recursion, binary trees, heaps, sorting algorithms, graphs, and binary tree.

**9. LearningObjectives:**

1. To impart the basic concepts of data structures.
2. To understand concepts about searching and sorting techniques
3. To understand basic concepts about stacks, queues, link lists, trees and graphs.
4. To enable them to write algorithms for solving problems with the help of fundamental data structures

**10. Course Outcomes (COs):**

1. For a given algorithm student will able to analyze the algorithms to determine the time and computation complexity and justify thecorrectness.
2. For a given Search problem (Linear Search and Binary Search) student will able to implementit.
3. For a given problem of Stacks, Queues and linked list student will able to implement it and analyze the same to determine the time and computationcomplexity.
4. Student will able to write an algorithm Selection Sort, Bubble Sort, Insertion Sort, Quick Sort, Merge Sort, Heap Sort and compare their performance in term of Space and Timecomplexity.
5. Student will able to implement Graph search and traversal algorithms and determine thetime and computation complexity

**11. Unit wise detailed content**

| | | |
|---|---|---|
| **Unit-1** | **Number of lectures = 09** | |

An introduction to various types of data structures, various operations associated with each data structure, Implementation of Data Structures. Basic concepts and notations, mathematical notation and functions, algorithmic complexity and time space trade off. Arrays: Types of arrays, Operations on Arrays Creation, Insertion, Deletion.

| | | |
|---|---|---|
| **Unit – 2** | **Number of lectures = 09** | |

Recursion: Introduction, Direct and Indirect Recursion, Tail Recursion, Efficiency of Recursion. Link List: Representation of linked list, Link list operations, Circular Linked List, Multi linked structures, Memory Representation: Fixed Block Storage and Variable Block Storage, Applications of LinkedList Stack: Memory Representation of Stacks via arrays and Linked List, Operations on Stack: Push, pop,Applicationofstack:Infixtopostfixandprefixformsforexpressions,Evaluationofpostfix expressions, Tower of Hanoi Problem.

| Unit – 3 | Number of lectures = 9 | |
|---|---|---|
| Queue: Representation using array and linked List, Operations on Queue, Insertion, deletion, Types of queues, Applications: Simulation etc.<br>Trees: Definitions and basic concepts, linked tree representation, representations in contiguous storage, binary trees and its types, Minimum Spanning Trees, B Tree, B+ Tree: definitions, algorithms and analysis. | | |
| **Unit – 4** | **Number of lectures = 9** | |
| Sorting and Hashing: Objective and properties of different sorting algorithms: Selection Sort, Bubble Sort, Insertion Sort, Quick Sort, Merge Sort, Heap Sort; Performance and Comparison among all the methods, Hashing.<br>Graph: Basic Terminologies and Representations, Graph search and traversal algorithms and complexity analysis. Physical Implementation of Binary Tree in Graph, Applications of Graphs – Shortest Path Problem. | | |
| **12. Brief Description of self-learning / E-learning component**<br>The students will be encouraged to learn using the SGT E-Learning portal and choose the relevant lectures delivered by subject experts of SGT University.<br>The link to the E-Learning portal.<br>https://elearning.sgtuniversity.ac.in/course-category/Journal papers; Patents in the respective field. | | |
| **13. Books Recommended** | | |
| **Text books:**<br>1. –FundamentalsofDataStructures‖,IllustratedEditionbyEllisHorowitz,SartajSahni,Computer SciencePress.<br>2. Seymour Lischutz, Data Structures, McGraw-Hill Book Company, Schaum's OutlineSeries, NewYork.<br><br>**Reference books:**<br>1. Trembley, J.P. and Sorenson P.G. An Introduction to Data Structures withApplications, McGraw-Hill International Student Edition, New York.<br>2. YedidyahLangsam, Moshe J Augernstein and AarsonM.Tanenbaum, Data Structures usingC and C ++, PHI, NewDelhi. | | |

**SEMESTER-II**

| | | | | | | |
|---|---|---|---|---|---|---|
| **1. Name of the Department- Computer Science & Engineering** | | | | | | |
| **2. Course Name** | **Web Development** | **L** | **T** | | **P** | |
| **3. Course Code** | | **3** | **0** | | **2** | |
| **4. Type of Course (use tick mark)** | | **Core (✓)** | **PE()** | | **OE ()** | |
| **5. Pre-requisite (if any)** | | **6. Frequency (use tick marks)** | Even (✓) | Odd () | Either Sem () | Every Sem (2) |
| **7. Total Number of Lectures, Tutorials, Practical (assuming 12 weeks of one semester)** | | | | | | |
| **Lectures = 36** | | **Tutorials = 0** | **Practical = 0** | | | |

**8. Course Description**

Skill development in web programming including mark-up and scripting languages. Introduction to structure and object oriented programming design. Course includes use of XHTML and JavaScript programming languages.

**9. Learningobjectives:**

After going through this course a student should be able to:

1. Use XHTML tags to create simple static webpages
2. format a simple Web page using Cascading Stylesheets
3. state the concepts applicable to web programming; represent data over the Webusing XML
4. appreciate the use of Rich Internet Applications, and perform server side scripting using Java Server Pages(JSP).

**10. Course Outcomes (COs):**

1. To get familiar with the concept of Search EngineBasics.
2. To gain knowledge of Rich Internet ApplicationTechnologies
3. To Learn Web ServiceEssentials
4. To learn different web programminglanguages
5. To be familiarized with Web Analytics 2.0 , Web 3.0 and Semantic webstandards.

**11. Unit wise detailed content**

| **Unit-1** | **Number of lectures = 09** | |
|---|---|---|

**Web 2.0 and XHTML :**What IsWeb 2.0? Introduction toWeb 2.0 terms: Search, Content Networks, Blogging, Social Networking, Social Media, Rich Internet Applications (RIAs), Web Services, Mashups, Widgets and Gadgets, Introduction to XHTML and WML, Syntactic Differences between HTML and XHTML, Standard XHTML Document Structure, An example of XHTML covering Basic Syntax, Images, Hypertext Links, Lists and Tables, Creation of an XHTML Form, Internal Linking and MetaElements.

**Using Style Sheets :**CSS: Inline Styles, Embedded Style Sheets, Linking External Style Sheets, Style Specification Formats Selector Forms, Colour, Property Value Forms, Font Properties, List Properties, Alignment of Text, The Box Model, Background Image ,The  and Tags.

| | | |
|---|---|---|
| **Unit – 2** | **Number of lectures = 09** | |
| **Introduction to XML :**XML Basics, XML Document Structure, XML Namespaces, Document Type Definitions, XML Schemas, Displaying XML Documents.<br>**Introduction to WAP and WML :**WAP and WML Basics, WML formatting and links, , WML variables, Example. | | |
| **Unit – 3** | **Number of lectures = 09** | |
| **JSP – Basic :**Basic JSP Lifecycle, JSP Directives and Elements, Scriptlets, Expressions, Action Elements, Standard Actions, Comments and Template Data, JSP variables, The out Object, Request, response, sessions and application objects.<br>**JSP Application Development :**Example applications using JSP, What is JDBC? Need for JDBC, Database Drivers, Connection using JDBC API. | | |
| **Unit – 4** | **Number of lectures = 09** | |
| **The Server Side Scripting :**Server side scripting and its need ,Two-Tier, Three-Tier, N-Tier and Enterprise Architecture, Various Languages/ Technologies for server scripting ,HTTP Methods (such as GET, POST, HEAD, and so on) , Purpose ,Technical characteristics, Method selection, Use of request and response primitives, Web container – Tomcat. | | |
| **12. Brief Description of self-learning / E-learning component**<br>The students will be encouraged to learn using the SGT E-Learning portal and choose the relevant lectures delivered by subject experts of SGT University.<br>The link to the E-Learning portal.<br>https://elearning.sgtuniversity.ac.in/course-category/ | | |
| **13. Books Recommended** | | |
| **Text Books**<br>Mastering HTML, CSS &Javascript Web Publishing by Lemay Laura<br>**Reference Books**<br>1. XHTML Black Book by Steven Holzner, 2000.<br>2. CGI Programming on the World Wide Web. O'ReillyAssociates.<br>3. Web Technologies By Achyut S Godbole ,AtulKahate, 2003,T.M.H.<br>4. Scott Guelich, ShishirGundararam, Gunther Birzniek; CGI Programing with Perl 2/eO'Reilly.<br>5. Doug Tidwell, James Snell, PavelKulchenko; Programming Web services,O'Reilly<br>6. Intranets by James D.Cimino, 1997, JaicoPubl.<br>7. Internet and Web Technologies – Raj Kamal, 2002, T.M.H. | | |

**SEMESTER-II**

<table>
<tr><td colspan="8">1. Name of the Department: Computer Science Engineering</td></tr>
<tr><td>2. Course Name</td><td colspan="2">Computer Architecture</td><td>L</td><td>T</td><td colspan="3">P</td></tr>
<tr><td>3. Course Code</td><td colspan="2"></td><td>3</td><td>0</td><td colspan="3">0</td></tr>
<tr><td colspan="3">4. Type of Course (use tick mark)</td><td>Core (√)</td><td>PE()</td><td colspan="3">OE()</td></tr>
<tr><td colspan="2">5. Pre-requisite (if any)</td><td></td><td>6. Frequency (use tick marks)</td><td>Even (✓)</td><td>Odd ()</td><td>Either Sem ()</td><td>Every Sem (2)</td></tr>
<tr><td colspan="8">7. Total Number of Lectures, Tutorials, Practical (assuming 12 weeks of one semester)</td></tr>
<tr><td colspan="3">Lectures = 36</td><td>Tutorials = 0</td><td colspan="4">Practical = 0</td></tr>
<tr><td colspan="8">8. Course DescriptionIntroduction to organizational Basic building block diagram of a digital computer system. As the course progresses each major block ranging from Processor to I/O will be discussed in their full architectural detail. The course talks primarily about Computer OrganizationandArchitectureissues,ArchitectureofatypicalProcessor,MemoryOrganization, I/O devices and their interface and System Bus organization etc.</td></tr>
<tr><td colspan="8">9. Learning objectives:<br>1. Provide the skills needed for building computer system for various applications in a career in Computer Science field.<br>2. Learn the concept of adder/subtractor<br>3. Learn the pipelining concept<br>4. Learn the memory organization</td></tr>
<tr><td colspan="8">10. Course Outcomes:<br>1. To understand the basic knowledge of Computer system and its component and functioning of eachcomponents.<br>2. To understand and analyze computer architecture and organization, computer arithmetic, and CPUdesign.<br>3. To understand I/O system and interconnection structures of computersystem.<br>4. To understand and analyze I/O techniques and functioning ofmemory.<br>5. To understand various types of buses in a computer system and illustrate how data transfers is performed.</td></tr>
<tr><td colspan="8">11. Unit wise detailed content</td></tr>
<tr><td>Unit-1</td><td colspan="2">Number of lectures = 9</td><td colspan="5"></td></tr>
<tr><td colspan="8">Functional Modules - Basic operational concepts - Bus structures - Software performance – Memory locations and addresses – Memory operations – Instruction and instruction sequencing – Addressing modes – Assembly language – Basic I/O operations– Stacks and queues.</td></tr>
<tr><td>Unit – 2</td><td colspan="2">Number of lectures =9</td><td colspan="5"></td></tr>
<tr><td colspan="8">Addition and subtraction of signed numbers – Design of fast adders – Multiplication of positive numbers - Signed operand multi-plication and fast multiplication – Integer division – Floating point numbers and operations.</td></tr>
<tr><td>Unit – 3</td><td colspan="2">Number of lectures = 9</td><td colspan="5"></td></tr>
<tr><td colspan="8">Fundamental concepts – Execution of a complete instruction – Multiple bus organization – Hardwired control – Micro programmed control - Pipelining – Basic concepts – Data hazards –Instruction hazards – Influence on Instruction sets – Data path and control consideration – Superscalar operation.</td></tr>
</table>

| | | |
|---|---|---|
| **Unit – 4** | **Number of lectures =9** | |

Basic concepts – Semiconductor RAMs - ROMs – Speed - size and cost – Cache memories - Performance consideration – Virtual memory- Memory Management requirements – Secondary storage.

**12. Brief Description of self learning / E-learning component.**

This learning method gives students to find out their learning capability. Students involve some sort of choice in this learning. As self directed learning learners can determine which modules orscenarios to review again and again.

**13. Books Recommended**

**TextBooks**

1) Computer Organization and Architecture – Designing for Performance - William Stallings, Pearson Education, 9th Edition, 2012.

**14. Reference Books Recommended**


**1)** Computer Organization - Carl Hamacher, ZvonkoVranesic and SafwatZaky, 5thEdition, McGraw- Hill, 2011

**2)** Computer Organisation and Design - Patterson, Elsevier Pub., 4th Edition,2011

**3)** Computer Organization and Design: The hardware / softwareinterface - David A.Patterson and John L.Hennessy, Morgan Kaufmann, 5th Edition, 2010

**4)** Computer Architecture and Organization - John P.Hayes, Tata McGraw Hill,3rdEdition,2017.

**SEMESTER-II**

| | | | | | | |
|---|---|---|---|---|---|---|
| **1. Name of the Department- Computer Science & Engineering** | | | | | | |
| **2. Course Name** | **Medical Measurement and Measuring Instruments** | **L** | **T** | | **P** | |
| **3. Course Code** | | **3** | **0** | | **0** | |
| **4. Type of Course (use tick mark)** | | **Core (✓)** | **EAS(✓)** | | **OE ()** | |
| **5. Pre-requisite (if any)** | Computer Basics | **6. Frequency (use tick marks)** | Even (✓) | Odd () | Either Sem() | Every Sem () |
| **7. Total Number of Lectures, Tutorials, Practical (assuming 12 weeks of one semester)** | | | | | | |
| **Lectures = 36** | | **Tutorials = 0** | **Practical = 0** | | | |

**8. Course Description**

This paper is designed to understand the concept of automation and apply the same in the field of medicine. It lays emphasis on specialized robotic systems and critical surgeries performed by them. Also, it attempts to make better understanding of Quality standards and management methodologies in Biomedical Engineering

**11. LearningObjectives:**

After the completion of the course, the candidate should be able to:

1. Handle the Biomedical Equipments at all levels used in Health care systems, from simple electronic design to highly sophisticated computerized equipments.
2. Supervise the operation and service of the equipments used in Medical field.
3. Guide specialists in various diagnostic and therapeutic procedures by acquiring sound knowledge of the functioning of Human body.
4. To undertake teaching and research in the Biomedical Engineering field.

**10. Course Outcomes (COs):**

At the end of the course the student able to

1. define commonly used technical terms from Medicine and Biomedical Engineering.
2. describe bio-signals that emanate from the body
3. learn the working principles of blood flow meters and Physiological assist devices
4. describe the engineering principles of commonly used medical devices and medical imaging systems
5. realize safety requirements of biomedical instrumentation

**11. Unit wise detailed content**

| | | |
|---|---|---|
| **Unit-1** | **Number of lectures = 9** | |

COMPONENTS OF MEDICAL INSTRUMENTATION SYSTEMS: Basic Medical Instrumentation System, Static and dynamic characteristics of medical instruments, Bio-signals and characteristics. Problems encountered with measurements from human beings. BIO-POTENTIAL ELECTRODES AND PHYSIOLOGICAL TRANSDUCERS: Electrode potential, Electrode equivalent circuit, Types of Electrodes-Surface Electrodes, Needle Electrodes, Micro Electrodes. Pressure transducers, Transducers for body temperature measurement

| | | |
|---|---|---|
| **Unit – 2** | **Number of lectures = 9** | |

BIO-SIGNAL ACQUISITION: Electrical Conduction system of the heart, Block diagram Of Electrocardiograph , ECG leads, Einthoven triangle, ECG amplifier, EEG 10-20 lead system, Specifications and Interpretation of ECG,EEG,EMG.

| **Unit – 3** | **Number of lectures = 9** | |
|---|---|---|

BIO-SIGNAL MEASUREMENTS: Blood flow meters- Electromagnetic blood flow meter, Ultrasonic Doppler blood flow meter. Blood pressure measurement- Ultrasonic blood pressure monitoring. PHYSIOLOGICAL ASSIST DEVICES & THERAPEUTIC EQUIPMENT: Pacemakers- External & internal, Defibrillators- External & internal, Hemodialysis machine.

| **Unit – 4** | **Number of lectures = 9** | |
|---|---|---|

OPERATION THEATRE EQUIPMENT: Spirometry, Pnemuotachograph, Ventilators MONITORING EQUIPMENT: Arrhythmia Monitor, Foetal Monitor, and Incubator. MEDICAL IMAGING EQUIPMENT: X-ray generation, X-ray tube, X-ray machine, Computed Tomography (CT), Ultrasound
PATIENT SAFETY: Electric shock hazards – Leakage currents – Test instruments for checking safety parameters of biomedical equipments.

**12. Brief Description of self-learning / E-learning component**

The students will be encouraged to learn using the SGT E-Learning portal and choose the relevant lectures delivered by subject experts of SGT University.
The link to the E-Learning portal.
https://elearning.sgtuniversity.ac.in/course-category/

**13. Books Recommended**

**Text Books**

- R.S. Khandpur, “Hand-book of Biomedical Instrumentation”, TMH, 2nd Ed., 2003

**14. Reference Books**

- Leslie Cromwell and F.J. Weibell, E.A. Pfeiffer, “Biomedical Instrumentation and Measurements”, PHI, 2nd ed, 1980. [3] “Bio-Medical Electronics and Instrumentation”, Onkar N. Pandey, Rakesh Kumar, Katson Books. REFERENCES: [1] John G. Webster, “Medical Instrumentation, Application and Design”,John Wiley, 3rd ed., 2009. [2] Dr. M. Arumugam, “Biomedical Instrumentation”, Anuradha publications, 2nd ed., 1994.

**SEMESTER-II**

<table>
<tr><td colspan="8">1. Name of the Department- Computer Science & Engineering</td></tr>
<tr><td colspan="2">2. Course Name</td><td colspan="2">Java Programming Lab</td><td colspan="2">L</td><td colspan="2">T</td><td>P</td></tr>
<tr><td colspan="2">3. Course Code</td><td colspan="2"></td><td colspan="2">3</td><td colspan="2">0</td><td>2</td></tr>
<tr><td colspan="3">4. Type of Course (use tick mark)</td><td colspan="2">Core (✓))</td><td colspan="2">PE()</td><td colspan="2">OE ()</td></tr>
<tr><td colspan="2">5. Pre-requisite (if any)</td><td colspan="2"></td><td colspan="2">6. Frequency (use tick marks)</td><td>Even (✓)</td><td>Odd ()</td><td>Either Sem()</td><td>Every Sem ()</td></tr>
<tr><td colspan="9">7. Total Number of Lectures, Tutorials, Practical (assuming 12 weeks of one semester)</td></tr>
<tr><td colspan="3">Lectures = 0</td><td colspan="3">Tutorials = 0</td><td colspan="3">Practical = 36</td></tr>
<tr><td colspan="9">8. Course Description<br>The course emphasis programming in the Java programming language and knowledge of object-oriented paradigm in the Java programming language make the students expertise the use of Java in a variety of technologies and on different platforms.</td></tr>
<tr><td colspan="9">9. Learningobjectives:<br>1. How to write Java code according to Object-Oriented Programmingprinciples<br>2. How to design GUI applications and Applets usingAWT</td></tr>
<tr><td colspan="9">10. Course Outcomes (COs):</td></tr>
<tr><td colspan="9">1. Describe Javaconcepts<br>2. Identify various datatypes<br>3. Evaluate various java concept usingprograms</td></tr>
<tr><td colspan="9">11. List of Experiments</td></tr>
<tr><td colspan="9">1. Make a java Program to check even or OddNumber<br>2. Implement Function overloadingconcept.<br>3. Fibonacci Series in Java<br>4. Prime Number Program inJava<br>5. Palindrome Program inJava<br>6. Factorial Program inJava<br>7. Write a program to implement the concept of inheritance having a base class representinga person, derived from this class make two classes, one about the students and other about employees. Input & output this information about students &employees.<br>8. Create an Applet Creating Thread which will move a StringContinuously.<br>9. Make a program using applets which will handle mouse events on clientside.<br>10. Make a program using applets which will handle key events on clientside.<br>11. Make a program using servlets and a web page using HTML so as to print thedynamic response from the servlets when the web page issubmitted.<br>List of projects:<br>• Payment Billing<br>• Library Management System<br>• Fee Management</td></tr>
<tr><td colspan="9">12. Brief Description of self-learning / E-learning component<br><br>The students will be encouraged to learn using Virtual Link.</td></tr>
</table>

**SEMESTER-II**

<table>
<tr><td colspan="8">1. Name of the Department:- Computer ScienceEngineering</td></tr>
<tr><td>2. Course Name</td><td colspan="2">Basics of Data Structure Lab</td><td>L</td><td>T</td><td colspan="2">P</td></tr>
<tr><td>3. Course Code</td><td colspan="2"></td><td>3</td><td>0</td><td colspan="2">2</td></tr>
<tr><td colspan="2">4. Type of Course (use tick mark)</td><td colspan="2">Core (✓)</td><td colspan="2">PE()</td><td>OE ()</td></tr>
<tr><td>5. Pre-requisite (if any)</td><td colspan="2"></td><td>6. Frequency (use tick marks)</td><td>Even (✓)</td><td>Odd ()</td><td>Either Sem()</td><td>Every Sem ()</td></tr>
<tr><td colspan="8">7. Total Number of Lectures, Tutorials, Practical (assuming 14 weeks of one semester)</td></tr>
<tr><td colspan="3">Lectures = 0</td><td colspan="2">Tutorials = 0</td><td colspan="3">Practical = 42</td></tr>
<tr><td colspan="8">8. Course Description</td></tr>
<tr><td colspan="8">The course focuses on basic and essential topics in data structures, including array-based lists, linked lists, hash tables, recursion, binary trees, heaps, sorting algorithms, graphs, and binary tree.</td></tr>
<tr><td colspan="8">9. Learningobjectives:<br>1. To impart the basic concepts of data structures andalgorithms.<br>2. To understand concepts about searching and sortingtechniques<br>3. To understand basic concepts about stacks, queues, link list, trees andgraphs.<br>4. To enable them to write algorithms for solving problems with the help of fundamental data structures</td></tr>
<tr><td colspan="8">10. Course Outcomes (COs):<br>1. For a given algorithm student will able to analyze the algorithms to determine the time and computation complexity and justify thecorrectness.<br>2. For a given Search problem (Linear Search and Binary Search) student will able to implement it.<br>3. For a given problem of Stacks, Queues and linked list student will able to implement it and analyze the same to determine the time and computationcomplexity.<br>4. Student will able to write an algorithm Selection Sort, Bubble Sort, Insertion Sort, Quick Sort, Merge Sort, Heap Sort and compare their performance in term of Space and Timecomplexity.<br>5. Student will able to implement Graph search and traversal algorithms and determinethe time and computationcomplexity</td></tr>
<tr><td colspan="8">11.List of Experiments<br>1. Revision of programs of Data Structures from pervious semester: Sorting and Searching Techniques.<br>2. Write a Program to Implement Bubble Sort usingRecursion<br>3. Write a Program to Implement Insertion Sort usingRecursion<br>4. Write a Program to Implement Selection Sort usingRecursion<br>5. Write a Program to Implement Linear Search usingRecursion<br>6. Write a Program to Implement a Linked List<br>7. Write a Program to Implement a Doubly LinkedList<br>8. Write a Program to Implement aStack.<br>9. Write a Program to Implement a Queuedynamically<br>10. Write a Program to Implement a Circular LinkedList</td></tr>
</table>

**11.** Write a Program to Implement Binary SearchTree
**12.** Write a Program to ImplementInorder
**13.** Write a Program to implementPostorder
**14.** Write a Program to implement Preorder
**15.** Write a Program to implementHeapsort
**16.** Write a program to implement Breadth Firstsearch
**17.** Write a program to implement Depth Firstsearch
**18.** Write a Program to implement Dijkstra‘sAlgorithm

**SEMESTER-II**

| **Name of the Department- Computer Science & Engineering** | | | | | | |
|---|---|---|---|---|---|---|
| **1.Course Name** | **Web Development Lab** | **L** | **T** | | **P** | |
| **2. Course Code** | | **3** | **0** | | **2** | |
| **3. Type of Course (use tick mark)** | | **Core (✓)** | **PE()** | | **OE ()** | |
| **4. Pre-requisite (if any)** | | **5. Frequency (use tick marks)** | Even (✓) | Odd () | Either Sem() | Every Sem () |
| **6. Total Number of Lectures, Tutorials, Practical (assuming 12 weeks of one semester)** | | | | | | |
| **Lectures = 0** | | **Tutorials = 0** | **Practical = 28** | | | |

**7. Course Description:**

Skill development in web programming including mark-up and scripting languages. Introduction to structure and object oriented programming design. Course includes use of XHTML and JavaScript programming languages.

**8. Learningobjectives:**

1. Design and implement dynamic websites with good aesthetic sense of designing andlatest technical know-how's.
2. Have a Good grounding of Web Application Terminologies, Internet Tools, E – Commerce and other web services.
3. Get introduced in the area of Online Game programming.

**9. Course Outcomes (COs):**

1. WEBBASICS: Design web pages through coding using HTML and DHTML.
2. Integrated Development Tool:Frontpage2000/Dreamweaver
3. BROWSER SIDE SCRIPTING using JavaScript with a focus on
4. Event Handling and Validation
5. SERVER SIDESCRIPTING:
6. PHP SYNTAX, variables, loops and constructs.
7. JAVAGRAPHICS

**10. List of Experiments**

1. Create a Web Page using basic tags in html5
2. Write a program to create all types of list inHTML
3. Create a table using Html 5 andCSS
4. Write a program using labels, radio buttons, and submitbuttons
5. Create a simple webpage usingHTML
6. Use frames to Include Images andVideos.
7. Add a Cascading Style sheet for designing the webpage.
8. Design a web page with validation usingJavaScript.
9. How to make all fields of a form mandatory in javascript
10. Create a registration form and validate it using javascript
11. Write a program to maintain session inPHP
12. Perform data base connectivity inPHP

11. Create a dynamic web page usingPHP

**11. Brief Description of self-learning / E-learning component**

https://html-iitd.vlabs.ac.in/

**SEMESTER-III**

| **1. Name of the Department- Computer Science Engineering** | | | | | | |
|---|---|---|---|---|---|---|
| **2. Course Name** | **Database Management Systems** | **L** | **T** | | **P** | |
| **3. Course Code** | | **3** | **0** | | **2** | |
| **4. Type of Course (use tick mark)** | | **Core (✓)** | **PE()** | | **OE ()** | |
| **5. Pre-requisite (if any)** | **Workshop Technology** | **6. Frequency (use tick marks)** | Even () | Odd (✓) | Either Sem() | Every Sem () |
| **7. Total Number of Lectures, Tutorials, Practical (assuming 12 weeks of one semester)** | | | | | | |
| **Lectures = 36** | | **Tutorials = 0** | **Practical = 0** | | | |

**8. Course Description**

The course, Database Management Systems, provides an introduction to the management of database systems. The course emphasizes the understanding of the fundamentals of relational systems including data models, database architectures, and database manipulations. The course also provides an understanding of new developments and trends such as Internet database environment and data warehousing. The course uses a problem-based approach to learning

**9. Learningobjectives:**

1. To understand the different issues involved in the design and implementation of a database system.
2. To study the physical and logical database designs, database modeling, relational, hierarchical, and networkmodels
3. To understand and use data manipulation language to query, update, and manage adatabase
4. To develop an understanding of essential DBMS concepts such as: database security,integrity,
5. concurrency, distributed database, and intelligent database, Client/Server (Database Server), Data Warehousing.
6. To design and build a simple database system and demonstrate competence with the fundamental tasks involved with modeling, designing, and implementing aDBMS

**10. Course Outcomes (COs):** On completion of the course,

1. Foragivenquerywriterelationalalgebraexpressionsforthatqueryandoptimizethe
   a. developed expressions
2. For a given specification of the requirement design the databases using E-R method and normalization.
3. For a given query optimize its execution using Query optimizationalgorithms

**11. Unit wise detailedcontent**

| **Unit-1** | **Number of lectures = 09** | |
|---|---|---|

Introduction: Overview of Database Management System: Various views of data Models, Schemes and Introduction to database Languages & Environments, Advantages of DBMS over file processing systems, Responsibility of Database Administrator. Three level architecture of Database Systems: Introduction to client/Server architecture. Data Models: E-R Diagram (Entity Relationship), mapping Constraints, keys, Reduction of E-R diagram into tables.

| **Unit – 2** | **Number of lectures = 09** | |
|---|---|---|
| Network & Hierarchical Models, File Organization: Sequential File, index sequential files, direct files, Hashing, B-trees Index files, Inverted Lists, Relational Models, Relational Algebra & various operations (set operations, select, project, join, division), Order, Relational calculus: Domain, Tuple, Well Formed Formula, specification, quantifiers, Introduction to Query Language,QBE | | |
| **Unit – 3** | **Number of lectures = 09** | |
| Integrity constrains, functional dependencies & Normalization, 1st, 2nd, 3rd and BCNF. Introduction to Distributed Data processing, Concurrency control: Transactions, Time stamping, Lock-based Protocols. | | |
| **Unit – 4** | **Number of lectures = 09** | |
| Database recovery.Database Security: Authentication, Authorization and access control, DAC, MAC and RBAC models | | |
| | | |

**12. Brief Description of self-learning / E-learning component**

The students will be encouraged to learn using the SGT E- Learning portal and choose the relevant lectures delivered by subject experts of SGT University.

The link to the E-Learning portal.

https://elearning.sgtuniversity.ac.in/course-category/Journal papers; Patents in the respective field.

**13. Books Recommended**

**Text book:**

1.–DatabaseSystemConcepts‖,6thEdition byAbrahamSilberschatz,HenryF.Korth,S.Sudarshan, McGraw-Hill.

**Reference books:**

1 –Principlesof Databaseand Knowledge–BaseSystems‖, Vol 1 byJ. D.Ullman, Computer Science Press.

2 –Fundamentals of DatabaseSystems‖, 5th Edition byR. Elmasri and S.Navathe, Pearson Education 3 –Foundations of Databases‖, Reprint by Serge Abiteboul, Richard Hull, Victor Vianu, Addison-Wesley

**SEMESTER-III**

<table>
<tr><td colspan="8">1. Name of the Department- Computer Science & Engineering</td></tr>
<tr><td>2. Course Name</td><td colspan="2">Software Engineering</td><td>L</td><td colspan="2">T</td><td colspan="2">P</td></tr>
<tr><td>3. Course Code</td><td colspan="2"></td><td>3</td><td colspan="2">0</td><td colspan="2">2</td></tr>
<tr><td colspan="3">4. Type of Course (use tick mark)</td><td>Core (✓)</td><td colspan="2">PE()</td><td colspan="2">OE ()</td></tr>
<tr><td colspan="2">5. Pre-requisite (if any)</td><td></td><td>6. Frequency (use tick marks)</td><td>Even ()</td><td>Odd (✓)</td><td>Either Sem()</td><td>Every Sem ()</td></tr>
<tr><td colspan="8">7. Total Number of Lectures, Tutorials, Practical (assuming 12 weeks of one semester)</td></tr>
<tr><td colspan="3">Lectures = 36</td><td colspan="2">Tutorials = 0</td><td colspan="3">Practical = 0</td></tr>
<tr><td colspan="8">8. Course Description</td></tr>
<tr><td colspan="8">In this course, new software models, techniques and technologies to bring out innovative and novelistic solutions for the growth of the society in all aspects and evolving into their continuous professional development.</td></tr>
<tr><td colspan="8">Learning objectives:<br>1. To Know the Basics of SoftwareArchitecture.<br>2. To Understand various phases of Software DevelopmentCycle.</td></tr>
<tr><td colspan="8">9. Course Outcomes (COs):</td></tr>
<tr><td colspan="8">1. Students will be able perform various life cycle activities like Analysis,Design,<br>2. Implementation, Testing and Maintenance.<br>3. Students will be able to know various processes used in all the phases of theproduct<br>4. Students can apply the knowledge, techniques, and skills in the development of a software product.</td></tr>
<tr><td colspan="8">10. Unit wise detailed content</td></tr>
<tr><td>Unit-1</td><td colspan="2">Number of lectures = 09</td><td colspan="5"></td></tr>
<tr><td colspan="8">Software: Characteristics, Components, Applications, And Software Process Models: Waterfall, Spiral, Prototyping, Fourth Generation Techniques, Concepts of Project Management, Role of Metrics & Measurements.</td></tr>
<tr><td>Unit – 2</td><td colspan="2">Number of lectures = 09</td><td colspan="5"></td></tr>
<tr><td colspan="8">Project Planning: Objectives, Decomposition techniques: S/W Sizing, Problem-based estimation, Process based estimation, Cost Estimation Models: COCOMO Model,The S/W Equation, System Analysis: Principles of Structured Analysis, Requirementanalysis, DFD, Entity Relationship diagram,Data dictionary.</td></tr>
<tr><td>Unit – 3</td><td colspan="2">Number of lectures = 09</td><td colspan="5"></td></tr>
<tr><td colspan="8">Design: Objectives, Principles, Concepts, Design methodologies: Data design, Architectural design, procedural design, Object -oriented concepts</td></tr>
<tr><td>Unit – 4</td><td colspan="2">Number of lectures = 09</td><td colspan="5"></td></tr>
<tr><td colspan="8">Testing fundamentals: Objectives, principles, Testability, Test cases: White box & Black box testing, Testing strategies: verification & validation, unit test, integration testing, validation testing, system testing.</td></tr>
</table>

**11. Brief Description of self-learning / E-learning component**

https://elearning.sgtuniversity.ac.in/course-category/Software engineering

**12. Books Recommended**

**Text Books**

**1.** Software Engineering - A Practitioner‟s Approach, Roger S. Pressman, MGH, NEW DELHI., NEW DELHI. Publications, New Delhi.

**Reference Books**

1. Fundamentals of Software Engineering, Rajib Mall, PHI, New Delhi.

2. An Integrated Approach to Software Engineering by PankajJalote, Narosa Publications, New Delhi.

**SEMESTER-III**

| **1. Name of the Department- Computer Science & Engineering** | | | | | | |
|---|---|---|---|---|---|---|
| **2. Course Name** | **Programming Language – Python** | **L** | **T** | | **P** | |
| **3. Course Code** | | **3** | **0** | | **2** | |
| **4. Type of Course (use tick mark)** | | **Core (✓)** | **PE()** | | **OE ()** | |
| **5. Pre-requisite (if any)** | | **6. Frequency (use tick marks)** | Even () | Odd (✓) | Either Sem() | Every Sem () |
| **7. Total Number of Lectures, Tutorials, Practical (assuming 12 weeks of one semester)** | | | | | | |
| **Lectures = 36** | | **Tutorials = 0** | **Practical = 0** | | | |

**8. Course Description**

The course begins with the concepts of Python Programming Language with Libraries

**Learning objectives:**

1. The Learn the concepts of Python Programming Language with Libraries.
2. To Learn different libraries Numpy,Pandas
3. To Learn the use of DataAnalysis

**9. Course Outcomes (COs):**

On completion of this course, the students are expected to learn

1. Python programming, Data Structure.
2. Learn Libraries Numpy,Pandas with the use of DataAnalysis.

**10. Unit wise detailed content**

| **Unit-1** | **Number of lectures = 09** | |
|---|---|---|

**Python programming Basic:** Python interpreter, IPython Basics, Tab completion, Introspection, %run command, magic commands, matplotlib integration, python programming, language semantics, scalar types. Control flow

**Data Structure, functions, files:** tuple, list, built-in sequence function, dict, set, functions, namescape, scope, local function, returning multiple values, functions are objects, lambda functions, error and exception handling, file and operation systems

| **Unit – 2** | **Number of lectures = 09** | |
|---|---|---|

**NumPy: Array and vectorized computation:** Multidimensional array object. Creating ndarrays, arithmetic with numpy array, basic indexing and slicing, Boolean indexing, transposing array and swapping axes, universal functions, array-oriented programming with arrays, conditional logic as arrays operations, file input and output with array

**Pandas:** Pandas data structure, series, DataFrame, Index Object, Reindexing, dropping entities from an axis, indexing, selection and filtering, integer indexes, arithmetic and data alignment, function application and mapping, soring and ranking, correlation and covariance, unique values, values controls and membership, reading and writing data in text format

| **Unit – 3** | **Number of lectures = 09** | |
|---|---|---|

**Visualization with Matplotlib:** Figures and subplots, colors, markers, line style, ticks, labels, legends, annotation and drawing on sublots, matplotlib configuration

| Unit – 4 | Number of lectures = 09 | |
|---|---|---|
| **Plotting with pandas and seaborn:** line plots, bar plots, histogram, density plots, scatter and point plots, facet grids and categorical data | | |
| **11. Brief Description of self-learning / E-learning component**<br><br>https://elearning.sgtuniversity.ac.in/course-category/Software engineering | | |
| **12. Books Recommended** | | |
| **Text Books**<br><br>• **1.** Learning Python: Powerful Object-Oriented Programming by Lutz M - Shroff; Fifth edition<br>• Python: The Complete Reference by Martin C. Brown - McGraw Hill Education; Forth edition<br>**Reference Books**<br><br>1. Pandas for Everyone: Python Data Analysis by Daniel Y. Chen - Pearson Education; First edition | | |

**SEMESTER-III**

| | | | | | | |
|---|---|---|---|---|---|---|
| **1. Name of the Department- Computer Science & Engineering** | | | | | | |
| **2. Course Name** | **Database Management System lab** | **L** | **T** | | **P** | |
| **3. Course Code** | | **3** | **0** | | **2** | |
| **4. Type of Course (use tick mark)** | | **Core (✓)** | **PE()** | | **OE ()** | |
| **5. Pre-requisite (if any)** | | **6. Frequency (use tick marks)** | Even () | Odd (✓) | Either Sem() | Every Sem () |
| **7. Total Number of Lectures, Tutorials, Practical (assuming 12 weeks of one semester)** | | | | | | |
| **Lectures = 0** | | **Tutorials = 0** | **Practical = 28** | | | |
| **8. Course Description:** Learn the database queries on RDBMS Package | | | | | | |

**9. Learning objectives:**

1. To describe the basics of SQL and construct queries using SQL.
2. Learn DDL, DML and DCL Command
3. Learn the concept of database keys
4. Learn subqueries

**10. Course Outcomes (COs):**

Upon completion of the course:

1. To describe the basics of SQL and construct queries using SQL.
2. Learn DDL, DML and DCL Command
3. Learn the concept of database keys
4. Learn subqueries

**11. List of Experiments**

1. Creating Database
   i. Creating a Database
   ii. Creating aTable
   iii. Specifying Relational Data Types
2. Table and Record Handling
   i. INSERT statement
   ii. Using SELECT and INSERT together
   iii. DELETE, UPDATE, TRUNCATE statements
   iv. DROP, ALTER statements
3. Indexes
   Create index, Drop Index and unique option
4. Integrity Constraints
   Primary Key, Referential ,Domain and Check Constraints
5. Retrieving Data from a Database
   i. The SELECT statement
   ii. Using the WHERE clause
   iii. Using Logical Operators in the WHERE clause
6. SQL functions
7. Advanced SQL functions
8. Using IN, BETWEEN, LIKE (pattern matching)operator
9. GROUP BY and GROUP BY functions
10. Subqueries
    Basic, multiple column, sub queries with having, correlated sub queries
11. Retrieving data from multiple columns
    Joining table (Inner Join, Outer Join, Equi Join, Non-Equi join) , Aliasing for table name
12. DCLstatements

**13. Brief Description of self-learning / E-learning component**

http://vlabs.iitb.ac.in/bootcamp/labs/dbms/exp8/exp/index.php

**SEMESTER-III**

| **1.Name of the Department- Computer Science Engineering** | | | | | | |
|---|---|---|---|---|---|---|
| **2.Course Name** | **Software Engineering Lab** | **L** | **T** | | **P** | |
| **3.Course Code** | | **3** | **0** | | **2** | |
| **4.Type of Course (use tick mark)** | | **Core (✓)** | **PE()** | | **OE()** | |
| **5.Pre-requisite (if any)** | | **6.Frequency (use tick marks)** | Even () | Odd (✓) | Either Sem () | Every Sem () |
| **7.Total Number of Lectures, Tutorials, Practical (assuming 12 weeks of one semester)** | | | | | | |
| **Lectures = 0** | | **Tutorials = 0** | **Practical = 48** | | | |

**8.Course Description**

This course focuses on providing hands-on experience in designing and developing large-scale software systems with emphasis on the use of automated analysis tools and techniques that enable large-scale software development.

**9. Learningobjectives**

- **I.** The program will prepare our students to be successful professionals in the field with solid fundamental knowledge of software engineering.
- **II.** Be successful professionals in the field with solid fundamental knowledge of software engineering
- **III.** Utilize and exhibit strong communication and interpersonal skills, as well as professionaland ethical principles when functioning as members and leaders of multi-disciplinary teams
- **IV.** Apply their foundations in software engineering to adapt to readily changing environments using the appropriate theory, principles and processes

**10.Course Outcomes (COs):**

| | |
|---|---|
| **I.** | An ability to apply knowledge of mathematics, science, and engineering. |
| **II.** | An ability to design and conduct experiments, as well as to analyze and interpret data. |
| **III.** | An ability to function on multi-disciplinary teams. |
| **IV.** | An ability to identify, formulates, and solves engineering problems. |
| **V.** | An understanding of professional and ethical responsibility. |

**List of Experiments**

1. Write down the problem statement for a suggested system of relevance.
2. Do requirement analysis and develop Software Requirement Specification Sheet (SRS) for suggested system.
3. To perform the function-oriented diagram: Data Flow Diagram (DFD) and Structured chart.
4. To perform the user_s view analysis for the suggested system: Use case diagram
5. To draw the structural view diagram for the system: Class diagram, object diagram.
6. To draw the behavioral view diagram : State-chart diagram, Activity diagram
7. To perform the behavioral view diagram for the suggested system : Sequence diagram, Collaboration diagram
8. To perform the implementation view diagram: Component diagram for the system.
9. To perform the environmental view diagram: Deployment diagram for the system.
10. To perform various testing using the testing tool unit testing, integration testing for a sample code of the suggested system.
11. Perform Estimation of effort using FP Estimation for chosen system
12. To prepare time line chart/Gantt Chart/PERT Chart for selected software project.

**SEMESTER-III**

<table>
<tr><td colspan="8">1. Name of the Department: Computer Science Engineering</td></tr>
<tr><td>2. Course Name</td><td colspan="2">Programming Language – Python Lab</td><td>L</td><td colspan="2">T</td><td colspan="2">P</td></tr>
<tr><td>3. Course Code</td><td colspan="2"></td><td>3</td><td colspan="2">0</td><td colspan="2">2</td></tr>
<tr><td colspan="2">4. Type of Course (use tick mark)</td><td>Core (√ )</td><td colspan="2">PE()</td><td colspan="2">OE()</td></tr>
<tr><td>5. Pre-requisite (if any)</td><td colspan="2"></td><td>6. Frequency (use tick marks)</td><td>Even ()</td><td>Odd (√)</td><td>Either Sem ()</td><td>Every Sem ()</td></tr>
<tr><td colspan="8">7. Total Number of Lectures, Tutorials, Practical (assuming 12 weeks of one semester)</td></tr>
<tr><td colspan="3">Lectures = 00</td><td>Tutorials = 0</td><td colspan="4">Practical = 24</td></tr>
<tr><td colspan="8">8.Course Description Python is next generation multi-purpose programming language that allows different users to create applications of various domains. Students will be able to learn primary fundamentals of python programming and potential of python is to achieve modern computing requirements.</td></tr>
<tr><td colspan="8">9. Learningobjectives:<br>1. Master the fundamentals of writing Pythonscripts.<br>2. Learn core Python scripting elements such as variables and flow controlstructures.<br>3. Discover how to work with lists and sequencedata.<br>4. Write Python functions to facilitate codereuse.<br>5. Use Python to read and writefiles</td></tr>
<tr><td colspan="8">9. CourseOutcomes:<br>After completion of this course, student will be able to<br>1. To learn basics of Python<br>2. To develop console application in python<br>3. To develop database application inpython<br>4. To develop basic machine learningapplication</td></tr>
<tr><td colspan="8">List of Experiments</td></tr>
<tr><td colspan="8">1. Implement a Python program to Calculate GCD of two numbers.</td></tr>
<tr><td colspan="8">2. Implement a Python Program to calculate the square root of a number by Newton's Method.</td></tr>
<tr><td colspan="8">3. Implement a Python program to calculate the exponentiation of a number.</td></tr>
<tr><td colspan="8">4. Implement a Python Program to calculate the maximum from a list of numbers.</td></tr>
</table>

| |
|---|
| 5. Implement a Python Program to perform Search |
| 6. Implement a Python Program to perform Liner search |
| 7. Implement a Python Program to perform Binary search |
| 8. Implement a Python Program to perform insertion sort. |
| 9. Implement a Python Program to perform selection sort. |
| 10. Implement a Python program to multiply matrices. |
| 11. Implement a Python program to Calculate the most frequent words in a text read from a file. |
| 12. Implement function overloading with different function signatures. |
| 13. Implement concept of class, instances and inheritance. |
| 14. Implement internal and external library. |
| 15. Solve algorithmic problems by program using different problem- solving strategies. |
| 16. Search content using regular expression library in python. |
| 17. Implement Matrix multiplication using multi-threading in python |

**SEMESTER IV**

| | | | | | | |
|---|---|---|---|---|---|---|
| **1.Name of the Department- Computer Science Engineering** | | | | | | |
| **2.Course Name** | **Operating Systems** | **L** | **T** | | **P** | |
| **3.Course Code** | | **3** | **0** | | **2** | |
| **4.Type of Course (use tick mark)** | | **Core ((✓)** | **PE()** | | **OE()** | |
| **5.Pre-requisite (if any)** | | **6.Frequency (use tick marks)** | Even (✓) | Odd () | Either Sem() | Every Sem () |
| **7.Total Number of Lectures, Tutorials, Practical (assuming 14 weeks of one semester)** | | | | | | |
| **Lectures = 36** | | **Tutorials = 0** | **Practical = 0** | | | |

**8.Course Description**

This course will introduce the core concepts of operating systems, such as processes and threads, scheduling, synchronization, memory management, file systems, input and output device management and security.

**9.Learningobjectives**

1. To learn the mechanisms of OS to handle processes and threads and theircommunication
2. To learn the mechanisms involved in memory management in contemporaryOS
3. To gain knowledge on distributed operating system concepts that includes architecture, Mutual exclusion algorithms, deadlock detection algorithms and agreementprotocols
4. To know the components and management aspects of concurrencymanagement
5. To learn to implement simple OSmechanisms

**10.Course Outcomes (COs):**

Create processes and threads.

1. Develop algorithms for process scheduling for a given specification of CPU utilization, Throughput, Turnaround Time, Waiting Time, Response Time
2. For a given specification of memory organization develop the techniques for optimally allocating memory to processes by increasing memory utilization and for improving the access time
3. Design and implement file management system.
4. For a given I/O devices and OS (specify) develop the I/O management functions in OS as part ofauniformdeviceabstractionbyperformingoperationsforsynchronizationbetweenCPU
    a. and I/O controllers.

**11.Unit wise detailed content**

| **Unit-1** | **Number of lectures = 9** | |
|---|---|---|

Introduction: Concept of Operating Systems, Generations of Operating systems, Types of Operating Systems, OS Services, System Calls, Structure of an OS-Layered, Monolithic, Microkernel Operating Systems, Concept of Virtual Machine. Case study on UNIX and WINDOWS Operating System.

| **Unit – 2** | **Number of lectures = 9** | |
|---|---|---|

Processes: Definition, Process Relationship, Different states of a Process, Process State transitions, Process Control Block (PCB), Context switching Thread: Definition, Various states, Benefits of threads, Types of threads, Concept of multithreads, Process Scheduling: Foundation andScheduling objectives, Types of Schedulers, Scheduling criteria: CPU utilization, Throughput, TurnaroundTime,

Waiting Time, Response Time; Scheduling algorithms: Pre-emptive and Non pre-emptive, FCFS, SJF, RR; Multiprocessor scheduling: Real Time scheduling: RM and EDF.

| **Unit – 3** | **Number of lectures = 9** | |
|---|---|---|

Inter-process Communication: Critical Section, Race Conditions, Mutual Exclusion, Hardware Solution, Strict Alternation, Peterson‘s Solution, The Producer\ Consumer Problem, Semaphores, Event Counters, Monitors, Message Passing, Classical IPC Problems: Reader‘s & Writer Problem, Dinning Philosopher Problem etc.

Deadlocks: Definition, Necessary and sufficient conditions for Deadlock, Deadlock Prevention, Deadlock Avoidance: Banker‘s algorithm, Deadlock detection and Recovery.

| **Unit – 4** | **Number of lectures = 9** | |
|---|---|---|

Memory Management: Basic concept, Logical and Physical address map, Memory allocation: Contiguous Memory allocation – Fixed and variable partition–Internal and External fragmentation and Compaction; Paging: Principle of operation – Page allocation – Hardware support for paging, Protection and sharing, Disadvantages of paging. Virtual Memory: Basics of Virtual Memory – Hardware and control structures – Locality of reference, Page fault , Working Set , Dirty page/Dirty bit – Demand paging, Page Replacement algorithms: Optimal, First in First Out (FIFO), Second Chance (SC), Not recently used (NRU) and Least Recently used(LRU).

Disk Management: Disk structure, Disk scheduling - FCFS, SSTF, SCAN, C-SCAN, Disk reliability, Disk formatting, Boot-block, Bad blocks

**12.Brief Description of self-learning / E-learning component**

The students will be encouraged to learn using the SGT E-Learning portal and choose the relevant lectures delivered by subject experts of SGT University.

The link to the E-Learning portal.

https://elearning.sgtuniversity.ac.in/course-category/Journal papers; Patents in the respective field.

**13.Books Recommended**

**Text book:**

1. Operating System Concepts Essentials, 9th Edition by AviSilberschatz, Peter Galvin, Greg Gagne, Wiley Asia Student Edition.

**Reference books:**

1. Operating System: A Design-oriented Approach, 1st Edition by Charles Crowley, IrwinPublishing
2. Operating Systems: A Modern Perspective, 2nd Edition by Gary J. Nutt,AddisonWesley
3. Design of the Unix Operating Systems, 8 th Edition by Maurice Bach, Prentice-Hall of India 4. Understanding the Linux Kernel, 3rd Edition, Daniel P. Bovet, Marco Cesati, O'Reilly andAssociates
5. Operating Systems: Internals and Design Principles, 5th Edition, William Stallings, Prentice Hall of India.

**SEMESTER IV**

| | | | | | | |
|---|---|---|---|---|---|---|
| **1.Name of the Department- Computer Science Engineering** | | | | | | |
| **2.Course Name** | **Design and Analysis of Algorithms** | **L** | **T** | | **P** | |
| **3.Course Code** | | **3** | **0** | | **2** | |
| **4.Type of Course (use tick mark)** | | **Core (✓)** | **PE()** | | **OE()** | |
| **5.Pre-requisite (if any)** | | **6.Frequency (use tick marks)** | Even (✓) | Odd () | Either Sem () | Every Sem () |
| **7.Total Number of Lectures, Tutorials, Practical (assuming 12 weeks of one semester)** | | | | | | |
| **Lectures = 36** | | **Tutorials = 0** | **Practical = 24** | | | |

**8.Course Description**

The objective of the course is to teach techniques for effective problem solving in computing. The use of different paradigms of problem solving will be used to illustrate clever and efficient ways to solve a given problem. In each case emphasis will be placed on rigorously proving correctness of the algorithm. In addition, the analysis of the algorithm will be used to show the efficiency of the algorithm over the naive techniques.

**9. Learning objectives**

I. Analyze the asymptotic performance of algorithms.
II. Write rigorous correctness proofs for algorithms.
III. Demonstrate a familiarity with major algorithms and data structures.
IV. Apply important algorithmic design paradigms and methods of analysis.
V. Synthesize efficient algorithms in common engineering design situations

**10.Course Outcomes (COs):**

**I.** For a given algorithms analyze worst-case running times of algorithms based on asymptotic analysis and justify the correctness of algorithms.

**II.** Describe the greedy paradigm and explain when an algorithmic design situation calls for it. For a given problem develop the greedy algorithms.

**III.** Describe the divide-and-conquer paradigm and explain when an algorithmic design situation calls for it. Synthesize divide-and-conquer algorithms. Derive and solve recurrence relation.

**IV.** Describe the dynamic-programming paradigm and explain when an algorithmic design situation calls for it. For a given problems of dynamic-programming and develop the dynamic programming algorithms, and analyze it to determine its computational complexity.

**V.** For a given model engineering problem model it using graph and write the corresponding algorithm to solve the problems.

**VI.** Explain the ways to analyze randomized algorithms (expected running time, probability of error).

**I1.Unit wise detailed content**

| **Unit-1** | **Number of lectures = 10** | |
|---|---|---|

Introduction: Characteristics of algorithm. Analysis of algorithm: Asymptotic analysis of complexity bounds – best, average and worst-case behavior; Performance measurements of Algorithm, Time and space trade-offs, Analysis of recursive algorithms through recurrence relations: Substitution method, Recursion tree method and Masters‘ theorem.

| **Unit – 2** | **Number of lectures = 08** | |
|---|---|---|

Fundamental Algorithmic Strategies: Brute-Force, Greedy, Dynamic Programming, Branchand-Bound and Backtracking methodologies for the design of algorithms; Illustrations of these techniques for Problem-Solving , Bin Packing, Knap Sack TSP. Heuristics – characteristics and their application domains

| **Unit – 3** | **Number of lectures = 08** | |
|---|---|---|

Graph and Tree Algorithms: Traversal algorithms: Depth First Search (DFS) and Breadth First Search (BFS); Shortest path algorithms, Transitive closure, Minimum Spanning Tree, Topological sorting, Network Flow Algorithm.

| **Unit – 4** | **Number of lectures = 10** | |
|---|---|---|

Tractable and Intractable Problems: Computability of Algorithms, Computability classes – P, NP, NP- complete and NP-hard. Cook's theorem, Standard NP-complete problems and Reduction techniques, Advanced Topics: Approximation algorithms, Randomized algorithms, Class of problems beyond NP
– P SPACE

**12.Brief Description of self-learning / E-learning component**

The students will be encouraged to learn using the SGT E-Learning portal and choose the relevant lectures delivered by subject experts of SGT University.
The link to the E-Learning portal.
https://elearning.sgtuniversity.ac.in/course-category/ Journal papers; Patents in the respective field.

**13.Books Recommended**

**I.** Introduction to Algorithms, 4TH Edition, Thomas H Cormen, Charles E Lieserson, Ronald L Rivest and Clifford Stein, MIT Press/McGraw-Hill.

**Reference books**

I. Algorithm Design, 1ST Edition, Jon Kleinberg and ÉvaTardos, Pearson.
II. Algorithm Design: Foundations, Analysis, and Internet Examples, Second Edition, Michael T Goodrich and Roberto Tamassia, Wiley.
III. Algorithms—a Creative Approach, 3RD Edition, UdiManber, Addison-Wesley, Reading, MA.
IV. Fundamentals of Algorithms – E. Horowitz et al.

**SEMESTER IV**

<table>
<tr><td colspan="8">1.Name of the Department- Computer Science Engineering</td></tr>
<tr><td>2.Course Name</td><td colspan="2">Probabilistic Modelling And Reasoning With Python</td><td colspan="2">L</td><td colspan="2">T</td><td>P</td></tr>
<tr><td>3.Course Code</td><td colspan="2"></td><td colspan="2">3</td><td colspan="2">0</td><td>2</td></tr>
<tr><td colspan="3">4.Type of Course (use tick mark)</td><td colspan="2">Core (✓)</td><td colspan="2">PE()</td><td>OE()</td></tr>
<tr><td colspan="2">5.Pre-requisite (if any)</td><td colspan="2">6.Frequency (use tick marks)</td><td>Even (✓)</td><td>Odd ()</td><td>Either Sem ()</td><td>Every Sem ()</td></tr>
<tr><td colspan="8">7.Total Number of Lectures, Tutorials, Practical (assuming 12 weeks of one semester)</td></tr>
<tr><td colspan="3">Lectures = 24</td><td colspan="2">Tutorials = 0</td><td colspan="3">Practical = 24</td></tr>
<tr><td colspan="8">8.Course Description</td></tr>
<tr><td colspan="8">9.Learning objectives<br>I. The objective of this course is to teach students the concepts of Statistics<br>II. Learn probability, probability distribution, and other statistical methods to solve various engineering problem</td></tr>
<tr><td colspan="8">9. Course Outcomes (COs):<br>I. To acquire programming skills in core Python.<br>II. To acquire Object Oriented Skills in Python.<br>III. To develop the skill of designing Graphical user Interfaces in Python.<br>IV. To develop the ability to write database applications in Python.</td></tr>
<tr><td colspan="8">11.Unit wise detailed content</td></tr>
<tr><td>Unit-1</td><td colspan="2">Number of lectures = 06</td><td colspan="5"></td></tr>
<tr><td colspan="8">Introduction to Statistics: Introduction to Statistics. Role of statistics in scientific methods, current applications of statistics.<br>Scientific data gathering: Sampling techniques, scientific studies, observational studies, data management.<br>Data description: Displaying data on a single variable (graphical methods, measure of central tendency, measure of spread), displaying relationship between two or more variables, measure of association between two or more variables.</td></tr>
<tr><td>Unit – 2</td><td colspan="2">Number of lectures = 6</td><td colspan="5"></td></tr>
<tr><td colspan="8">Probability Theory: Sample space and events, probability, axioms of probability, independent events, conditional probability, Bayes‘ theorem.<br>Random Variables: Discrete and continuous random variables. Probability distribution of discrete random variables, binomial distribution, poisson distribution. Probability distribution of continuous random variables, The uniform distribution, normal (gaussian) distribution, exponential distribution, gamma distribution, beta distribution, t-distribution, $\chi^2$ distribution. Expectations, variance and<br>covariance. Probability Inequalities. Bivariate distributions</td></tr>
<tr><td>Unit – 3</td><td colspan="2">Number of lectures = 6</td><td colspan="5"></td></tr>
</table>

| |
|---|
| Point Estimations: Methods of finding estimators, method of moments, maximum likelihood estimators, Bayes estimators. Methods of evaluating estimators, mean squared error, best unbiased estimator, sufficiency and unbiasedness<br>Interval Estimations: Confidence interval of means and proportions, Distribution free confidence interval of percentiles |

| **Unit – 4** | **Number of lectures = 6** | |
|---|---|---|
| Test of Statistical Hypothesis and p-values: Tests about one mean, tests of equality of two means, test about proportions, p-values, likelihood ratio test, Bayesian tests<br>Bayesian Statistics: Bayesian inference of discrete random variable, Bayesian inference of binomial proportion, comparing Bayesian and frequentist inferences of proportion, comparing Bayesian and frequentist inferences of mean, Univariate Statistics using Python: Mean, Mode. Median, Variance, Standard Deviation, Normal Distribution, t-distribution, interval estimation, Hypothesis Testing, Pearson correlation test, ANOVA F-test | | |
| **12.Brief Description of self-learning / E-learning component**<br>The students will be encouraged to learn using the SGT E-Learning portal and choose the relevant lectures delivered by subject experts of SGT University.<br>The link to the E-Learning portal.<br>https://elearning.sgtuniversity.ac.in/course-category/ Journal papers; Patents in the respective field. | | |
| **13.Books Recommended** | | |
| | | |

**SEMESTER IV**

| | | | | | | |
|---|---|---|---|---|---|---|
| **1. Name of the Department- Computer Science & Engineering** | | | | | | |
| **2. Course Name** | **Medical Imaging Techniques** | **L** | **T** | | **P** | |
| **3. Course Code** | | **3** | **0** | | **0** | |
| **4. Type of Course (use tick mark)** | | **Core (✓)** | **PE()** | **EAS(✓)** | **OE ()** | |
| **5. Pre-requisite (if any)** | | **6. Frequency (use tick marks)** | Even (✓) | Odd () | Either Sem() | Every Sem () |
| **7. Total Number of Lectures, Tutorials, Practical (assuming 12 weeks of one semester)** | | | | | | |
| **Lectures = 36** | | **Tutorials = 0** | **Practical = 0** | | | |

**8. Course Description**

The objective of this paper is to understand the underlying physics of the medical imaging systems and to give an overview of major modern diagnostic imaging technologies. Also, it supports more in depth investigations into radiography and nuclear medicine imaging modalities.

**12. LearningObjectives:**

After the completion of the course, the candidate should be able to:

1. Manage medical information.
2. Record keeping and lab work.
3. Manage Database and recent trends in Biomedical imaging.

**10. Course Outcomes (COs):**

At the end of the course the student able to

1. Manage medical information.
2. Record keeping and lab work.
3. Manage Database and recent trends in Biomedical imaging.

**11. Unit wise detailed content**

| | | |
|---|---|---|
| **Unit-1** | **Number of lectures = 9** | |

MEDICAL INFORMATICS Introduction - Structure of Medical Informatics –Internet and Medicine -Security issues, Computer based medical information retrieval, Hospital management and informationSystem, Functional capabilities of a computerized HIS, E-health services, HealthInformatics – Medical Informatics, Bioinformatics.

| | | |
|---|---|---|
| **Unit – 2** | **Number of lectures = 9** | |

COMPUTERISED PATIENT RECORD Introduction - History taking by computer, Dialogue with the computer, Components and functionality of CPR, Development tools, Intranet, CPR in Radiology- Application serverprovider, Clinical information system, computerized prescriptions for patients.

| | | |
|---|---|---|
| **Unit – 3** | **Number of lectures = 9** | |

COMPUTERS IN CLINICAL LABORATORY AND MEDICAL IMAGING Automated clinical laboratories- Automated methods in hematology, cytology andhistology, Intelligent Laboratory Information System - Computerized ECG, EEG andEMG, Computer assisted medical imaging- nuclear medicine, ultrasound imagingUltrasonographycomputed X-ray tomography, Radiation therapy and planning,Nuclear Magnetic Resonance.

COMPUTER ASSISTED MEDICAL DECISION-MAKING Neuro computers and Artificial Neural Networks application, Expert system – Generalmodel of CMD, Computer –assisted decision support system-production rule systemcognitivemodel, semester networks , decisions analysis in clinical medicine-computersin the care of critically patients-computer assisted surgery-designing

| Unit – 4 | Number of lectures = 9 | |
|---|---|---|
| RECENT TRENDS IN MEDICAL INFORMATICS Virtual reality applications in medicine, Computer assisted surgery, Surgical simulation, Telemedicine - Tele surgery computer aids for the handicapped, computer assisted Instrumentation in Medical Informatics - Computer assisted patient education and health Medical education and health care information.<br>DATABASES AND COMPUTER NETWORK Basics of databases- Relational, distributed and other types of databases, Integrity and security of databases, DBMS. Popular databases available in medical related applications. Basics of Computer networks- types and topologies | | |

**12. Brief Description of self-learning / E-learning component**

The students will be encouraged to learn using the SGT E-Learning portal and choose the relevant lectures delivered by subject experts of SGT University.

The link to the E-Learning portal.

https://elearning.sgtuniversity.ac.in/course-category/

**13. Books Recommended**

**Text Books**

- R.D.Lele "Computers in medicine progress in medical informatics", Tata McGraw Hill Publishing computers Ltd,2005, New Delhi.

**14. Reference Books**

- Mohan Bansal, "Medical informatics" Tata McGraw Hill Publishing computers Ltd, 2003 New Delhi.

**SEMESTER IV**

<table>
<tr><td colspan="8">1.Name of the Department- Computer Science Engineering</td></tr>
<tr><td colspan="2">2.Course Name</td><td>Operating System Lab</td><td>L</td><td colspan="2">T</td><td colspan="2">P</td></tr>
<tr><td colspan="2">3.Course Code</td><td></td><td>3</td><td colspan="2">0</td><td colspan="2">2</td></tr>
<tr><td colspan="3">4.Type of Course (use tick mark)</td><td>Core ((✓)</td><td colspan="2">PE()</td><td colspan="2">OE()</td></tr>
<tr><td colspan="2">5.Pre-requisite (if any)</td><td></td><td>6.Frequency (use tick marks)</td><td>Even (✓)</td><td>Odd ()</td><td>Either Sem()</td><td>Every Sem ()</td></tr>
<tr><td colspan="8">7.Total Number of Lectures, Tutorials, Practical (assuming 14 weeks of one semester)</td></tr>
<tr><td colspan="3">Lectures =0</td><td>Tutorials = 0</td><td colspan="4">Practical = 36</td></tr>
<tr><td colspan="8">8.Course Description<br>Unix and other OS based exercises to practice/simulate: Scheduling, Memory management Algorithms, Concurrent programming, Use of threads and processes, Kernel reconfiguration, Device drivers and systems administration of different operating system.</td></tr>
<tr><td colspan="8">9.Learningobjectives<br>1. To learn the fundamentals of OperatingSystems.<br>2. To learn the mechanisms of OS to handle processes and threads and theircommunication<br>3. To learn the mechanisms involved in memory management in contemporaryOS<br>4. To gain knowledge on distributed operating system concepts that includes architecture, Mutual exclusion algorithms, deadlock detection algorithms and agreementprotocols<br>5. To know the components and management aspects of concurrencymanagement<br>6. To learn to implement simple OSmechanisms</td></tr>
<tr><td colspan="8">10.Course Outcomes (COs):<br>• Create processes and threads.<br>1. Develop algorithms for process scheduling for a given specification of CPU utilization, Throughput, Turnaround Time, Waiting Time, ResponseTime.<br>2. For a given specification of memory organization develop the techniques for optimally allocating memory to processes by increasing memory utilization and for improving the access time.<br>3. Design and implement file managementsystem.<br>4. For a given I/O devices and OS (specify) develop the I/O management functions in OS aspart of a uniform device abstraction by performing operations for synchronization between CPU and I/O controllers.</td></tr>
<tr><td colspan="8">11.List of Experiments<br>1. Basics of UNIXcommands.<br>2. Shellprogramming<br>3. Implementation of CPU scheduling. a) Round Robin b) SJF c) FCFS d)Priority<br>4. Implement all file allocation strategies<br>5. ImplementSemaphores<br>6. Implement File Organization Techniques<br>7. Implement Bankers algorithm for Dead LockAvoidance<br>8. Implement an Algorithm for Dead LockDetection<br>9. Implement the all page replacement algorithms a) FIFO b) LRU c)LFU</td></tr>
</table>

**SEMESTER IV**

| | | | | | | |
|---|---|---|---|---|---|---|
| **1.Name of the Department- Computer Science Engineering** | | | | | | |
| **2.Course Name** | **Design & Analysis of Algorithms Lab** | **L** | **T** | | **P** | |
| **3.Course Code** | | **3** | **0** | | **2** | |
| **4.Type of Course (use tick mark)** | | **Core (✓)** | **PE()** | | **OE()** | |
| **5.Pre-requisite (if any)** | | **6.Frequency (use tick marks)** | Even (✓) | Odd () | Either Sem () | Every Sem () |
| **7.Total Number of Lectures, Tutorials, Practical (assuming 12 weeks of one semester)** | | | | | | |
| **Lecture = 0** | | **Tutorials = 0** | **Practical = 24** | | | |
| **8.Course Description** | | | | | | |

**9. Learning objectives**

1. Analyze the asymptotic performance of algorithms.
2. Write rigorous correctness proofs for algorithms.
3. Demonstrate a familiarity with major algorithms and data structures.
4. Apply important algorithmic design paradigms and methods of analysis.
5. Synthesize efficient algorithms in common engineering design situations

**10.Course Outcomes (COs):**

1. For a given algorithms analyze worst-case running times of algorithms based on asymptotic
2. analysis and justify the correctness of algorithms.
3. Describe the greedy paradigm and explain when an algorithmic design situation calls for it.
4. For a given problem develop the greedy algorithms.
5. Describe the divide-and-conquer paradigm and explain when an algorithmic design situation
6. calls for it. Synthesize divide-and-conquer algorithms. Derive and solve recurrence relation.
7. Describe the dynamic-programming paradigm and explain when an algorithmic design
8. situation calls for it. For a given problems of dynamic-programming and develop the dynamic programming algorithms, and analyze it to determine its computational complexity.

**List of Experiments**

1. Sort a given set of elements using the Quick sort method and determine the time required to sort the elements. Repeat the experiment for different values of n, the number of elements in the list to be sorted and plot a graph of the time taken versus n. The elements can be read from a file or can be generated using the random number generator.
2. Using OpenMP, implement a parallelized Merge Sort algorithm to sort a given set of elements and determine the time required to sort the elements. Repeat the experiment for different values of n, the number of elements in the list to be sorted and plot a graph of the time taken versus n. The elements can be read from a file or can be generated using the random number generator.
3. Obtain the Topological ordering of vertices in a given digraph.
4. Compute the transitive closure of a given directed graph using Warshall's algorithm.
5. Implement 0/1 Knapsack problem using Dynamic Programming.
6. From a given vertex in a weighted connected graph, find shortest paths to other vertices using Dijkstra's algorithm.
7. Find Minimum Cost Spanning Tree of a given undirected graph using Kruskal's algorithm.
8. Print all the nodes reachable from a given starting node in a digraph using BFS method.
9. Check whether a given graph is connected or not using DFS method.
10. Find a subset of a given set S = {sl,s2,. ,sn} of n positive integers whose sum is equal to a given

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| | positive integer d. For example, if S= {1, 2, 5, 6, 8} and d = 9 there are two solutions{1,2,6}and{1,8}.A suitable message is to be displayed if the given problem instance doesn't have a solution. |
| 11. | Implement any scheme to find the optimal solution for the Traveling Salesperson problem and then solve the same problem instance using any approximation algorithm and determine the error in the approximation. |
| 12. | Find Minimum Cost Spanning Tree of a given undirected graph using Prim‘s algorithm. |
| 13. | Implement All-Pairs Shortest Paths Problem using Floyd's algorithm. Parallelize this algorithm, implement it using OpenMP and determine the speed-up achieved. |
| 14. | Implement N Queen's problem using Back Tracking. |

**SEMESTER V**

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|---|---|---|---|---|---|---|
| **1. Name of the Department- CSE** | | | | | | |
| **2. Course Name** | **Theory of Computation** | **L** | **T** | | **P** | |
| **3. Course Code** | | **3** | **0** | | **0** | |
| **4. Type of Course (use tick mark)** | | **Core (√ )** | **PE()** | | **OE ()** | |
| **5. Pre-requisite (if any)** | | **6. Frequency (use tick marks)** | Even () | Odd ( ✔) | Either Sem () | Every Sem () |

| | | |
|---|---|---|
| **7. Total Number of Lectures, Tutorials, Practical (assuming 12 weeks of one semester)** | | |
| **Lectures = 36** | **Tutorials = 0** | **Practical = 0** |

**8. Course Description**

This course provides students a synopsis of latest trends in automotive industry used in evaluation of world. This includes understanding the basic principles of various hybrid and electric vehicles with importance, applications and limitations.

**9. Learning objectives:**

1. Develop a formal notation for strings, languages and machines.
2. Design finite automata to accept a set of strings of a language.
3. Prove that a given language is regular and apply the closure properties of languages.
4. Design context free grammars to generate strings from a context free language and convert them into normal forms.
5. Prove equivalence of languages accepted by Push Down Automata and languages generated by context free grammars
6. Identify the hierarchy of formal languages, grammars and machines

**10. Course Outcomes (COs):**

1. Write a formal notation for strings, languages and machines.
2. Design finite automata to accept a set of strings of a language.
3. For a given language determine whether the given language is regular or not.
4. Design context free grammars to generate strings of context free language .
5. Determine equivalence of languages accepted by Push Down Automata and languages generated by context free grammars

**11. Unit wise detailed content**

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|---|---|---|
| **Unit-1** | **Number of lectures = 10** | **Title of the unit: Introduction** |

Introduction: Alphabet, languages and grammars, productions and derivation, Chomsky hierarchy of languages, Regular languages and finite automata: Regular expressions and languages, deterministic finite automata (DFA) and equivalence with regular expressions, nondeterministic finite automata (NFA) and equivalence with DFA, regular grammars and equivalence with finite automata, properties of regular languages, pumping lemma for regular languages, minimization of finite

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| automata. | | |
| **Unit – 2** | **Number of lectures = 08** | **Title of the unit: Context-free languages and pushdown automata** |
| Context-free languages and pushdown automata: Context-free grammars (CFG) and languages (CFL), Chomsky and Greibach normal forms, nondeterministic pushdown automata (PDA) and equivalence with CFG, parse trees, ambiguity in CFG, pumping lemma for context-free languages, deterministic pushdown automata, closure properties of CFLs. | | |
| **Unit – 3** | **Number of lectures = 08** | **Title of the unit: Context-sensitive languages** |
| Context-sensitive languages: Context-sensitive grammars (CSG) and languages, linear bounded automata and equivalence with CSG. | | |
| **Unit – 4** | **Number of lectures = 10** | **Title of the unit: Turing machines** |
| Turing machines: The basic model for Turing machines (TM), Turing-recognizable (recursively enumerable) and Turing-decidable (recursive) languages and their closure properties, variants of Turing machines, nondeterministic TMs and equivalence with deterministic TMs, unrestricted grammars and equivalence with Turing machines, TMs as enumerators. Undecidability: Church-Turing thesis, universal Turing machine, the universal and diagonalization languages, reduction between languages and Rice s theorem, undecidable problems about languages. | | |
| **12. Brief Description of self-learning / E-learning component**<br>The students will be encouraged to learn using the SGT E-Learning portal and choose the relevant lectures delivered by subject experts of SGT University.<br>The link to the E-Learning portal. | | |
| **13. Text Books Recommended** | | |
| **I.** K.L.P Mishra, Theory Of Computer Science: Theory, Automata, And Computation, 3rd Edition, PHI,2006 | | |
| **14. Reference Books Recommended** | | |
| **I.** John E. Hopcroft, Rajeev Motwani and Jeffrey D. Ullman, Introduction to Automata Theory, Languages, and Computation, Pearson Education Asia, , 3rd Edition,2016 | | |
| **II.** Dexter C. Kozen, Automata and Computability, Undergraduate Texts in Computer Science, Springer.,2007 | | |
| **III.** Michael Sipser, Introduction to the Theory of Computation, PWS Publishing.,3rd Edition ,2014 | | |
| **IV.** John Martin, Introduction to Languages and The Theory of Computation, Tata McGraw Hill.,4th Edition, 2010 | | |

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|---|---|---|---|---|---|---|
| **1. Name of the Department- Computer Science & Engineering** | | | | | | |
| **2. Course Name** | **Artificial Intelligence** | **L** | **T** | | **P** | |
| **3. Course Code** | | **3** | **0** | | **0** | |
| **4. Type of Course (use tick mark)** | | **Core (✓)** | **PE()** | | **OE ()** | |
| **5. Pre-requisite (if any)** | | **6. Frequency (use tick marks)** | Even () | Odd (✓) | Either Sem() | Every Sem () |
| **7. Total Number of Lectures, Tutorials, Practical (assuming 12 weeks of one semester)** | | | | | | |
| **Lectures = 36** | | **Tutorials = 0** | **Practical = 2** | | | |

**8. Course Description**

Artificial intelligence (AI) is a research field that studies how to realize the intelligent human behaviors on a computer. The ultimate goal of AI is to make a computer that can learn, plan, and solve problems autonomously.

**9. Learning objectives:**

1. AI must improve with the progression of time and technology.
2. AI must evolve in a direction that the masses demand.
3. AI must have a mechanism whereby it can be reliably patched/updated, once it has been installed on a user's PC.
4. AI must be developed in a modular fashion, by different contributors, where modules can be removed, added, modified and interchanged where necessary.
5. AI's 'consciousness' must be fully transferable from PC to PC, to home/building, to car/vehicle, to robot.

**10. Course Outcomes (CO):**

1. Apply the basic principles, models, and algorithms of AI to recognize, model, andsolve problems in the analysis and design of information systems.
2. Analyze the structures and algorithms of a selection of techniques related tosearching, reasoning, machine learning, and language processing.

**11. Unit wise detailed content**

| | | |
|---|---|---|
| **Unit-1** | **Number of lectures = 09** | |

Overview of A.I: Introduction to AI, Importance of AI, AI and its related field, AI techniques, Criteria for success. Problems, problem space and search: Defining the problem as a state space search, Production system and its characteristics, Issues in the design of the search problem Heuristic search techniques :Generate and test, hill climbing, best first search technique, problem reduction, constraint satisfaction.

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| **Unit – 2** | **Number of lectures = 09** | |

Knowledge representation: Definition and importance of knowledge, Knowledge representation,various approaches used in knowledge representation, Issues in knowledge representation Using Predicate Logic: Represent ting Simple Facts in logic, Representing instances and is a relationship, Computable function and predicate.

| | | |
|---|---|---|
| **Unit – 3** | **Number of lectures = 09** | |

Expert System: Introduction, Representing using domain specific knowledge, Expert system shells. LISP and other AI Programming Language Natural language processing.

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|---|---|---|
| **Unit – 4** | **Number of lectures = 09** | |

| |
|---|
| Introduction syntactic processing, Semantic processing, Discourse and pragmatic processing<br>Learning: Introduction learning, Rote learning. |
| **12. Brief Description of self-learning / E-learning component**<br><br>https://elearning.sgtuniversity.ac.in/course-category/Artificial Intelligence |
| **13. Books Recommended** |
| **Text Books**<br>D.W. Patterson, "Introduction to AI and Expert Systems", PHI, 2019 |
| **Reference Books** |
| Nils J Nilsson ,"Artificial Intelligence -A new Synthesis" New Edition (2020), Harcourt Asia Ltd. |
| E. Rich and K. Knight, "Artificial intelligence", TMH, New Edition, 2020. |

**SEMESTER V**

| | | | | | | |
|---|---|---|---|---|---|---|
| **1.Name of the Department- Computer Science Engineering** | | | | | | |
| **2.Course Name** | **Machine LearningAnd Pattern Recognition** | **L** | **T** | | **P** | |
| **3.Course Code** | | **3** | **0** | | **0** | |
| **4.Type of Course (use tick mark)** | | **Core (✓)** | **PE()** | | **OE()** | |
| **5.Pre-requisite (if any)** | | **6.Frequency (use tick marks)** | Even () | Odd (✓) | Either Sem () | Every Sem () |
| **7.Total Number of Lectures, Tutorials, Practical (assuming 12 weeks of one semester)** | | | | | | |
| **Lectures = 24** | | **Tutorials = 0** | **Practical = 24** | | | |

**8.Course Description**

This course will cover several topics on pattern recognition (PR), artificial neural networks (ANN), and machine learning (ML). Pattern recognition is a classical research area that deals with recognizing patterns (objects) based on their features (traits or appearance).

**9. Learning objectives**

1. Learn the basic concepts of machinelearning,
2. Learn the basic concepts of supervised learning, unsupervised learning, and reinforcement learning

**10.Course Outcomes (COs):**

1. Learn the concept of machine learning
2. Learn the concept of linear regression
3. Learn the concept of linear technique
4. Learn the concept of Unsupervised Learning

**11.Unit wise detailed content**

| **Unit-1** | **Number of lectures = 06** | |
|---|---|---|

Introduction: Learning systems, real world applications of machine learning, why machine learning, variable types and terminology, function approximation
Types of machine learning: Supervised learning, unsupervised learning, reinforcement learning
Important concepts of machine learning: Parametric vs non-parametric models, the trade-off between prediction accuracy and model interpretability, the curse of dimensionality, measuring the quality of fit, bias-variance trade off, overfitting, model selection, no free lunch theorem

| **Unit – 2** | **Number of lectures = 06** | |
|---|---|---|

Linear Regression: Linear regression, estimating the coefficients, accessing the accuracy of coefficient estimates, accessing the accuracy of the model, multiple linear regression, qualitative predictors
Classification: Logistic regression, estimating regression coefficients, making predictions, multiple logistic regressions, linear discriminant analysis, bayes_ theorem of classification, LDA for p=1, LDA for p>1, quadratic discriminant analysis

| **Unit – 3** | **Number of lectures = 06** | |
|---|---|---|

Resampling Methods, Model Selection and Regularization: Cross-validation, leave-one-out cross-validation, k-fold cross-validation, the bootstrap, subset selection, shrinkage methods, ridge and lasso regression, dimension reduction methods, principal components regression, partial least square
Tree Based Methods: Advantages and disadvantages of trees, regression Trees, classification trees, bagging, random forest, boosting

| Unit – 4 | Number of lectures = 06 | |
|---|---|---|

Support Vector Machine: Maximum margin classifier, classification using a separating hyperplane, the maximal margin classifier, support vector classifier, support vector machines, classification with non-linear decision boundaries, support vector machine, one-versus-one classification, one-versus- many classification, Unsupervised Learning**:** Principle component analysis, what are principal components, clustering methods, k-means clustering, hierarchical clustering, Independent component
analysis, latent semantic indexing, Markov Models, Hidden Markov Models.

**12.Brief Description of self-learning / E-learning component**

The students will be encouraged to learn using the SGT E-Learning portal and choose the relevant lectures delivered by subject experts of SGT University.
The link to the E-Learning portal.
https://elearning.sgtuniversity.ac.in/course-category/
Journal papers; Patents in the respective field.

**13. Books Recommended**

I. C.M.Bishop, Pattern Recognition and Machine Learning, Springer,2006
II. R.O.Duda, P.E.Hart and D.G.Stork, Pattern Classification, John Wiley,2001

**Reference Books**

I. S. Theodoridis and K. Koutroumbas, Pattern Recognition, Academic Press,2009
II. E. Alpaydin, Introduction to Machine Learning, Prentice-Hall of India,2010
III. G. James, D. Witten, T. Hastie and R. Tibshirani, Introduction to StatisticalLearning, Springer,2013.

**SEMESTER V**

| | | | | | | |
|---|---|---|---|---|---|---|
| **1. Name of the Department- Computer Science & Engineering** | | | | | | |
| **2. Course Name** | **Medical Informatics** | **L** | **T** | | **P** | |
| **3. Course Code** | | **3** | **0** | | **0** | |
| **4. Type of Course (use tick mark)** | | **Core (✓)** | **PE()** | **EAS(✓)** | **OE ()** | |
| **5. Pre-requisite (if any)** | | **6. Frequency (use tick marks)** | Even () | Odd (✓) | Either Sem() | Every Sem () |
| **7. Total Number of Lectures, Tutorials, Practical (assuming 12 weeks of one semester)** | | | | | | |
| **Lectures = 36** | | **Tutorials = 0** | **Practical = 0** | | | |

**8. Course Description**

The objective of this paper is to understand the underlying physics of the medical imaging systems and to give an overview of major modern diagnostic imaging technologies. Also, it supports more in depth investigations into radiography and nuclear medicine imaging modalities.

**13. LearningObjectives:**

After the completion of the course, the candidate should be able to:

1. Handle the Biomedical Equipments at all levels used in Health care systems, from simple electronic design to highly sophisticated computerized equipments.
2. Supervise the operation and service of the equipments used in Medical field.
3. Guide specialists in various diagnostic and therapeutic procedures by acquiring sound knowledge of the functioning of Human body.
4. To undertake teaching and research in the Biomedical Engineering field.

**10. Course Outcomes (COs):**

At the end of the course the student able to

1. define commonly used technical terms from Medicine and Biomedical Engineering.
2. describe bio-signals that emanate from the body
3. learn the working principles of blood flow meters and Physiological assist devices
4. describe the engineering principles of commonly used medical devices and medical imaging systems
5. realize safety requirements of biomedical instrumentation

**11. Unit wise detailed content**

| **Unit-1** | **Number of lectures = 9** | |
|---|---|---|

Basic imaging principle image modalities, Image properties Projection radiography, interaction between X – Rays and matter, Intensity of an X – Ray, Attenuation, X – Ray Generation and Generators, Beam Restrictors and Grids, Intensifying screens, fluorescent screens and image intensifiers, X – Ray, detectors, Conventional X – Ray radiography, Fluoroscopy, Angiography, Digital radiography

| **Unit – 2** | **Number of lectures = 9** | |
|---|---|---|

COMPUTED TOMOGRAPHY 10 hrs. Basic Principle, Generation of CT machines, Detectors & Detector arrays, Details of Acquisition, Digital image display Radiation Dose, Image quality.

| **Unit – 3** | **Number of lectures = 9** | |
|---|---|---|

ULTRASOUND 10 hrs. Acoustic propagation, Attenuation, Absorption and Scattering, Ultrasonic transducers, Transducer Arrays, A mode, B mode, M mode scanners, Tissue characterization, Color Doppler flow imaging, Echocardiography.

RADIO NUCLIDE IMAGING 10 hrs. Interaction of nuclear particles and matter, nuclear sources, Radionuclide generators, nuclear radiation detectors, rectilinear scanner, scintillation camera, SPECT,

PET, Gamma ray camera, LINAC, molecular imaging.

| **Unit – 4** | **Number of lectures = 9** | |
|---|---|---|

MAGNETIC RESONANCE IMAGING 10 hrs. Angular momentum, Magnetic dipole moment, Magnetization, Larmor frequency Rotating frame of reference, free induction decay, Relaxation times, Pulse sequences, Generation and Detection of NMR Imager, Slice selection, Frequency encoding, Phase encoding, Spin – Echo imaging, Gradient – Echo imaging, Imaging safety, Biological effects of magnetic field, Introduction to FMRI, EMRI.

**12. Brief Description of self-learning / E-learning component**

The students will be encouraged to learn using the SGT E-Learning portal and choose the relevant lectures delivered by subject experts of SGT University.
The link to the E-Learning portal.
https://elearning.sgtuniversity.ac.in/course-category/

**13. Books Recommended**

**Text Books**


- K Kirk Shung, Michael B smith & Benjamim M W Tsui, "Principles of Medical Imaging", Academic press inc, 1992.
- Jerry L Prince & Jonathan M Links, "Medical Imaging Signals and Systems", Pearson Prentice Hall, 2006.
- Jerrold T. Bushberg "The essential Physics of Medical Imaging", Lippincott Williams and Wilkins, 2002.
- R S Khandpur, "Hand Book of Biomedical Instrumentation", Tata McGraw Hill Publication, Second Edition. 2003.
- Ray H. Hashemi , William G. Bradley, Christopher, J. Lisanti, MRI: The Basics, 2004.
- Frederick W Kremkau "Diagnostic Ultrasound Principles & Instruments", Saunders Elsevier, 2005.

**SEMESTER V**

| | | | | | | |
|---|---|---|---|---|---|---|
| **1. Name of the Department- Computer Science & Engineering** | | | | | | |
| **2. Course Name** | **Artificial Intelligence Lab** | **L** | **T** | | **P** | |
| **3. Course Code** | | **0** | **0** | | **4** | |
| **4. Type of Course (use tick mark)** | | **Core (✓)** | **PE()** | | **OE ()** | |
| **5. Pre-requisite (if any)** | | **6. Frequency (use tick marks)** | Even () | Odd (✓) | Either Sem() | Every Sem () |
| **7. Total Number of Lectures, Tutorials, Practical (assuming 12 weeks of one semester)** | | | | | | |
| **Lectures = 0** | | **Tutorials = 0** | **Practical = 24** | | | |

**8. Course Description**

Artificial intelligence (AI) is a research field that studies how to realize the intelligent human behaviors on a computer. The ultimate goal of AI is to make a computer that can learn, plan, and solve problems autonomously.

**9. Learning objectives:**

1. AI must improve with the progression of time and technology.
2. AI must evolve in a direction that the masses demand.
3. AI must have a mechanism whereby it can be reliably patched/updated, once it has been installed on a user's PC.
4. AI must be developed in a modular fashion, by different contributors, where modules can be removed, added, modified and interchanged where necessary.
5. AI's 'consciousness' must be fully transferable from PC to PC, to home/building, to car/vehicle, to robot.

**10. Course Outcomes (CO):**

1. Apply the basic principles, models, and algorithms of AI to recognize, model, and solve problems in the analysis and design of information systems.
2. Aanalyze the structures and algorithms of a selection of techniques related to searching, reasoning, machine learning, and language processing.
3. Solve AI Problems using Prolog.

**11. List of Experiments**

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

**Note:At least 5 to 10 more exercises to be given by the teacher concerned.**

**12. Brief Description of self-learning / E-learning component**

https://www.vlab.co.in/

**SEMESTER V**

| | | | | | | |
|---|---|---|---|---|---|---|
| **1. Name of the Department- Computer Science & Engineering** | | | | | | |
| **2. Course Name** | **Machine learning and Pattern recognition Lab** | **L** | **T** | | **P** | |
| **3. Course Code** | | **3** | **0** | | **2** | |
| **4. Type of Course (use tick mark)** | | **Core (✓)** | **PE()** | | **OE ()** | |
| **5. Pre-requisite (if any)** | | **6. Frequency (use tick marks)** | Even () | Odd (✓) | Either Sem() | Every Sem () |
| **7. Total Number of Lectures, Tutorials, Practical (assuming 12 weeks of one semester)** | | | | | | |
| **Lectures = 0** | | **Tutorials = 0** | **Practical = 24** | | | |

**8. Course Description**

Machine Learning is concerned with computer programs that automatically improve their performance through experience.

**10. Learningobjectives:**

1. Make use of Data sets in implementing the machine learning algorithms
2. Implement the machine learning concepts and algorithms in any suitable language of choice
3. Learn Python ML library classes

**10. Course Outcomes (CO):**

1. Understand the implementation procedures for the machine learning algorithms.
2. Design Java/Python programs for various Learning algorithms.
3. Applyappropriate data sets to the Machine Learning algorithms.
4. Identify and apply Machine Learning algorithms to solve real world problems.

**11. List of Experiments**

1. Implement and demonstrate the FIND-Salgorithm for finding the most specific hypothesis based on a given set of training data samples. Read the training data from a .CSV file.
2. For a given set of training data examples stored in a .CSV file, implement and demonstrate the Candidate-Elimination algorithm to output a description of the set of all hypotheses consistent with the training examples.
3. Write a program to demonstrate the working of the decision tree based ID3 algorithm. Use an appropriate data set for building the decision tree and apply this knowledge to classify a new sample.
4. Build an Artificial Neural Network by implementing the Backpropagation algorithm and test the same using appropriate data sets.
5. Write a program to implement the naïve Bayesian classifier for a sample training data set stored as a .CSV file. Compute the accuracy of the classifier, considering few test data sets.
6. Assuming a set of documents that need to be classified, use the naïve Bayesian Classifier model to perform this task. Built-in Java classes/API can be used to write the program. Calculate the accuracy, precision, and recall for your data set.
7. Write a program to construct aBayesian network considering medical data. Use this model to demonstrate the diagnosis of heart patients using standard Heart Disease Data Set. You can use Java/Python ML library classes/API.
8. Apply EM algorithm to cluster a set of data stored in a .CSV file. Use the same data set for clustering using k-Means algorithm. Compare the results of these two algorithms and comment on the quality of clustering. You can add Java/Python ML library classes/API in the program.
9. Write a program to implement k-Nearest Neighbour algorithm to classify the iris data set. Print both correct and wrong predictions. Java/Python ML library classes can be used for this problem.
10. Implement the non-parametric Locally Weighted Regressionalgorithm in order to fit data points. Select appropriate data set for your experiment and draw graphs.

**SEMESTER VI**

<table>
<tr><td colspan="8">1. Name of the Department: CSE</td></tr>
<tr><td>2. Course Name</td><td colspan="2">Compiler design</td><td colspan="2">L</td><td colspan="2">T</td><td>P</td></tr>
<tr><td>3. Course Code</td><td colspan="2"></td><td colspan="2">3</td><td colspan="2">0</td><td>2</td></tr>
<tr><td colspan="3">4. Type of Course (use tick mark)</td><td colspan="2">Core (√ )</td><td colspan="2">PE()</td><td>OE()</td></tr>
<tr><td>5. Pre-requisite (if any)</td><td colspan="2">TOC</td><td colspan="2">6. Frequency (use tick marks)</td><td>Even (✓)</td><td>Odd ()</td><td>Either Sem ()</td><td>Every Sem ()</td></tr>
<tr><td colspan="8">7. Total Number of Lectures, Tutorials, Practical (assuming 12 weeks of one semester)</td></tr>
<tr><td colspan="3">Lectures = 36</td><td colspan="2">Tutorials = 0</td><td colspan="3">Practical = 0</td></tr>
<tr><td colspan="8">8. Course Description:<br>It is capable of creating code for a platform other than the one on which the compiler is running.</td></tr>
<tr><td colspan="8">Source-to-source Compiler or Trans compiler is a compiler that translates source code written in one programming language into source code of another programming language.</td></tr>
<tr><td colspan="8">9. Learning objectives:<br>1. Provide an understanding of the fundamental principles in compiler design<br>2. Provide the skills needed for building compilers for various situations that one may encounter in a career in Computer Science.<br>3. Learn the process of translating a modern high-level language to executable code required for compiler construction.</td></tr>
<tr><td colspan="8">9. CourseOutcomes:<br>At the end of the course student will be able to:<br>1. Understand fundamentals of compiler and identify the relationships among different phases of the compiler.<br>2. Understand the application of finite state machines, recursive descent, production rules, parsing, and language semantics.<br>3. Analyze & implement required module, which may include front-end, back-end, and a small set of middle-end optimizations.<br>4. Use modern tools and technologies for designing new compiler.</td></tr>
<tr><td colspan="8">11. Unit wise detailed content</td></tr>
<tr><td>Unit-1</td><td colspan="2">Number of lectures =10</td><td colspan="5">Title of the unit: Introduction</td></tr>
<tr><td colspan="8">Introduction to Compiler, Phases and passes, Bootstrapping, Finite state machines and regular expressions and their applications to lexical analysis, Optimization of DFA-Based Pattern Matchers implementation of lexical analyzers, lexical-analyzer generator, LEX-compiler, Formal grammars and their application to syntax analysis, BNF notation, ambiguity, YACC. The syntactic specification of programming languages: Context free grammars, derivation and parse trees, capabilities of CFG.</td></tr>
<tr><td>Unit - 2</td><td colspan="2">Number of lectures =8</td><td colspan="5">Title of the unit: Basic Parsing Techniques</td></tr>
<tr><td colspan="8">Parsers, Shift reduce parsing, operator precedence parsing, top down parsing, predictive parsers Automatic Construction of efficient Parsers: LR parsers, the canonical Collection of LR (0) items, constructing SLR parsing tables, constructing Canonical LR parsing tables, Constructing LALR<br>parsing tables, using ambiguous grammars, an automatic parser generator, and implementation ofLR parsingtables.</td></tr>
</table>

| Unit - 3 | Number of lectures = 8 | Title of the unit: Syntax-directed Translation |
|---|---|---|
| Syntax-directed Translation schemes, Implementation of Syntax directed Translators, Intermediate code, postfix notation, Parse trees & syntax trees, three address code, quadruple & triples, translation of assignmentstatements,Booleanexpressions,statementsthataltertheflow ofcontrol,postfix<br>translation, translation with a top down parser. More about translation: Array references inarithmetic expressions, procedures call, declaration sand case statements. | | |
| **Unit - 4** | **Number of lectures = 10** | **Title of the unit: Symbol Tables** |
| Data structure for symbols tables, representing scope information. Run-Time Administration: Implementation of simple stack al-location scheme, storage allocation in block structured language. Error Detection & Recovery: Lexical Phase errors, syntactic phase errors semantic errors. **Code Generation:** Selected Topics: Algebraic Computation, Fast Fourier Transform, String Matching,<br>Theory of NP-completeness, Approximation algorithms and Randomized algorithms. | | |
| **12. Brief Description of self learning / E-learning component**<br>The students will be encouraged to learn using the SGT E-Learning portal and choose the relevant | | |
| lectures delivered by subject experts of SGT University.<br><br>The link to the E-Learning portal.<br><br>https://elearning.sgtuniversity.ac.in/course-<br><br>category/ | | |
| **13. Text BooksRecommended** | | |
| ALFREDVAUTORAHO,JEFFREYDAUTORULLMAN-Principles of Compiler Design‖. Addison-Wesley, 2002 | | |
| **14. Reference Books Recommended** | | |
| Aho,Sethi&Ullman,-Compilers: Principles, Techniques and Tools‖,Pearson Education,2nd edition, 2006 | | |
| Charles Fischer and Ricard LeBlanc,‖ Crafting a Compiler with C‖, Pearson Education , 1991 | | |
| V Raghvan, ― Principles of Compiler Design‖, TMH, 2009 | | |

**SEMESTER VI**

<table>
<tr><td colspan="7">1.Name of the Department- Computer Science Engineering</td></tr>
<tr><td>2.Course Name</td><td colspan="2">Data Science Tools & Techniques</td><td colspan="2">L</td><td colspan="2">T</td><td>P</td></tr>
<tr><td>3.Course Code</td><td colspan="2"></td><td colspan="2">3</td><td colspan="2">0</td><td>2</td></tr>
<tr><td colspan="2">4.Type of Course (use tick mark)</td><td colspan="2">Core (✓)</td><td colspan="2">PE()</td><td colspan="2">OE()</td></tr>
<tr><td rowspan="2">5.Pre-requisite (if any)</td><td rowspan="2"></td><td rowspan="2" colspan="2">6.Frequency (use tick marks)</td><td>Even</td><td>Odd</td><td>Either</td><td>Every</td></tr>
<tr><td>(✓)</td><td>()</td><td>Sem ()</td><td>Sem ()</td></tr>
<tr><td colspan="7">7.Total Number of Lectures, Tutorials, Practical (assuming 12 weeks of one semester)</td></tr>
<tr><td colspan="3">Lectures =24</td><td colspan="2">Tutorials = 0</td><td colspan="2">Practical = 24</td></tr>
<tr><td colspan="7">8.Course Description</td></tr>
<tr><td colspan="7">The student learns the architecture of HDFS and MapReduce along with other tools such as pig, hive, spark, Zookeeper, HBase</td></tr>
<tr><td colspan="7">9. Learningobjectives<br>1. The objective of this course is to teach students the conceptual framework of BigData,<br>2. To understand Virtualization, MapReduce, HDFS, Pig, Hive, Spark, ZooKeeper,HBase.</td></tr>
<tr><td colspan="7">9. Course Outcomes(COs):<br>On completion of this course, the students are expected to learn<br>1. Concepts of Hadoop andHDFS<br>2. Concepts of MapReduce<br>3. Big data tools Pig, Hive, Spark, Zookeeper, HBase</td></tr>
<tr><td colspan="7">11.Unit wise detailed content</td></tr>
<tr><td>Unit-1</td><td colspan="2">Number of lectures = 06</td><td colspan="4"></td></tr>
<tr><td colspan="7">Big Data: Fundamentals of Big Data, defining big data, building successful big data management architecture, big data journey<br>Big Data Types: Structured and unstructured data types, real time and non-real time requirements<br>Distributed Computing: History of distributed computing, basics of distributed computing</td></tr>
<tr><td>Unit – 2</td><td colspan="2">Number of lectures = 06</td><td colspan="4"></td></tr>
<tr><td colspan="7">Big Data Technology Foundation: Big Data stack, redundant physical infrastructure, security infrastructure, operational databases, organising data services and tools, analytical data warehouse, big data analytics<br>Virtualization: Basics of virtualization, hypervisor, abstraction and virtualization, implementing virtualization with big data<br>Cloud and Big Data: Defining cloud, cloud deployment and delivery models, cloud as an imperative for big data, use the cloud for big data</td></tr>
</table>

| Unit – 3 | Number of lectures = 06 | |
|---|---|---|

**Operational Databases:** Relational database, nonrelational database, key-value pair databases, document databases, columnar databases, graph databases, spatial databases

**MapReduce Fundamentals:** Origin of MapReduce, map function, reduce function, putting map and reduce together, optimizing map reduce

**Hadoop:** Discovering Hadoop, Hadoop distributed file system, Hadoop MapReduce, Hadoop file system, dataflow, Hadoop I/O, data integrity, compression, serialization, file-based data structure

| Unit – 4 | Number of lectures = 06 | Writing introduction and conclusion |
|---|---|---|

**Avro:** Avro data types and schemas, in-memory serialization and deserialization, avro datafiles, schema resolution

**Pig:** Comparison with databases, pig latin, user defined functions, data processing operators

**Hive:** Running hive, comparison with traditional databases, HiveQL, tables, querying data, user- defined functions

**Spark:** Resilient distributed datasets, shared variables, anatomy of a spark job run, executors and cluster managers,

**HBase:** HBasics, concepts, clients, HBase vs RDBMS, Praxis

**ZooKeeper:** ZooKeeper services, building application with ZooKeeper

**12.Brief Description of self-learning / E-learning component**

The students will be encouraged to learn using the SGT E-Learning portal and choose the relevant lectures delivered by subject experts of SGT University.
The link to the E-Learning portal.
https://elearning.sgtuniversity.ac.in/course-category/Journal papers; Patents in the respective field.

**13.Books Recommended**

**Text book:**

Hadoop: The Definitive Guide, 4th Edition by Tom White - Shroff Publishers & Distributers Private Limited - Mumbai; Fourth edition (2015)

**Reference books:**

Big Data: Principles and Best Practices of Scalable Real-time Data Systems by James Warren and Nathan Marz, Manning Publications (2015) On Writing Well. William Zinsser. Harper Resource Book. 2001

**SEMESTER VI**

| | | | | | | |
|---|---|---|---|---|---|---|
| **1. Name of the Department- Computer Science & Engineering** | | | | | | |
| **2. Course Name** | **Machine learning with Python, Scikit-learn, Matplotlib, Tensorflow** | **L** | **T** | | **P** | |
| **3. Course Code** | | **3** | **0** | | **2** | |
| **4. Type of Course (use tick mark)** | | **Core (✓)** | **PE()** | | **OE ()** | |
| **5. Pre-requisite (if any)** | Python | **6. Frequency (use tick marks)** | Even (✓) | Odd () | Either Sem() | Every Sem () |
| **7. Total Number of Lectures, Tutorials, Practical (assuming 12 weeks of one semester)** | | | | | | |
| **Lectures = 36** | | **Tutorials = 0** | **Practical = 0** | | | |

**8. Course Description**

An introduction to the machine learning concepts. Supervised learning, Unsupervised Learning, Re-enforcement learning, Machine Learning algorithms, Data Visualization and also the concepts of deep learning.

**14. LearningObjectives:**

1. To introduce students to the basic concepts and techniques of Machine Learning.
2. To develop skills of using recent machine learning software for solving practical problems.
3. To gain experience of doing independent study and research.

**10. Course Outcomes (COs):**

The students will be able to: -

1. Students will learn about supervised learning, a common class of methods for model construction.
2. Students will learn the foundations of neural network design and training in TensorFlow.
3. Students you will learn to implement unsupervised learning methods for different kinds of problem domains.
4. Visualization of the data using different libraries.

**11. Unit wise detailed content**

| | | |
|---|---|---|
| **Unit-1 Introduction to machine Learning** | **Number of lectures = 9** | |

Brief Introduction to Machine Learning- Supervised Learning, Unsupervised Learning, Reinforcement Learning. Learning theory, Hypothesis and target class, Inductive bias and bias-variance tradeoff, Limitations of inference machines, Approximation and estimation errors.

| | | |
|---|---|---|
| **Unit – 2 Machine Learning Algorithms using Scikit** | **Number of lectures = 9** | |

Supervised learning: Linear separability and decision regions, Linear discriminants, Bayes optimal classifier, Linear regression, Standard and stochastic gradient descent, Lasso and Ridge Regression, Logistic regression, Perceptron, Artificial Neural Networks, Decision Tree Induction, Overfitting, pruning of decision trees, Bagging and Boosting, Dimensionality reduction and Feature selection.

Unsupervised Learning Clustering, Mixture models, Expectation Maximization, Spectral Clustering, Non-parametric density estimation.

| | | |
|---|---|---|
| **Unit – 3Data Visualization** | **Number of lectures = 9** | |
| Introduction to Visualization, Matplotlib, Seaborn and Plotly, visualization techniques & comparing plots, Data visualization using seaborn and Matplotlib. | | |
| **Unit – 4** | **Number of lectures = 9** | |
| Introduction to TensorFlow, HelloWorld with TensorFlow, ActivationFunctions, Convolutional Neural Networks (CNN), CNNHistory, UnderstandingCNNs,CNN Application, Recurrent Neural Networks (RNN),Intro to RNN Model, Long Short-Term memory (LSTM),Recursive Neural Tensor Network Theory, Recurrent Neural Network Model. | | |

**12. Brief Description of self-learning / E-learning component**

The students will be encouraged to learn using the SGT E-Learning portal and choose the relevant lectures delivered by subject experts of SGT University.
The link to the E-Learning portal.
https://elearning.sgtuniversity.ac.in/course-category/

**13. Books Recommended**

**Text Books**

- Pattern Recognition and Machine Learning, Christopher Bishop, Springer 2006.

**14. Reference Books**

- Introduction to Statistical Learning, Gareth James, Daniela Witten, Trevor Hastie, Robert Tibshirani, Springer, 2013.
- Pattern Classification, 2nd Ed., Richard Duda, Peter Hart, David Stork, John Wiley & Sons, 2001.

**SEMESTER VI**

| | | | | | | |
|---|---|---|---|---|---|---|
| **1. Name of the Department- Computer Science & Engineering** | | | | | | |
| **2. Course Name** | **Compiler Design Lab** | **L** | **T** | | **P** | |
| **3. Course Code** | | **3** | **0** | | **2** | |
| **4. Type of Course (use tick mark)** | | **Core (✓)** | **PE()** | | **OE ()** | |
| **5. Pre-requisite (if any)** | | **6. Frequency (use tick marks)** | Even (✓) | Odd () | Either Sem() | Every Sem () |
| **7. Total Number of Lectures, Tutorials, Practical (assuming 12 weeks of one semester)** | | | | | | |
| **Lectures = 0** | | **Tutorials = 0** | **Practical = 24** | | | |

**8. Course Description**

This course is a study of the theory and practice required for the design and implementation of interpreters and compilers for programming languages.

**11. Learningobjectives:**

1. To implement the different Phases of compiler.
2. To implement and test simple optimization techniques.
3. To give exposure to compiler writing tools.•

**10. Course Outcomes (CO):**

The Student will be able to :

1. Implement the techniques of Lexical Analysis and Syntax Analysis.
2. Apply the knowledge of Lex & Yacc tools to develop programs.
3. Generate intermediate code. iv. Implement Optimization techniques and generate machine level code.

**11. List of Experiments**

1. Design and implement a lexical analyzer for given language using C and the lexical analyzer should ignore redundant spaces, tabs and new lines.

2. Implementation of Lexical Analyzer using Lex Tool

3. Generate YACC specification for a few syntactic categories. a) Program to recognize a valid arithmetic expression that uses operator +, – , * and /. b) Program to recognize a valid variable which starts with a letter followed by any number of letters or digits. c) Implementation of Calculator using LEX and YACC d) Convert the BNF rules into YACC form and write code to generate abstract syntax tree
4. Write program to find ε – closure of all states of any given NFA with ε transition.
5. Write program to convert NFA with ε transition to NFA without ε transition.
6. Write program to convert NFA to DFA
7. Write program to minimize any given DFA.
8. Develop an operator precedence parser for a given language.
9. Write program to find Simulate First and Follow of any given grammar.
10. Construct a recursive descent parser for an expression.
11. Construct a Shift Reduce Parser for a given language.
12. Write a program to perform loop unrolling.
13. Write a program to perform constant propagation.
14. Implement Intermediate code generation for simple expressions

**SEMESTER VI**

<table>
<tr><td colspan="8">1. Name of the Department- Computer Science & Engineering</td></tr>
<tr><td>2. Course Name</td><td colspan="2">Data Science tools & Techniques Lab</td><td>L</td><td colspan="2">T</td><td colspan="2">P</td></tr>
<tr><td>3. Course Code</td><td colspan="2"></td><td>3</td><td colspan="2">0</td><td colspan="2">2</td></tr>
<tr><td colspan="3">4. Type of Course (use tick mark)</td><td>Core (√)</td><td colspan="2">PE( )</td><td colspan="2">OE ()</td></tr>
<tr><td colspan="2">5. Pre-requisite (if any)</td><td></td><td>6. Frequency (use tick marks)</td><td>Even (√)</td><td>Odd ()</td><td>Either Sem ()</td><td>Every Sem ()</td></tr>
<tr><td colspan="8">7. Total Number of Lectures, Tutorials, Practical (assuming 12 weeks of one semester)</td></tr>
<tr><td colspan="3">Lectures = 0</td><td>Tutorials = 0</td><td colspan="4">Practical = 24</td></tr>
<tr><td colspan="8">8. Course Description This Course will explore knowledge on different popular Python libraries in the world such as collections, numerical pyhton, matplotlib, seaborn and pandas data frames.</td></tr>
<tr><td colspan="8">1. Learning objectives:<br>2. Learn Data Insights Visualization<br>3. Learn Collections - List, Set, Dictionaries, Tuples<br>4. Pandas DataFrames - Intruduction and Operations</td></tr>
<tr><td colspan="8">9. Course Outcomes (COs):</td></tr>
<tr><td colspan="8">1. Basic Python- Creating Identifiers, Operators, Decision Controls, Loops<br>2. Numerical Python - 1 to Multidimensional array and Operations and more.<br>3. isual plots such as line, bar, scatter, histogram etc.<br>4. Seaborn for basic visualizations to retrieve meaningful insights</td></tr>
<tr><td colspan="8">10. List of Experiments</td></tr>
<tr><td colspan="8">1) Python Basics<br>2) Collection<br>3) Numpy Array<br>4) Pandas Dataframe<br>5) MatplotlibVisualizations<br>6) Seaborn Visualization<br>7) Dataset and Goal of Analysis<br>8) Exploratory Data Analysis<br>9) Dataset and Goal of Exploratory Data Analysis</td></tr>
<tr><td colspan="8">11. Brief Description of self-learning / E-learning component</td></tr>
</table>

**SEMESTER VI**

<table>
<tr><td colspan="8">1. Name of the Department- Computer Science & Engineering</td></tr>
<tr><td>2. Course Name</td><td colspan="2">Machine learning with Python, Scikit-learn, Matplotlib, TensorflowLab</td><td colspan="2">L</td><td colspan="2">T</td><td>P</td></tr>
<tr><td>3. Course Code</td><td colspan="2"></td><td colspan="2">3</td><td colspan="2">0</td><td>2</td></tr>
<tr><td colspan="3">4. Type of Course (use tick mark)</td><td colspan="2">Core (√)</td><td colspan="2">PE( )</td><td>OE ()</td></tr>
<tr><td colspan="2">5. Pre-requisite (if any)</td><td></td><td colspan="2">6. Frequency (use tick marks)</td><td>Even (√)</td><td>Odd ()</td><td>Either Sem ()</td><td>Every Sem ()</td></tr>
<tr><td colspan="9">7. Total Number of Lectures, Tutorials, Practical (assuming 12 weeks of one semester)</td></tr>
<tr><td colspan="3">Lectures = 0</td><td colspan="3">Tutorials = 0</td><td colspan="3">Practical = 24</td></tr>
<tr><td colspan="9">8. Course Description</td></tr>
<tr><td colspan="9">9. Learning objectives:<br>1. Make use of Data sets in implementing the machine learning algorithms<br>2. Implement the machine learning concepts and algorithms in python programming language.<br>3. Solve complex heterogeneous data intensive analytical based problems of real time scenario using state of the art hardware/software tools.</td></tr>
<tr><td colspan="9">10. Course Outcomes (COs):</td></tr>
<tr><td colspan="9">1. Analyze a problem, identify and define computing requirements, design and implement appropriate solutions</td></tr>
<tr><td colspan="9">2. Implementation and application of machine learning techniques in prediction problems.</td></tr>
<tr><td colspan="9">3. Independently carry out research/investigation and development work to solve practical problems</td></tr>
<tr><td colspan="9">4. Demonstrate a degree of mastery in emerging areas of CSE/IT like IoT, AI, Data Analytics, Machine Learning, cyber security, etc.</td></tr>
<tr><td colspan="9">11. List of Experiments</td></tr>
<tr><td colspan="9">1) Python AS CALCULATOR APPLICATION.<br>2) Write a program to implement the naïve Bayesian classifier for a sample training data set stored as a .CSV file. Compute the accuracy of the classifier, considering few test data sets.<br>3) READING AND WRITING DIFFERENT TYPES OF DATASETS<br>4) VISUALIZATIONS<br>5) REGRESSION MODEL.<br>6) MULTIPLE REGRESSION MODEL<br>7) REGRESSION MODEL FOR PREDICTION.<br>8) CLASSIFICATION MODEL<br>9) CLUSTERING MODEL<br>10) Write a program to implement k-Nearest Neighbour algorithm to classify the iris data set. Print both correct and wrong predictions. Java/Python ML library classes can be used for this problem.</td></tr>
<tr><td colspan="9">12. Brief Description of self-learning / E-learning component<br>https://nlp-iiith.vlabs.ac.in/</td></tr>
</table>

# List of Program Elective

| Specialization | IoT | Blockchain | Data Analytics | Cyber Security & Forensics |
|---|---|---|---|---|
| **DE-I** | Wireless Ad-hoc and sensor Networks | Cryptography Fundamentals | Applied Statistical Analysis | Cryptography Fundamentals(manu phogat |
| **DE-II** | Embedded System Architecture | Introduction to Blockchain(prabhjyot) | Data Mining and Predictive Modeling | Network Security(prabhjyot) |
| **DE-III** | Privacy & Security in IoT | Blockchain Architecture Design and Use Cases | Data Warehouse & Multidimensional Modeling | Android Security |
| **DE-IV** | Sensors and Actuator Devices | Public Blockchain-Ethereum | Business Intelligence | Disaster recovery and business continuity management |
| **DE-V** | Software defined Networks | Blockchain and Distributed Ledger Technology | R programming | Digital Watermarking and Steganography |
| **DE-VI** | Architecting smart IoT Devices | Crypto Currency Technologies | Social, Web & Mobile Analytics | Biometrics |

# IoT

**Wireless Ad-hoc and sensor Networks**

| | | | | | | |
|---|---|---|---|---|---|---|
| **1. Name of the Department- Computer Science & Engineering** | | | | | | |
| **2. Course Name** | **Wireless Ad-hoc and sensor Networks** | **L** | **T** | | **P** | |
| **3. Course Code** | | **3** | **0** | | **2** | |
| **4. Type of Course (use tick mark)** | | **Core (√)** | **PE(√)** | | **OE ()** | |
| **5. Pre-requisite (if any)** | Basics of Networking | **6. Frequency (use tick marks)** | Even () | Odd (√) | Either Sem() | Every Sem () |
| **7. Total Number of Lectures, Tutorials, Practical (assuming 12 weeks of one semester)** | | | | | | |
| **Lectures = 36** | | **Tutorials = 0** | **Practical = 0** | | | |

**8. Course Description**

This course will provide students with an understanding of wireless adhoc and sensor networks enable them to recognize the wide range of applicability of these networks and provide them with an understanding of the major design issues including topics such as protocol mechanisms and resource constraints.

**9. LearningObjectives:**

1. Learn Ad-hoc network and Sensor Network fundamentals.
2. Understand the different routing protocols.
3. Have an in-depth knowledge on sensor network architecture and design issues.
4. Understand the transport layer and security issues possible in Ad-hoc networks.

**10. Course Outcomes (COs):**

The students will be able to:

1. Know the basics of Ad-hoc networks and Wireless Sensor Networks.
2. Apply this knowledge to identify the suitable routing algorithm based on the network and user requirement.
3. Apply the knowledge to identify appropriate physical and MAC layer protocols.
4. Understand the transport layer and security issues possible in Ad-hoc and sensor networks.

**11. Unit wise detailed content**

| **Unit-1** | **Number of lectures = 9** | |
|---|---|---|

**Wireless AD HOC NETWORKS – INTRODUCTION AND ROUTING PROTOCOLS:**Fundamentals of Wireless Communication Technology -The Electromagnetic Spectrum - Radio propagation Mechanisms - Characteristics of the Wireless channel mobile ad hoc networks (MANETs) - Applications of Ad Hoc and Sensor Networks - Design Challenges in Ad hoc and Sensor Networks. Elements of Ad hoc Wireless Networks, Issues in Ad hoc wireless networks, Example commercial applications of Ad hoc networking.

| **Unit – 2** | **Number of lectures = 9** | |
|---|---|---|

**MAC PROTOCOLS FOR AD HOC WIRELESS NETWORKS**: Issues in designing a MAC Protocol - Issues in Designing a MAC Protocol for Ad Hoc Wireless Networks - Design Goals of a MAC Protocol for Ad Hoc Wireless Networks - Classification of MAC Protocols -Contention based protocols - Contention based protocols with Reservation Mechanisms - Contention based protocols with Scheduling Mechanisms - Multi channel MAC - IEEE 802.11.

| Unit – 3 | Number of lectures = 9 | |
|---|---|---|

**ROUTING PROTOCOLS AND TRANSPORT LAYER IN AD HOC WIRELESS Networks:** Routing Protocol: Issues in designing a routing protocol for Ad hoc networks - Classification- proactive routing - reactive routing (on-demand) - hybrid routing - Transport Layer protocol for Ad hoc networks - Design Goals of a Transport Layer Protocol for Ad Hoc Wireless Networks -Classification of Transport Layer solutions-TCP over Ad hoc wireless - Network Security - Security in Ad Hoc Wireless Networks - Network Security Requirements

| Unit – 4 | Number of lectures = 9 | |
|---|---|---|

**WIRELESS SENSOR NETWORKS (WSNS) AND MAC PROTOCOLS**: Single node architecture: hardware and software components of a sensor node -WSN Network architecture: typical network architectures -data relaying and aggregation strategies -MAC layer protocols: self-organizing - Hybrid TDMA/FDMA and CSMA based MAC -IEEE 802.15.4.

**WSN ROUTING, LOCALIZATION & QOS:** Issues in WSN routing –OLSR - Localization –Indoor and Sensor Network Localization - absolute and relative localization - triangulation - QOS in WSN - Energy Efficient Design – Synchronization.

**12. Brief Description of self-learning / E-learning component**

The students will be encouraged to learn using the SGT E-Learning portal and choose the relevant lectures delivered by subject experts of SGT University.
The link to the E-Learning portal.
https://elearning.sgtuniversity.ac.in/course-category/

**13. Books Recommended**

**Text Books**


- Holger Karl , Andreas willig, ―Protocol and Architecture for Wireless Sensor Networks‖, John wiley publication, Jan 2006.
- C. Siva Ram Murthy, and B. S. Manoj, "Ad Hoc Wireless Networks: Architectures and Protocols ", Pearson Education, 2008.
- Labiod. H, "Wireless Adhoc and Sensor Networks", Wiley, 2008.
- Li, X, "Wireless ad -hoc and sensor Networks: theory and applications", Cambridge University Press, 2008.


**14. Reference Books**


- Feng Zhao, Leonidas Guibas, ―Wireless Sensor Networks: an information processing approach‖, Elsevier publication, 2004.
- Charles E. Perkins, ―Ad Hoc Networking‖, Addison Wesley, 2000.
- I.F. Akyildiz, W. Su, Sankarasubramaniam, E. Cayirci, ―Wireless sensor networks: a survey‖, computer networks, Elsevier, 2002, 394 - 422.
- Carlos De Morais Cordeiro, Dharma Prakash Agrawal "Ad Hoc & Sensor Networks: Theory and Applications", World Scientific Publishing Company, 2nd edition, 2011.
- Feng Zhao and Leonides Guibas, "Wireless Sensor Networks", Elsevier Publication.
- Holger Karl and Andreas Willig "Protocols and Architectures for Wireless Sensor Networks", Wiley, 2005 (soft copy available).
- Kazem Sohraby, Daniel Minoli, & Taieb Znati, "Wireless Sensor Networks Technology, Protocols, and Applications", John Wiley, 2007(soft copyavailable).
- Anna Hac, "Wireless Sensor Network Designs", John Wiley, 2003(soft copy available).

**Wireless Ad-hoc and sensor Networks Lab**

| | | | | | | |
|---|---|---|---|---|---|---|
| **1. Name of the Department- Computer Science & Engineering** | | | | | | |
| **2. Course Name** | **Wireless Ad-hoc and sensor Networks Lab** | **L** | **T** | | **P** | |
| **3. Course Code** | | **3** | **0** | | **2** | |
| **4. Type of Course (use tick mark)** | | **Core (√)** | **PE(√)** | | **OE ()** | |
| **5. Pre-requisite (if any)** | Basics of Networking | **6. Frequency (use tick marks)** | Even () | Odd (√) | Either Sem() | Every Sem () |
| **7. Total Number of Lectures, Tutorials, Practical (assuming 12 weeks of one semester)** | | | | | | |
| **Lectures = 0** | | **Tutorials = 0** | **Practical = 48** | | | |

**8. Course Description**

This course will provide students with an understanding of wireless adhoc and sensor networks enable them to recognize the wide range of applicability of these networks and provide them with an understanding of the major design issues including topics such as protocol mechanisms and resource constraints.

**10. LearningObjectives:**

1. Learn Ad-hoc network and Sensor Network fundamentals.
2. Understand the different routing protocols.
3. Have an in-depth knowledge on sensor network architecture and design issues.
4. Understand the transport layer and security issues possible in Ad-hoc networks.

**10. Course Outcomes (COs):**

The students will be able to:

1. Describe the unique issues in ad-hoc/sensor networks.
2. Describe current technology trends for the implementation and deployment of wireless ad-hoc networks.
3. Discuss the challenges in designing MAC, routing and transport protocols for wireless ad-hoc networks.
4. Discuss the challenges in designing routing and transport protocols for wireless Ad-hoc networks

**11. List of Experiments**

1. Installation of NS2 in Ubuntu 12.04 Linux.
2. Build and exchange data in simple infrastructure and Adhoc network by using personal computer and Android based mobile.
3. Develop sample wireless network in which implement AODV and AOMDV protocol.
4. Calculate the time to receive reply from the receiver using NS2.
5. Generate graphs which show the transmission time for packet.
6. Implement wireless network. Capture data frame and identify fields using NS2.
7. Configure Wireless Access Point (WAP) and build different networks.
8. Implement Mobile device as a wireless access point.
9. Communicate between two different networks
10. Case study on Security in wireless Ad hoc wireless Networks.

**Embedded System Architecture**

<table>
<tr><td colspan="8">1. Name of the Department- Computer Science & Engineering</td></tr>
<tr><td>2. Course Name</td><td colspan="2">Embedded System Architecture</td><td colspan="2">L</td><td colspan="2">T</td><td>P</td></tr>
<tr><td>3. Course Code</td><td colspan="2"></td><td colspan="2">3</td><td colspan="2">0</td><td>2</td></tr>
<tr><td colspan="2">4. Type of Course (use tick mark)</td><td colspan="2">Core (√)</td><td colspan="2">PE(√)</td><td colspan="2">OE ()</td></tr>
<tr><td>5. Pre-requisite (if any)</td><td>Basic knowledge of Microprocessors and microcontrollers</td><td colspan="2">6. Frequency (use tick marks)</td><td>Even (√)</td><td>Odd ()</td><td>Either Sem()</td><td>Every Sem ()</td></tr>
<tr><td colspan="8">7. Total Number of Lectures, Tutorials, Practical (assuming 12 weeks of one semester)</td></tr>
<tr><td colspan="3">Lectures = 36</td><td colspan="2">Tutorials = 0</td><td colspan="3">Practical = 0</td></tr>
<tr><td colspan="8">8. Course Description</td></tr>
<tr><td colspan="8">.In this class, the fundamentals of embedded system hardware and firmware design will be explored. Issues such as embedded processor selection, hardware/firmware partitioning, glue logic, circuit design, circuit layout, circuit debugging, development tools, firmware architecture, firmware design, and firmware debugging will be discussed. The Intel 8051, a very popular microcontroller, will be studied. The architecture and instruction set of the microcontroller will be discussed, and a wirewrapped microcontroller board will be built and debugged by each student. The course will culminate with a significant final project which will extend the base microcontroller board completed earlier in the course. Learning may be supplemented with periodic guest lectures by embedded systems engineers from industry. Depending on the interests of the students, other topics may be covered.</td></tr>
<tr><td colspan="8">11. LearningObjectives:<br>1. To understand the major components that constitute an embedded system<br>2. To implement programs in embedded to solve well- defined problems on an embedded platform<br>3. To develop familiarity with tool used to develop an embedded environment</td></tr>
<tr><td colspan="8">10. Course Outcomes (COs):</td></tr>
<tr><td colspan="8">The students will be able to:-<br>1. Understand hardware and software design requirements of embedded systems.<br>2. Analyze the embedded systems' specification and develop software programs<br>3. Evaluate the requirements of programming Embedded Systems, related software architectures and tool chain for Embedded Systems</td></tr>
<tr><td colspan="8">11. Unit wise detailed content</td></tr>
<tr><td>Unit-1</td><td colspan="2">Number of lectures = 9</td><td colspan="5">Overview of Embedded Systems</td></tr>
<tr><td colspan="8">Overview of Embedded Systems:Definition of embedded system, Characteristics of an Embedded System, Types of Embedded Systems, and quality attributes of embedded systems, Challenges in Embedded System Design, Application and Domain specific embedded systems.</td></tr>
<tr><td>Unit – 2</td><td colspan="2">Number of lectures = 9</td><td colspan="5">Embedded Communication Protocols</td></tr>
</table>

**Core of Embedded Systems:**Basics of Architecture: Vonneuman architecture, Harvard Architecture, RISC and CISC controllers,Architecture of PIC18F microcontroller, Registers & Memory of PIC18F, Special function registers.
**Network Embedded Systems:** Why Network Embedded Systems, Common Methods Of Networking, Examples Of Networked Embedded Systems. Controller Area Network: basics of CAN, CAN physical layer, CAN message format, Error control, error process, error detection, CAN applications.

| **Unit – 3** | **Number of lectures = 9** | Embedded Systems development Environment |
|---|---|---|

**Embedded Communication Protocols: E**mbedded Networking: Introduction–Serial / Parallel Communication–Serial communication protocols - RS232 standard – RS485 – Synchronous Serial Protocols - Serial Peripheral Interface (SPI) – Inter Integrated Circuits (I2C) –Wireless communication: WLANs, Bluetooth, Piconet, Scatter net
**Embedded System development environment** - IDE, Types of file generated on cross compilation, disassembler / decompile, simulator, emulator and debugging, embedded product development life-cycle, trends in embedded industry.

| **Unit – 4** | **Number of lectures = 9** | **Embedded Systems Security** |
|---|---|---|

**Networked Embedded Systems Security:** Security threats of embedded systems, effect of the attacks, challenges in security of embedded systems, counter measures

**Controller Area Network:** Controller Area Network – Underlying Technology, CAN Overview – Selecting a CAN Controller – CAN development tools. Implementing CAN open Communication layout and requirements – Comparison of implementation methods – Micro CAN open – CAN open source code – Conformance test – Entire design life cycle.

**12. Brief Description of self-learning / E-learning component**
The students will be encouraged to learn using the SGT E-Learning portal and choose the relevant lectures delivered by subject experts of SGT University.
The link to the E-Learning portal.
https://elearning.sgtuniversity.ac.in/course-category/

**13. Books Recommended**

**Text Books**

- Embedded Systems Architecture Programming and Design by Raj Kamal, II edition, Tata MC Graw-Hill
- Designing Embedded Systems with PIC Microcontrollers: principles and applications by Tim Wilmshurst, Elsevier

**14. Reference Books**

- Tammy Noergard, “Embedded system architecture”, Elsevier, 2006.
- Embedded Systems Design by Steve Heath, II edition, Newnes publications
- Embedded Systems Architecture: A Comprehensive Guide for Engineers and Programmers by Tammy Noergaard, Elsevier.

**Embedded System Architecture Lab**

| | | | | | | |
|---|---|---|---|---|---|---|
| **1. Name of the Department- Computer Science & Engineering** | | | | | | |
| **2. Course Name** | **Embedded System Architecture Lab** | **L** | **T** | | **P** | |
| **3. Course Code** | | **3** | **0** | | **2** | |
| **4. Type of Course (use tick mark)** | | **Core (√)** | **PE(√)** | | **OE ()** | |
| **5. Pre-requisite (if any)** | Basics of Networking | **6. Frequency (use tick marks)** | Even (√) | Odd () | Either Sem() | Every Sem () |
| **7. Total Number of Lectures, Tutorials, Practical (assuming 12 weeks of one semester)** | | | | | | |
| **Lectures = 0** | | **Tutorials = 0** | **Practical = 48** | | | |

**8. Course Description**

This course will provide students with an understanding of wireless adhoc and sensor networks enable them to recognize the wide range of applicability of these networks and provide them with an understanding of the major design issues including topics such as protocol mechanisms and resource constraints.

**12. LearningObjectives:**

1. Learn Ad-hoc network and Sensor Network fundamentals.
2. Understand the different routing protocols.
3. Have an in-depth knowledge on sensor network architecture and design issues.
4. Understand the transport layer and security issues possible in Ad-hoc networks.

**10. Course Outcomes (COs):**

The students will be able to:

1. Describe the unique issues in ad-hoc/sensor networks.
2. Describe current technology trends for the implementation and deployment of wireless ad-hoc networks.
3. Discuss the challenges in designing MAC, routing and transport protocols for wireless ad-hoc networks.
4. Discuss the challenges in designing routing and transport protocols for wireless Ad-hoc networks

**11. List of Experiments**

Using Embedded C Note: Any 10 Programs form the following

1. Write a simple program to print “hello world”

2. Write a simple program to show a delay.

3. Write a loop application to copy values from P1 to P2

4. Write a c program for counting the no of times that a switch is pressed & released.

5. Illustrate the use of port header file (port M) using an interface consisting of a keypad and liquid crystal display.

6. Write a program to create a portable hardward delay.

7. Write a c program to test loop time outs.

8. Write a c program to test hardware based timeout loops.

9. Develop a simple EOS showing traffic light sequencing.

10. Write a program to display elapsed time over RS-232 link.

11. Write a program to drive SEOS using Timer 0.

12. Develop software for milk pasteurization system.

13. A Study of Code Composer Studio (CC Studio Latest Version)

14. Flashing a light by a software delay.
15. Displaying Characters on LCD.
16. Serial Communication using UART.
17. Basic Input and Output using MSP430 UART.
18. Interrupt Handling using MSP430.
19. Analog to Digital Conversion using MSP430.
20. Interfacing external Devices to GPIO Ports

**12. Brief Description of self-learning / E-learning component**

http://vlabs.iitkgp.ac.in/

**Privacy and security in IoT**

| | | | | | | |
|---|---|---|---|---|---|---|
| **1. Name of the Department- Computer Science & Engineering** | | | | | | |
| **2. Course Name** | **Privacy and security in IoT** | **L** | **T** | | **P** | |
| **3. Course Code** | | **3** | **0** | | **2** | |
| **4. Type of Course (use tick mark)** | | **Core (√)** | **PE(√)** | | **OE ()** | |
| **5. Pre-requisite (if any)** | Basics of Information Technology, Discrete Mathematics, Computer Network | **6. Frequency (use tick marks)** | Even () | Odd (√) | Either Sem() | Every Sem () |
| **7. Total Number of Lectures, Tutorials, Practical (assuming 12 weeks of one semester)** | | | | | | |
| **Lectures = 36** | | **Tutorials = 0** | **Practical = 0** | | | |

**8. Course Description**

The course begins with the introduction of classical cryptography and mathematics used in modern cryptography. The student are then introduced to Symmetric key algorithm, Asymetric key algorithm hash function Digital signature in real life.

The course further emphasizes on the concept of Digital certificate, E-mail security, Web security.

**LearningObjectives:**

1. Develop understanding among the students about the various encryption techniques and concept of Public key cryptography.
2. Demonstrate methods to apply hash functions, digital signature and security practices which are adopted
3. Teach use and application of usage and development of the security services

**Course Outcomes (COs):**

The students will be able to:-

1. Understand several types of attacks and Cryptographic protocols
2. Calculate hash values, implement Digital Signature and Digital certificate.
3. Compare within different Network Security applications and Firewalls.

**11. Unit wise detailed content**

| | | |
|---|---|---|
| **Unit-1** | **Number of lectures = 9** | *Mathematical Background* |

FOUNDATIONS OF CRYPTOGRAPHY TECHNIQUES: Services, Mechanisms and attacks - Network security model- Classical Encryption techniques. FINITE FIELDS AND NUMBER THEORY: Groups, Rings, Fields - Modular arithmetic – Euclid's algorithm - Finite fields - Polynomial Arithmetic – Prime numbers-Fermat's and Euler's theorem - Testing for primarily - The Chinese remainder theorem - Discrete logarithms.

**Symmetric and Asymmetric Algorithm:** Data Encryption Standard - Block cipher principles - block cipher modes of operation - Advanced Encryption Standard (AES) - Triple DES - Blowfish - RC5 algorithm. Public key cryptography: Principles of public key cryptosystems - The RSA algorithm - Key management

| | | |
|---|---|---|
| **Unit – 2** | **Number of lectures = 9** | **Hash Function and System Security Practice** |

Authentication and Hash Functions: requirement – Authentication function – MAC – Hash function – Security of hash function and MAC –MD5 – SHA – HMAC – CMAC – Digital signature and authentication protocols – DSS – EI Gamal – Schnorr Algorithm
Network Security Authentication applications – Kerberos – X.509 Authentication services – Internet Firewalls for Trusted System: Roles of Firewalls – Firewall related terminology- Types of Firewalls – Firewall designs – SET for E-Commerce Transactions. Intruder – Intrusion detection system – Virus and related threats – Countermeasures – Firewalls design principles – Trusted systems – Practical implementation of cryptography and security.

| **Unit – 3** | **Number of lectures = 9** | **Email and Web Security** |
|---|---|---|

**E**-mail security: Security Services for E-mail - attacks possible through E-mail – establishing keys privacy - authentication of the source - Message Integrity - Non-repudiation - Pretty Good Privacy-S/MIME.

| **Unit – 4** | **Number of lectures = 9** | **IpSecurity** and **Web Security** |
|---|---|---|

IPSecurity: Overview of IPSec – IP and IPv6 - Authentication Header - Encapsulation Security Payload (ESP) - Internet Key Exchange (Phases of IKE, ISAKMP/IKE Encoding).

Web Security: SSL/TLS Basic Protocol - computing the keys - client authentication - PKI as deployed by SSL Attacks fixed in v3 - Exportability - Encoding - Secure Electronic Transaction (SET).

**12. Brief Description of self-learning / E-learning component**

The students will be encouraged to learn using the SGT E-Learning portal and choose the relevant lectures delivered by subject experts of SGT University.
The link to the E-Learning portal.
https://elearning.sgtuniversity.ac.in/course-category/

**13. Books Recommended**

**Text Books**

- William Stallings, Cryptography and Network Security, 6th Edition, Pearson Education.
- Behrouz A. Forouzan, Cryptography & Network Security, 2nd Edition, Tata McGraw Hill

**14. Reference Books**

R1: Alfred J. Menezes, Paul C. van Oorschot, Scott A. Vanstone, "Handbook of Applied Cryptography", CRC Press, 1997.
R2: OdedGoldreich, "Foundations of Cryptography: A Primer", Second Edition, NOW Publishers, USA.
R3: Charlie Kaufman and Radia Perlman, Mike Speciner, “Network Security, Private Communication in Public World”, Second Edition, Prentice Hall of India, 2002.

**Privacy & Security in IoT Lab**

| | | | | | | |
|---|---|---|---|---|---|---|
| **1. Name of the Department- Computer Science & Engineering** | | | | | | |
| **1. Course Name** | **Privacy & Security in IoT Lab** | **L** | **T** | | **P** | |
| **2.Course Code** | | **3** | **0** | | **2** | |
| **3. Type of Course (use tick mark)** | | **Core (√)** | **PE(√)** | | **OE ()** | |
| **4. Pre-requisite (if any)** | | **5. Frequency (use tick mark)** | Even () | Odd (√) | Either Sem() | Every Sem () |
| **6. Total Number of Lectures, Tutorials, Practical (assuming 12 weeks of one semester)** | | | | | | |
| **Lectures = 0** | | **Tutorials = 0** | **Practical = 24** | | | |

**7. Course Description:** students will learn the introduction (EEE 4717) on the security of Internet-of-Things and Cyber-Physical Systems by gaining hands-on training on real IoT and CPS devices. Students will demonstrate the ability to develop security solutions utilizing the state-ofthe art IoT and CPS devices.

**Learning objectives:**

1. Impart strong technical understanding security mechanisms within the IoT
2. Introduce application areas, current practices, and research activity
3. Develop familiarity of current technologies, tools, and implementation strategies

**8. Course Outcomes (COs):**

1. Students will learn the fundamental security mechanisms within the IoT and CPS realms.
2. Students will understand the advanced concepts in software and hardware architecture of the IoT and CPS devices.
3. Students will the advanced design principles for the IoT and CPS platforms.

**9. List of Experiments**

1. Internet of Things (IoT) and Cyber-Physical Systems (CPS) concepts
2. IoT and CPS platforms (Google Glass, Google Nest Thermostat, Google Watch, MS Kinect, iRobot Create, etc.)
3. Software architecture of IoT and CPS devices
4. Hardware architecture of IoT and CPS devices
5. Distributed networking concepts in IoT and CPS platforms
6. Fundamental security services
7. Confidentiality, integrity, authentication in IoT and CPS
8. Access control, non-repudiation, availability in IoT and CPS
9. Key management in IoT and CPS
10. Intrusion detection and prevention in IoT and CPS
11. Malicious software in IoT and CPS
12. Digital forensics in IoT and CPS
13. Energy-efficient design principles in Iot and CPS
14. Privacy-preserving operations in IoT and CPS

**Sensors and Actuator Devices**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Name of the Department: Electronics and Communication Engineering** | | | | | | | |
| **Course Name** | **Sensors and Actuator Devices** | **L** | **T** | **P** | | | |
| **Course Code** | | **3** | **0** | **0** | | | |
| **Type of Course (use tick mark)** | **Core ()** | **PE(✓)** | **OE()** | | | | |
| **Pre-requisite (if any)** | **Measurements and Instrumentation** | **Frequency (use tick marks)** | Even (√) | Odd () | Either Sem() | Every Sem () | |
| **Total Number of Lectures, Tutorials, Practical (assuming 12 weeks of one semester)** | | | | | | | |
| **Lectures = 36** | **Tutorials = 00** | **Practical = 0** | | | | | |

**Course Description:** This course deals with the different type of sensors and transducers. This also describe their role to know the domain status. It alos deals with the process to further processing of sensing elements.

**Learning objectives:** By the completion of the course, you should be able to:

1. Educate students to understand the functioning of different types of sensors & their role in order to sense various parameters.
2. To utilize the status of different signal parameters in the real time application to conrol the working.

**Course Outcomes:** On completion of this course, the students will be able to

1. Select the correct sensor for an given problem.
2. And also capable to interface that sensor with the processor for further processing.

1. Unit wise detailed content

| | | |
|---|---|---|
| **Unit-1** | **Number of lectures = 12** | Introduction to Sensors |

Principle of sensing & transduction , classification of sensors, Resistive sensors, Inductive sensor, Ferromagnetic plunger type, short analysis;

| | | |
|---|---|---|
| **Unit-2** | **Number of lectures = 8** | Capacitive sensors: & Piezoelectric sensors |

variable distance-parallel plate type, variable area- parallel plate, serrated plate/teeth type and cylindrical type, variable dielectric constant type,

Stretched diaphragm type: microphone, response characteristics;

Piezoelectric element: piezoelectric effect, crystal model, force & stress sensing, ultrasonic sensors.

| | | |
|---|---|---|
| **Unit-3** | **Number of lectures = 6** | Thermal sensors |

Material expansion type: solid, liquid, gas & vapor;

Resistance change type: RTD materials, tip sensitive & stem sensitive type.

Thermo emf sensor: Thermoelectric power, Junction semiconductor type IC and PTAT Type;

Radiation sensors: LDR, Photovoltaic cells, photodiodes;

| | | |
|---|---|---|
| **Unit-4** | **Number of lectures = 8** | Magnetic Sensors |

Sensor based on Villari effect for assessment of force, torque, proximity, Wiedemann effect for yoke coil sensors, Thomson effect, Hall effect, and Hall drive, performance characteristics;

2. Brief Description of self learning / E-learning component

The students will be encouraged to learn using the SGT E-Learning portal and choose the relevant lectures delivered by subject experts of SGT University. The link to the E-Learning portal.
https://elearning.sgtuniversity.ac.in/course-category/

3. Books Recommended

- Sensor & transducers, D. Patranabis, 2nd edition, PHI
- Instrument transducers, H.K.P. Neubert, Oxford University press.
- Measurement systems: application & design, E. A. Doebelin, Mc Graw Hill.

**Software Defined Networks**

<table>
<tr><td colspan="8">1. Name of the Department- Computer Science & Engineering</td></tr>
<tr><td>2. Course Name</td><td colspan="2">Software Defined Networks</td><td>L</td><td>T</td><td colspan="2">P</td><td></td></tr>
<tr><td>3. Course Code</td><td colspan="2"></td><td>3</td><td>0</td><td colspan="2">2</td><td></td></tr>
<tr><td colspan="2">4. Type of Course (use tick mark)</td><td>Core (✓)</td><td colspan="2">PE(√)</td><td colspan="2">OE ()</td><td></td></tr>
<tr><td>5. Pre-requisite (if any)</td><td colspan="2">Computer Basics</td><td>6. Frequency (use tick marks)</td><td>Even ()</td><td>Odd (✓)</td><td>Either Sem()</td><td>Every Sem ()</td></tr>
<tr><td colspan="8">7. Total Number of Lectures, Tutorials, Practical (assuming 12 weeks of one semester)</td></tr>
<tr><td colspan="3">Lectures = 36</td><td colspan="2">Tutorials = 0</td><td colspan="3">Practical = 0</td></tr>
<tr><td colspan="8">8. Course Description</td></tr>
<tr><td colspan="8">This course introduces about software defined networking, an emerging paradigm in computer networking that allows a logically centralized software program to control the behavior of an entire network.</td></tr>
<tr><td colspan="8">13. LearningObjectives:<br>1. To aware students about Software Defined Networks<br>2. To promote the development of computer-related skills for immediate application toother curriculararеas.<br>3. To provide a foundation for post-secondaryeducation.<br>4. To facilitate the development and application of problem-solving skills instudents.</td></tr>
<tr><td colspan="8">10. Course Outcomes (COs):</td></tr>
<tr><td colspan="8">The students will be able to:-<br>1. Explain the key benefits of SDN by the separation of data and control planes<br>2. Interpret the SDN data plane devices and Openflow Protocols<br>3. Implement the operation of SDN control plane with different controllers<br>4. Apply techniques that enable applications to control the underlying network using SDN<br>5. Describe Network Functions Virtualization components and their roles in SDN</td></tr>
<tr><td colspan="8">11. Unit wise detailed content</td></tr>
<tr><td>Unit-1</td><td colspan="2">Number of lectures = 9</td><td colspan="5"></td></tr>
<tr><td colspan="8">SDN Background and Motivation<br>Evolving network requirements-The SDN Approach: Requirements, SDN Architecture, Characteristics of Software-Defined Networking, SDN and NFV-Related Standards: Standards-Developing Organizations, Industry Consortia, Open Development Initiatives.</td></tr>
<tr><td>Unit – 2</td><td colspan="2">Number of lectures = 9</td><td colspan="5"></td></tr>
<tr><td colspan="8">SDN Data plane and OpenFlow<br>SDN data plane: Data plane Functions, Data plane protocols, Openflow logical network Device: Flow table Structure, Flow Table Pipeline, The Use of Multiple Tables, Group Table- OpenFlow Protocol.</td></tr>
<tr><td>Unit – 3</td><td colspan="2">Number of lectures = 9</td><td colspan="5"></td></tr>
</table>

SDN Control Plane
SDN Control Plane Architecture: Control Plane Functions, Southbound Interface, Northbound Interface, Routing, ITU-T Model- OpenDaylight-REST- Cooperation and Coordination Among Controllers.
SDN Application Plane
SDN Application Plane Architecture: Northbound Interface, Network Applications, User Interface- Network Services Abstraction Layer: Abstractions in SDN, Frenetic- Traffic Engineering Measurement and Monitoring- Security- Data Center Networking- Mobility and Wireless.

| **Unit – 4** | **Number of lectures = 9** | |
|---|---|---|

**Network Functions Virtualization**

Background and Motivation for NFV- Virtual Machines- NFV Concepts: Simple Example of the Use of NFV, NFV Principles, High-Level NFV Framework, NFV Benefits and Requirements- NFV Reference Architecture: NFV Management and Orchestration.

**12. Brief Description of self-learning / E-learning component**

The students will be encouraged to learn using the SGT E-Learning portal and choose the relevant lectures delivered by subject experts of SGT University.
The link to the E-Learning portal.
https://elearning.sgtuniversity.ac.in/course-category/

**13. Books Recommended**

**Text Books**

- Software Defined Networks: A Comprehensive Approach by Paul Goransson and Chuck Black,Morgan Kaufmann Publications, 2014
- SDN - Software Defined Networks by Thomas D. Nadeau & Ken Gray, O'Reilly, 2013

**14. Reference Books**


- Feamster, Nick, Jennifer Rexford, and Ellen Zegura. "The road to SDN: an intellectual history of programmable networks." ACM SIGCOMM Computer Communication Review 44.2 (2014): 87-98..
- Kreutz, Diego, et al. "Software-defined networking: A comprehensive survey." Proceedings of the IEEE 103.1 (2015): 14-76.

**Software defined Networks Lab**

<table>
<tr><td colspan="8">1. Name of the Department- Computer Science & Engineering</td></tr>
<tr><td colspan="2">2. Course Name</td><td>Software defined NetworksLab</td><td>L</td><td colspan="2">T</td><td colspan="2">P</td></tr>
<tr><td colspan="2">3. Course Code</td><td></td><td>3</td><td colspan="2">0</td><td colspan="2">2</td></tr>
<tr><td colspan="3">4. Type of Course (use tick mark)</td><td>Core (✓))</td><td colspan="2">PE(√)</td><td colspan="2">OE ()</td></tr>
<tr><td colspan="2">5. Pre-requisite (if any)</td><td></td><td>6. Frequency (use tick marks)</td><td>Even</td><td>Odd (✓)</td><td>Either Sem()</td><td>Every Sem ()</td></tr>
<tr><td colspan="8">7. Total Number of Lectures, Tutorials, Practical (assuming 14 weeks of one semester)</td></tr>
<tr><td colspan="3">Lectures = 0</td><td>Tutorials = 0</td><td colspan="4">Practical = 36</td></tr>
<tr><td colspan="8">8. Course Description</td></tr>
<tr><td colspan="8">9. Learningobjectives:<br>1. Understand what Mininet is and why it is useful for testing network topologies.<br>2. Invoke Mininet from the CLI.<br>3. Construct network topologies using the GUI.<br>4. Save/load Mininet topologies using the GUI.<br>5. Configure the interfaces of a router using the CLI.</td></tr>
<tr><td colspan="8">10. Course Outcomes (COs):</td></tr>
<tr><td colspan="8">1. Understand the features of SDN<br>2. Understand the use of Mininet<br>3. Understand theuse of Virtual Box</td></tr>
<tr><td colspan="8">11. List of Experiments</td></tr>
<tr><td colspan="8">Lab 1: Introduction to Mininet<br>Lab 2: Legacy Networks: BGP Example as a Distributed System and Autonomous Forwarding Decisions<br>Lab 3: Early efforts of SDN: MPLS Example of a Control Plane that Establishes Semi-static Forwarding Paths<br>Lab 4: Introduction to SDN<br>Lab 5: Configuring VXLAN to Provide Network Traffic Isolation<br>Lab 6: Introduction to OpenFlow<br>Lab 7: Routing within an SDN network<br>Lab 8: Interconnection between Legacy Networks and SDN Networks<br>Lab 9: Configuring Virtual Private LAN Service (VPLS)<br>Lab 10: Applying Equal-cost Multi-path Protocol (ECMP) within SDN networks</td></tr>
<tr><td colspan="8">12. Brief Description of self-learning / E-learning component<br><br>http://vlabs.iitb.ac.in/vlabs-dev/labs/oops/index.php</td></tr>
</table>

**Architecting smart IoT Devices**

| | | | | | | |
|---|---|---|---|---|---|---|
| **1. Name of the Department- Computer Science & Engineering** | | | | | | |
| **2. Course Name** | **Architecting smart IoT Devices** | **L** | **T** | | **P** | |
| **3. Course Code** | | **3** | **0** | | **2** | |
| **4. Type of Course (use tick mark)** | | **Core (√)** | **PE(√)** | | **OE ()** | |
| **5. Pre-requisite (if any)** | | **6. Frequency (use tick marks)** | Even (√) | Odd () | Either Sem() | Every Sem () |
| **7. Total Number of Lectures, Tutorials, Practical (assuming 12 weeks of one semester)** | | | | | | |
| **Lectures = 36** | | **Tutorials = 0** | **Practical = 0** | | | |

**8. Course Description**

This course will teach you how to develop an embedded systems device. In order to reduce the time to market, many pre-made hardware and software components are available today.

**14. LearningObjectives:**

1. Identify different IoT Applications with IoT architecture.
2. Identify, test and interconnect components/parts of IoT system.
3. . Identify and test various parts of embedded system.
4. Identify and select various types of sensors used in Smart City.

**10. Course Outcomes (COs):**

1. Identify and test Smart Lighting system and its components
2. Identify, select, install and troubleshoot different module / devices used in SMART Street Light based on IoT and Cloud Technology.
3. Identify, select, install and troubleshoot different module / devices used in SMART Parking
4. Identify, select, install and troubleshoot different module / devices used in SMART Traffic.

**11. Unit wise detailed content**

| | | |
|---|---|---|
| **Unit-1** | **Number of lectures = 9** | |

**Fundamentals of Iot**

Evolution of Internet of Things – Enabling Technologies – IoT Architectures: oneM2M, IoT World Forum (IoTWF) and Alternative IoT Models – Simplified IoT Architecture and Core IoT Functional Stack – Fog,

| | | |
|---|---|---|
| **Unit – 2** | **Number of lectures = 9** | |

Edge and Cloud in IoT – Functional Blocks of an IoT Ecosystem -Sensors, Actuators, and Smart Objects – Open Hardware Platforms for IoT.

| | | |
|---|---|---|
| **Unit – 3** | **Number of lectures = 9** | |

Routing over Low Power and Lossy Networks (RPL) – Application Transport Methods: Application Layer Not Present, Supervisory Control and Data Acquisition (SCADA) -Application Layer Protocols: CoAP and MQTT – Service discovery – mDNS.

| Unit – 4 | Number of lectures = 9 | |
|---|---|---|
| Smart and Connected Cities: Street Layer, City Layer, Data Center Layer and Services Layer, Street Lighting, Smart Parking Architecture and Smart Traffic Control – Smart Transportation – Connected Cars. | | |

**12. Brief Description of self-learning / E-learning component**

The students will be encouraged to learn using the SGT E-Learning portal and choose the relevant lectures delivered by subject experts of SGT University.
The link to the E-Learning portal.
https://elearning.sgtuniversity.ac.in/course-category/

**13. Books Recommended**

**Text Books**

1. David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Rob Barton, Jerome Henry, "IoT Fundamentals: Networking Technologies, Protocols and Use Cases for Internet of Things", CISCO Press, 2017.

**14. Reference Books**


1. Perry Lea, "Internet of things for architects", Packt, 2018.
2. Jan Ho"ller, VlasiosTsiatsis, Catherine Mulligan, Stamatis, Karnouskos, Stefan Avesand, David Boyle, "From Machine-to-Machine to the Internet of Things -Introduction to a New Age of Intelligence", Elsevier, 2014.
3. Olivier Hersent, David Boswarthick, Omar Elloumi , "The Internet of Things – Key Applications and Protocols", Wiley, 2012.
4. Dieter Uckelmann, Mark Harrison, Michahelles, Florian (Eds), "Architecting the Internet of Things", Springer, 2011.

**Architecting smart IoT Devices Lab**

**1. Name of the Department:** Computer Science & Engineering

| | | | | | | |
|---|---|---|---|---|---|---|
| **Course Name** | **Architecting smart IoT Devices Lab** | **L** | **T** | | **P** | |
| **3. Course Code** | | **3** | **0** | | **2** | |
| **Type of Course (use tick mark)** | | **Core (√)** | **PE(√)** | | **OE ()** | |
| **Pre-requisite (if any)** | | **6. Frequency (use tick marks)** | Even (√) | Odd () | Either Sem() | Every Sem () |

**7. Total Number of Lectures, Tutorials, Practical (assuming 12 weeks of one semester)**

| | | |
|---|---|---|
| **lectures = 0** | **orials = 0** | **ctical = 24** |

**8. Brief Syllabus**

This course will teach you how to develop an embedded systems device. In order to reduce the time to market, many pre-made hardware and software components are available today.

**15. LearningObjectives:**

1. Identify different IoT Applications with IoT architecture.
2. Identify, test and interconnect components/parts of IoT system.
3. . Identify and test various parts of embedded system.
4. Identify and select various types of sensors used in Smart City.

**10 Course Outcomes (COs):**

1. Identify and test Smart Lighting system and its components
2. Identify, select, install and troubleshoot different module / devices used in SMART Street Light based on IoT and Cloud Technology.
3. Identify, select, install and troubleshoot different module / devices used in SMART Parking
4. Identify, select, install and troubleshoot different module / devices used in SMART Traffic.

**11. Lab Experiment**

| **No.** | **Title** |
|---|---|
| 1 | Development Tools and Environments. Debugging Basics. Debugging Specials. |
| 2 | Real-Time Scheduling. Synchronisation and Communication web tour. Device Drivers. Multithreading Design. |
| 3 | Hardware & Software for EmS |
| 4 | Study of a few Embedded Processor Families. MCU, SOC, FPGA. Cache, pipeline and coupling |
| 5 | Networks. Software Components |
| 6 | OS for IoTEvaluation reports on the embedded OS |

**12. Brief Description of self-learning / E-learning component**

# Blockchain

**Cryptography Fundamentals**

| | | | | | | |
|---|---|---|---|---|---|---|
| **Name of the Department- Computer Science and Engineering** | | | | | | |
| **Course Name** | **Cryptography Fundamentals** | **L** | **T** | | **P** | |
| **Course Code** | | **3** | **0** | | **2** | |
| **Type of Course (use tick mark)** | | **Core (√)** | **PE(√)** | | **OE ()** | |
| **Pre-requisite (if any)** | | **Frequency (use tick marks)** | Even () | Odd (√) | Either Sem () | Every Sem () |
| **Total Number of Lectures, Tutorials, Practical (assuming 12weeks of one semester)** | | | | | | |
| **Lectures = 36** | | **Tutorials = 0** | **Practical = 0** | | | |

**Course Description**

The course covers theory and practice of computer security, focusing in particular on the security aspects of the web and Internet. System security issues, such as viruses, intrusion, and firewalls, will also be covered.

**Learning objectives:**

1. Explain the importance and application of each of confidentiality, integrity, authenticationand availability
2. Understand various cryptographic algorithms.
3. Understand the basic categories of threats to computers andnetworks
4. Describe public-keycryptosystem.
5. To defend the security attacks.

**Course Outcomes (COs):**

On completion of this course, the students will be able to

1. Identify basic security attacks and services
2. Use symmetric and asymmetric key algorithms for cryptography
3. Analyze Key Management techniques and importance of number Theory.
4. Understanding of Authentication functions the manner in which Message Authentication Codes and Hash Functions works..

**Unit wise detailed content**

| | | |
|---|---|---|
| **Unit-1** | **Number of lectures = 08** | **Title of the unit: Attacks on Computers and Computer Security** |

Introduction: The need for security, Security approaches, Principles of security, Types of Security attacks.Introduction to Number Theory**:** Divisibility and the Division Algorithm, The Euclidean Algorithm, Modular Arithmetic, Prime Numbers and The Chinese Remainder Theorem.

| | | |
|---|---|---|
| **Unit – 2** | **Number of** | **Title of the unit: Symmetric key Ciphers** |
| | **lectures = 10** | |

Cryptography: Concepts and Techniques: Introduction, Plain text and Cipher text, Substitution Techniques, Transposition Techniques, Stenography.
Block Cipher principles &Algorithms: Stream Ciphers vs. Block Ciphers,Feistel networks,Data Encryption Standard (DES),International Data Encryption Algorithm (IDEA)Basics of finite fields,Advanced Encryption Standard (AES), Principles of Pseudorandom Number Generation: PRNGs, TRNGs.

| **Unit – 3** | **Number of lectures = 08** | **Title of the unit:Asymmetric key Ciphers** |
|---|---|---|

Asymmetric key Ciphers: Symmetric vs. Asymmetric Cryptography, Principles of public key cryptosystems, RSA Algorithm, Diffie-Hellman Key Exchange, Elliptic Curve Cryptography.
Key Management and Distribution: Key Establishment Using Symmetric-Key and Asymmetric Techniques, Distribution of Public Keys.

| **Unit – 4** | **Number of lectures = 10** | **Title of the unit: Data Integrity Algorithms** |
|---|---|---|

Applications of Cryptographic Hash Functions: Security Requirements of Hash Functions, Hash Algorithms (MD5 and SHA-1), Principles of Message Authentication Codes, HMAC, CMAC Principles of Digital Signatures, Elgamal Digital Signature Scheme, Digital Signature Algorithm (DSA).

**Brief Description of self-learning / E-learning component**
The students will be encouraged to learn using the SGT E-Learning portal and choose the relevant lectures delivered by subject experts of SGT University.

The link to the E-Learning portal.

https://elearning.sgtuniversity.ac.in/course-

category/Journal papers; Patents in the respective

field.

**Books Recommended**


i. W. Stallings, Cryptography and Network Security: Principles and Practice, 7th Ed. Pearson Publishers, 2017. (ISBN No.: 978-0-13-44446-11)

ii. Cryptography and Network Security : Atul Kahate, Mc Graw Hill Edition

iii. Understanding Cryptography: Christof Paarand Jan Pelzl,Springer Heidelberg Dordrecht London New York,ISBN 978-3-642-04100-6.

iv. D. R. Stinson, Cryptography: Theory and Practice, 3rd Ed. Boca Raton, FL: Chapman & Hall/CRC, 2005. (ISBN No.: 978-1-58-488508-5)

v. Information Security, Principles and Practice: Mark Stamp, Wiley India.

vi. Principles of Computer Security: WM.Arthur Conklin, Greg White, TMH

vii. Introduction to Network Security: Neal Krawetz, CENGAGE Learning

# Cryptography Fundamental Lab

| | | | | | | |
|---|---|---|---|---|---|---|
| **1. Name of the Department- Computer Science & Engineering** | | | | | | |
| **2. Course Name** | **Cryptography Fundamental Lab** | **L** | **T** | | **P** | |
| **3. Course Code** | | **3** | **0** | | **2** | |
| **4. Type of Course (use tick mark)** | | **Core (✓)** | **PE ()** | | **OE ()** | |
| **5. Pre-requisite (if any)** | | **6. Frequency (use tick marks)** | Even | Odd (✓) | Either Sem() | Every Sem () |
| **7. Total Number of Lectures, Tutorials, Practical (assuming 14 weeks of one semester)** | | | | | | |
| **Lectures = 0** | | **Tutorials = 0** | **Practical = 36** | | | |

**Course Description:** Cryptography is the practice of techniques used to protect the secure transmission of information. This course is an excellent starting point to understand what is cryptography, learn how cryptography is used, and understand hash, symmetric, and asymmetric cryptographic algorithms.

**10. Learningobjectives:**

1. Explain the importance and application of each of confidentiality, integrity, authenticationand availability
2. Understand various cryptographic algorithms.
3. Understand the basic categories of threats to computers andnetworks
4. Describe public-keycryptosystem.

**10. Course Outcomes (COs):**

1. Understand security concepts and type of attacks and network security algorithms.
2. Apply symmetric and asymmetric key cryptography technique to encrypt and decrypt text.
3. Apply the knowledge of symmetric key algorithm.
4. Apply Cryptography Hash Function for message authentication and to solve other applications.
5. Understand the concept of security with different key management things.

**11. List of Experiments**

1. Write a program to perform encryption and decryption for Ceaser cipher.
2. Write a program to implement Rail fence Cipher technique.
3. Write a program to implement the DES algorithm logic.
4. User A want to send message “welcome to SGT University” to user B by using AES algorithms encrypt it and decrypt it at receiver end.
5. Write a program to implement RSA algorithm.
6. Implement the Diffie-Hellman Key Exchange mechanism using HTML and JavaScript.
7. Write a program to implement Secure Hash Algorithm.
8. Calculate the message digest of a text using the MD5 algorithm in JAVA.
9. Write a program to implement digital Signature.

**Introduction to BlockChain**

| | | | | | | |
|---|---|---|---|---|---|---|
| **1. Name of the Department- Computer Science & Engineering** | | | | | | |
| **2. Course Name** | **Introduction to BlockChain** | **L** | **T** | | **P** | |
| **3. Course Code** | | **3** | **0** | | **2** | |
| **4. Type of Course (use tick mark)** | | **Core (✓)** | **PE(√)** | | **OE ()** | |
| **5. Pre-requisite (if any)** | Basic Programming & Cryptography | **6. Frequency (use tick marks)** | Even (√) | Odd () | Either Sem() | Every Sem () |
| **7. Total Number of Lectures, Tutorials, Practical (assuming 12 weeks of one semester)** | | | | | | |
| **Lectures =** | | **Tutorials = 0** | **Practical = 0** | | | |

**8. Course Description**

The course begins with the introduction of Blockchain Technology which is widely utilized in all engineering applications. The students are then introduced to the concept of Decentralization, on which Blockchain Technology Works. The course further emphasizes on the concept of Smart Contract, Digital Identity, and Bitcoin. Then the students are introduced about the implementation of Ethereum and Solidity in Blockchain Technology.

**16. LearningObjectives:**

1. Impart strong technical understanding of Blockchain technologies
2. Learn how the individual components of the Bitcoin protocol make the whole system tick: transactions, script, blocks, and the peer-to-peer network.
3. Discuss a few of the many best practices exclusive to smart contracts and Dapps that will improve your basic Dapp design.

**10. Course Outcomes (COs):**

The students will be able to:-

1. Blockchain Technology landscape
2. How Bitcoins works in practice: its storage, security measures, and types of services
3. How to build & test compelling blockchain applications using the Ethereum Blockchain

**11. Unit wise detailed content**

| | | |
|---|---|---|
| **Unit-1** | **Number of lectures = 9** | Introduction to Blockchain Technology |

The growth of blockchain technology, Distributed systems, The history of blockchain and Bitcoin, Electronic cash, Blockchain, Peer-to-peer, Distributed ledger, Cryptographically-secure, Append-only, Updateable via consensus, Generic elements of a blockchain, How blockchain works, How blockchain accumulatesblocks, Benefits and limitations of blockchain, Tiers of blockchain technology, Features of a blockchain, Types of blockchain, Distributed ledgers, Distributed Ledger Technology, Public blockchains, Private blockchains, Semiprivate blockchains, Sidechains, Permissioned ledger, Shared ledger, Fully private and proprietary blockchains, Tokenized blockchains, Tokenless blockchains, Consensus, Consensus mechanism, Types of consensus mechanisms, Consensus in blockchain, CAP theorem and blockchain. Decentralization using blockchain, Methods of decentralization, Routes to decentralization, Blockchain and full ecosystem decentralization, Smart contracts, Decentralized Organizations, Platforms for decentralization

| | | |
|---|---|---|
| **Unit – 2** | **Number of lectures = 9** | Satoshi's Bitcoin |

What Is Bitcoin?, History of Bitcoin, Bitcoin Uses, Users, and Their Stories, Getting Started. How Bitcoin Works: Transactions, Blocks, Mining, and the Blockchain, Bitcoin Transactions, Constructing a Transaction, Bitcoin Mining, Mining Transactions in Blocks, Spending the Transaction.

Introduction, Bitcoin Addresses, Implementing Keys and Addresses in Python, Wallets, Advanced Keys and Addresses. Introduction, Transaction Lifecycle, Transaction Structure, Transaction Outputs and Inputs, Transaction Chaining and Orphan Transactions, Transaction Scripts and Script Language, Standard Transactions

| **Unit – 3** | **Number of lectures = 9** | **The Bitcoin Network** and Advanced Theories |
|---|---|---|

Nodes Types and Roles, The Extended Bitcoin Network, Network Discovery, Full Nodes, Exchanging "Inventory", Simplified Payment Verification (SPV) Nodes. EthereumBasics :Components of a Blockchain, The Birth of Ethereum, Ethereum's Four Stages of Development, Ethereum: A General-Purpose Blockchain, Ethereum's Components, Ethereum and Turing Completeness, From General-Purpose Blockchains to DecentralizedApplications (DApps), The Third Age of the Internet, Ethereum's Development Culture, Why Learn Ethereum? Ether Currency Units, Choosing an Ethereum Wallet, Control and Responsibility, Getting Started with MetaMask

| **Unit – 4** | **Number of lectures = 9** | Ethereum Clients |
|---|---|---|

Ethereum Networks, Running an Ethereum Client, The First Synchronization of Ethereum-Based Blockchains, Remote Ethereum Clients.Smart Contracts and Solidity:What Is a Smart Contract?, Life Cycle of a Smart Contract, Introduction to Ethereum High-Level Languages, Building a Smart Contract with Solidity, The Ethereum Contract ABI, Programming with Solidity, Gas Considerations, Vulnerabilities and Vyper, Comparison to Solidity, Decorators, Function and Variable Ordering, Compilation, Protecting Against Overflow Errors at the Compiler Level, Reading and Writing

**12. Brief Description of self-learning / E-learning component**

The students will be encouraged to learn using the SGT E-Learning portal and choose the relevant lectures delivered by subject experts of SGT University.
The link to the E-Learning portal.
https://elearning.sgtuniversity.ac.in/course-category/

**13. Books Recommended**

**Text Books**


- Imran Bashir, "Mastering Blockchain: Distributed Ledger Technology, decentralization, and smart contracts explained", Packt Publishing, 2018.
- Andreas M. Antonopoulos, "Mastering Bitcoin: Unlocking Digital Cryptocurrencies", O'Reilly Publications, 2nd Edition.
- Melanie Swan, "Blockchain: Blueprint for a new economy", O'Reilly Publications, First Edition.


**14. Reference Books**


- Mark Gates, " Ethereum: Complete Guide to Understanding Ethereum, Blockchain, Smart Contracts, ICOs, and Decentralized Apps", Inverted Forest Publishing, 2016
- Chris Dannen, "Introducing Ethereum and Solidity", APress Publishing, 2017.
- EladErom, "The Blockchain Developer", APress Publishing, 2017
- Andreas M. Antonopoulos, "Mastering Bitcoin: Programming the Open Blockchain", O'Reilly Publications, First Edition

**Introduction to Blockchain Lab**

| | | | | | | |
|---|---|---|---|---|---|---|
| **10. Name of the Department- Computer Science & Engineering** | | | | | | |
| **11. Course Name** | **Introduction to Blockchain Lab** | **L** | **T** | | **P** | |
| **12. Course Code** | | **3** | **0** | | **2** | |
| **13. Type of Course (use tick mark)** | | **Core (√)** | **PE(√ )** | | **OE ()** | |
| **14. Pre-requisite (if any)** | | **15. Frequency (use tick marks)** | Even (√) | Odd () | Either Sem() | Every Sem () |
| **16. Total Number of Lectures, Tutorials, Practical (assuming 12 weeks of one semester)** | | | | | | |
| **Lectures = 0** | | **Tutorials = 0** | **Practical = 24** | | | |

**17. Course Description:** in this course, you will learn to create a website for your fictional startup and conduct an Initial Coin Offering (ICO). Here you will learn how to create your own crypto tokens.

**Learning objectives:**

1. Impart strong technical understanding of Blockchain technologies
2. Introduce application areas, current practices, and research activity
3. Develop familiarity of current technologies, tools, and implementation strategies

**18. Course Outcomes (COs):**

1. The student will be able to comfortably discuss and describe the history, technology, and applications of Blockchain (1)
2. The student will be able to assess Blockchain applications in a structured manner
3. The student will be able to present Blockchain concepts clearly and persuasively

**19. List of Experiments**

1. creating wallets and sending cryptocurrency
2. starting a Wordpress website
3. blockchain explorer
4. Introduction to bitcoin (history, distributed P2P network, immutable ledger, forks and Byzantine Fault Tolerance
5. History and the role of money
6. create your own cryptocurrency
7. Crypto-anarchism and Cypherpunks
8. Hash cryptography, mining and consensus
9. Proof-of-Work consensus
10. tokenization and trading cryptocurrencies
11. start your own ICO Exchanges
12. Smart contracts and dApps

**20. Brief Description of self-learning / E-learning component**

Andreas Antonopoulos, The internet of money, 2016

Paul Vigna & Michael J. Casey, The age of cryptocurrency, 2015

**Blockchain Architecture Design and Use Cases**

| | | | | | | |
|---|---|---|---|---|---|---|
| **1. Name of the Department- Computer Science & Engineering** | | | | | | |
| **2. Course Name** | **Blockchain Architecture Design and Use Cases** | **L** | **T** | | **P** | |
| **3. Course Code** | | **3** | **0** | | **2** | |
| **4. Type of Course (use tick mark)** | | **Core (✓)** | **PE(✓)** | | **OE ()** | |
| **5. Pre-requisite (if any)** | | **6. Frequency (use tick marks)** | Even () | Odd (✓) | Either Sem() | Every Sem () |
| **7. Total Number of Lectures, Tutorials, Practical (assuming 12 weeks of one semester)** | | | | | | |
| **Lectures = 36** | | **Tutorials = 0** | **Practical = 0** | | | |

**8. Course Description**

The primary objective of this course is to make the students familiar with such emerging technologies. Students are expected to understand the cryptographic concept behind the Blockchain technology and differentiate the technical aspect of Blockchain with that of Bitcoin commercial aspect. Students are supposed to understand and learn the use-cases and applications aspects of blockchain with implementation options

**17. LearningObjectives:**

1. Understand the difference between Blockchain and Bitcoin
2. Understand the strength and limitations of Blockchain
3. Understand the Application domain and use-cases of Blockchain
4. Understand consensus mechanism and mining process in Blockchain
5. Implement small Blockchain experimentations
6. Have introductory knowledge about Ethereum and Solidity

**10. Course Outcomes (COs):**

The students will be able to:-

1. Understand the concept of cryptocurrency and security features blockchain
2. Understand the concept of consensus mechanism and permissioned blockchain.
3. Practical applications of the blockchain in various domains.
4. Understand the concept of hyperleger,

**11. Unit wise detailed content**

| **Unit-1** | **Number of lectures = 9** | |
|---|---|---|

Introduction to Blockchain: Digital Money to Distributed Ledgers , Design Primitives: Protocols, Security, Consensus, Permissions, Privacy. Blockchain Architecture and Design: Basic crypto primitives: Hash, Signature,) Hashchain to Blockchain, Basic consensus mechanisms.

| **Unit – 2** | **Number of lectures = 9** | |
|---|---|---|

Consensus: Requirements for the consensus protocols, Proof of Work (PoW), Scalability aspects of Blockchain consensus protocols Permissioned Blockchains: Design goals, Consensus protocols for Permissioned Blockchains Mining: What is mining, Mining Difficulty, Miner, Mining pool, Mining pool methods

| **Unit – 3** | **Number of lectures = 9** | |
|---|---|---|

Hyperledger Fabric (A): Decomposing the consensus process, Hyperledger fabric components, Chaincode Design and Implementation

Hyperledger Fabric (B): Beyond Chaincode: fabric SDK and Front End (b) Hyperledger composer tool

| Unit – 4 | Number of lectures = 9 | |
|---|---|---|

Use case 1 : Blockchain in Financial Software and Systems (FSS): (i) Settlements, (ii) KYC, (iii) Capital markets, (iv) Insurance

Use case 2: Blockchain in trade/supply chain: (i) Provenance of goods, visibility, trade/supply chain finance, invoice management discounting, etc

Use case 3: Blockchain for Government: (i) Digital identity, land records and other kinds of record keeping between government entities, (ii) public distribution system social welfare systems Blockchain Cryptography, Privacy and Security on Blockchain

**12. Brief Description of self-learning / E-learning component**

The students will be encouraged to learn using the SGT E-Learning portal and choose the relevant lectures delivered by subject experts of SGT University.

The link to the E-Learning portal.

https://elearning.sgtuniversity.ac.in/course-category/

**13. Books Recommended**

**Text Books**

- Mastering Bitcoin: Unlocking Digital Cryptocurrencies, by Andreas Antonopoulos

**14. Reference Books**

- Blockchain by Melanie Swa, O'Reilly
- Hyperledger Fabric - https://www.hyperledger.org/projects/fabric 4.
- Zero to Blockchain - An IBM Redbooks course, by Bob Dill, David Smits - https://www.redbooks.ibm.com/Redbooks.nsf/RedbookAbstracts/crse0401.html

**Blockchain Architecture Design and Use Cases Lab**

| | | | | | | |
|---|---|---|---|---|---|---|
| **1. Name of the Department- Computer Science & Engineering** | | | | | | |
| **2. Course Name** | **Blockchain Architecture Design and Use Cases Lab** | **L** | **T** | **P** | | |
| **3. Course Code** | | **3** | **0** | **2** | | |
| **4. Type of Course (use tick mark)** | | **Core (√)** | **PE(√)** | **OE ()** | | |
| **5. Pre-requisite (if any)** | | **6. Frequency (use tick marks)** | Even () | Odd (✓) | Either Sem() | Every Sem () |
| **6. Total Number of Lectures, Tutorials, Practical (assuming 12 weeks of one semester)** | | | | | | |
| **Lectures = 0** | | **Tutorials = 0** | **Practical = 24** | | | |

**7. Course Description**

**Learning objectives:**

1. Impart strong technical understanding of Blockchain technologies
2. Introduce application areas, current practices, and research activity
3. Develop familiarity of current technologies, tools, and implementation strategies

**8. Course Outcomes (COs):**

1. Blockchain technology landscape
2. Applications and implementation strategies
3. Implementation and application of blockchain
4. Understand the State-of-the-art, open research challenges, and future directions
5.

**9. List of Experiments**

1) Basic Cryptography Concepts for Blockchain
2) Overview of Blockchain
3) Creating and Building Up Bitcoin Wallet.
4) Building a Private Ethereum Network and Deploying Smart Contract
5) Introduction to Solidity.
6) Ethereum Smart Contract
7) CLUSTERING MODEL
8) Creating and Building Up Crypto Token.
9) Creating a Business Network using Hyperledger.
10) Simple Project on Data Pre-processingHyperledger.

**10. Brief Description of self-learning / E-learning component**

https://nlp-iiith.vlabs.ac.in/

http://vlab.co.in/participating-institute-iiit-hyderabad

**Public Blockchain- Ethereum**

| | | | | | | |
|---|---|---|---|---|---|---|
| **1. Name of the Department- Computer Science & Engineering** | | | | | | |
| **2. Course Name** | **Public Blockchain-Ethereum** | **L** | **T** | | **P** | |
| **3. Course Code** | | **3** | **0** | | **0** | |
| **4. Type of Course (use tick mark)** | | **Core (√)** | **PE(√)** | | **OE ()** | |
| **5. Pre-requisite (if any)** | | **6. Frequency (use tick marks)** | Even (√) | Odd () | Either Sem() | Every Sem () |
| **7. Total Number of Lectures, Tutorials, Practical (assuming 12 weeks of one semester)** | | | | | | |
| **Lectures = 36** | | **Tutorials = 0** | **Practical = 0** | | | |

**8. Course Description**

This course is intended to study the basics of Blockchain technology. During this course learner will explore various aspects of Blockchain technology like application in various domains. By implementing learner will have idea about private and public Blockchain, and smart contract

**18. LearningObjectives:**

1. Impart strong technical understanding of Blockchain technologies
2. Learn how the individual components of the Bitcoin protocol make the whole system tick: transactions, script, blocks, and the peer-to-peer network.
3. Discuss a few of the many best practices exclusive to smart contracts and Dapps that will improve your basic Dapp design.

**10. Course Outcomes (COs):**

The students will be able to:-

1. Understand and explore the working of Blockchain technology (Understanding)
2. Analyze the working of Smart Contracts (Analyze)
3. Apply the learning of solidity and de-centralized apps on Ethereum (Apply).

**11. Unit wise detailed content**

| | | |
|---|---|---|
| **Unit-1** | **Number of lectures = 9** | Introduction of Cryptography and Blockchain: |

What is Blockchain, Blockchain Technology Mechanisms & Networks, Blockchain Origins, Objective of Blockchain, Blockchain Challenges, Transactions And Blocks, P2P Systems, Keys As Identity, Digital Signatures, Hashing, and public key cryptosystems, private vs. public Blockchain.

| | | |
|---|---|---|
| **Unit – 2** | **Number of lectures = 9** | BitCoin and Cryptocurrency: |

What is Bitcoin, The Bitcoin Network, The Bitcoin Mining Process, Mining Developments, Bitcoin Wallets, Decentralization and Hard Forks, Ethereum Virtual Machine (EVM), Merkle Tree, Double-Spend Problem, Blockchain And Digital Currency, Transactional Blocks, Impact Of Blockchain Technology On Cryptocurrency.

| | | |
|---|---|---|
| **Unit – 3** | **Number of lectures = 9** | Introduction to Ethereum: |

What is Ethereum, Introduction to Ethereum, Consensus Mechanisms, How Smart Contracts Work, Metamask Setup, Ethereum Accounts, Receiving Ether’s What's a Transaction?, Smart Contracts.

| | | |
|---|---|---|
| **Unit – 4** | **Number of lectures = 9** | Ethereum Clients |

Ethereum Networks, Running an Ethereum Client, The First Synchronization of Ethereum-Based Blockchains, Remote Ethereum Clients. Smart Contracts and Solidity: What Is a Smart Contract?, Life Cycle of a Smart Contract, Introduction to Ethereum High-Level Languages, Building a Smart Contract with Solidity, The Ethereum Contract ABI, Programming with Solidity, Gas Considerations, Vulnerabilities and Vyper, Comparison to Solidity, Decorators, Function and Variable Ordering, Compilation, Protecting Against Overflow Errors at the Compiler Level, Reading and Writing

**12. Brief Description of self-learning / E-learning component**

The students will be encouraged to learn using the SGT E-Learning portal and choose the relevant lectures delivered by subject experts of SGT University.
The link to the E-Learning portal.
https://elearning.sgtuniversity.ac.in/course-category/

**13. Books Recommended**

**Text Books**


- Imran Bashir, "Mastering Blockchain: Distributed Ledger Technology, decentralization, and smart contracts explained", Packt Publishing, 2018.
- Andreas M. Antonopoulos, "Mastering Bitcoin: Unlocking Digital Cryptocurrencies", O'Reilly Publications, 2nd Edition.
- Melanie Swan, "Blockchain: Blueprint for a new economy", O'Reilly Publications, First Edition.


**14. Reference Books**


- Mark Gates, " Ethereum: Complete Guide to Understanding Ethereum, Blockchain, Smart Contracts, ICOs, and Decentralized Apps", Inverted Forest Publishing, 2016
- Chris Dannen, "Introducing Ethereum and Solidity", APress Publishing, 2017.
- EladErom, "The Blockchain Developer", APress Publishing, 2017
- Andreas M. Antonopoulos, "Mastering Bitcoin: Programming the Open Blockchain", O'Reilly Publications, First Edition

**Blockchain and Distributed Ledger Technology**

| | | | | | | |
|---|---|---|---|---|---|---|
| **1. Name of the Department- Computer Science & Engineering** | | | | | | |
| **2. Course Name** | **Blockchain and Distributed Ledger Technology** | **L** | **T** | | **P** | |
| **3. Course Code** | | **3** | **0** | | **2** | |
| **4. Type of Course (use tick mark)** | | **Core (✓)** | **PE(√)** | | **OE ()** | |
| **5. Pre-requisite (if any)** | | **6. Frequency (use tick marks)** | Even () | Odd (√) | Either Sem() | Every Sem () |
| **7. Total Number of Lectures, Tutorials, Practical (assuming 12 weeks of one semester)** | | | | | | |
| **Lectures =** | | **Tutorials = 0** | **Practical = 0** | | | |

**8. Course Description**

Blockchain technology and distributed ledgers have been hailed as a turning point in scaling information technology services at a global level. Although the digital currency Bitcoin is the best-known Blockchain application today, the technology is set to play a much broader role in cyber security innovation.

**19. LearningObjectives:**

1. Understand what is a blockchain and a distributed ledger
2. Develop or extend the ability to think critically about cybersecurity
3. Understand the challenges of scaling information technology services across organizational barriers and at a global level.
4. Analyse the security of basic cryptographic primitives like hash functions and digital signatures

**10. Course Outcomes (COs):**

1. Understand how blockchain systems (mainly Bitcoin and Ethereum) work.
2. To securely interact with them.
3. Design, build, and deploy smart contracts and distributed applications.
4. Integrate ideas from blockchain technology into their own projects

**11. Unit wise detailed content**

| | | |
|---|---|---|
| **Unit-1** | **Number of lectures = 9** | Introduction to Blockchain Technology |

Introduction to Blockchain
Blockchain concepts, evolution, structure, characteristics, a sample blockchain application, the blockchain stack, benefits and challenges, What is a Blockchain, Public Ledgers, Blocks in a Blockchain, Blockchains as public ledgers, Transactions, Distributed consensus. Building a block: Elements of Cryptography-Cryptographic Hash functions, Merkle Tree, Elements of Game Theory.

| | | |
|---|---|---|
| **Unit – 2** | **Number of lectures = 9** | Satoshi's Bitcoin |

Blockchain Architecture and Use cases
Design methodology for blockchain applications, blockchain application templates, blockchain application development, Ethereum, Solidity, Sample use cases from Industries, Business problems.

| | | |
|---|---|---|
| **Unit – 3** | **Number of lectures = 9** | **The Bitcoin Network** and Advanced Theories |

Decentralized applications (Dapps)
Dapps, implementing Dapps, Ethereum Dapps, case studies related to Dapps, Byzantine fault tolerance, proof-of-work vs proof-of-stake, Security and Privacy of Blockchains, smart contract vulnerabilities, Scalability of Blockchains

| **Unit – 4** | **Number of lectures = 9** | Ethereum Clients |
|---|---|---|

Distributed Ledger Technology
Distributed Database, Two General Problem, Byzantine General problem and Fault Tolerance, Hadoop Distributed File System, Distributed Hash Table, ASIC resistance, Turing Complete. Cryptography: Hash function, Digital Signature - ECDSA, Memory Hard Algorithm, Zero Knowledge Proof.

**12. Brief Description of self-learning / E-learning component**

The students will be encouraged to learn using the SGT E-Learning portal and choose the relevant lectures delivered by subject experts of SGT University.

**13. Books Recommended**

**Text Books**

Blockchain applications: a hands-on approach, Bahga A., Madisetti V., VPT, 2017.

**14. Reference Books**


1. Beginning Blockchain, A Beginner's Guide to Building Blockchain Solutions, Bikramaditya Singhal, Gautam Dhameja, Priyansu Sekhar Panda, Apress, 2018.
2. Blockchain A Practical Guide to Developing Business, Law, and Technology Solutions, Joseph J. Bambara and Paul R. Allen, McGraw Hill, 2018.
3. Blockchain enabled Applications Vikram Dhillon, David Metcalf and Max Hooper, Apress, 2017,
4. The Business Blockchain: Promise, Practice, and Application of the Next Internet Technology, William Mougayar, Wiley, 2016.
5. Blockchain Science: Distributed Ledger Technology, Roger Wattenhofer, Inverted Forest Publishing; 3rd edition, 2019.

**Blockchain and Distributed Ledger Technology Lab**

| | | | | | | |
|---|---|---|---|---|---|---|
| **11. Name of the Department- Computer Science & Engineering** | | | | | | |
| **12. Course Name** | **Blockchain and Distributed Ledger Technology Lab** | **L** | **T** | | **P** | |
| **13. Course Code** | | **3** | **0** | | **2** | |
| **14. Type of Course (use tick mark)** | | **Core (✓)** | **PE(√)** | | **OE ()** | |
| **15. Pre-requisite (if any)** | | **Frequency (use tick marks)** | Even () | Odd (√) | Either Sem() | Every Sem () |
| **16. Total Number of Lectures, Tutorials, Practical (assuming 12 weeks of one semester)** | | | | | | |
| **Lectures = 0** | | **Tutorials = 0** | **Practical = 24** | | | |

**17. Course Description**

**Learning objectives:**

1. Students should be able to learn different types of blockchain platforms.
2. Students should be able to understand different types of Decentralized applications developed using blockchain technology.
3. Students should be able to understand several types of blockchain use cases.

**18. Course Outcomes (COs):**

1. To distinguish between different types of blockchain platforms.
2. To understand different types of uses of blockchain and apply it to some real-life scenarios accordingly.
3. To learn about the shortcomings of blockchain technology and their corresponding solutions.

**19. List of Experiments**

1) 1. Create a Simple Blockchain in any suitable programming language.
2) 2. Use Geth to Implement Private Ethereum Block Chain.
3) 3. Build Hyperledger Fabric Client Application.
4) 4. Build Hyperledger Fabric with Smart Contract.
5) 5. Create Case study of Block Chain being used in illegal activities in real world.
6) 6. Using Python Libraries to develop Block Chain Application.
7) 7. Write a program to generate Hash key.
8) 8. Using Java Libraries to develop Block Chain Applications.
9) 9. Write a program to create public key in Blockchain.

10 Write a program to create private Key in Blockchain.

**20. Brief Description of self-learning / E-learning component**

https://nlp-iiith.vlabs.ac.in/

http://vlab.co.in/participating-institute-iiit-hyderabad

**Crypto Currency Technologies**

| | | | | | | |
|---|---|---|---|---|---|---|
| **1. Name of the Department- Computer Science & Engineering** | | | | | | |
| **2. Course Name** | **Crypto Currency Technologies** | **L** | **T** | | **P** | |
| **3. Course Code** | | **3** | **0** | | **2** | |
| **4. Type of Course (use tick mark)** | | **Core (✓)** | **PE(✓)** | | **OE ()** | |
| **5. Pre-requisite (if any)** | Computer Basics | **6. Frequency (use tick marks)** | Even (✓) | Odd () | Either Sem() | Every Sem () |
| **7. Total Number of Lectures, Tutorials, Practical (assuming 12 weeks of one semester)** | | | | | | |
| **Lectures = 36** | | **Tutorials = 0** | **Practical = 0** | | | |

**8. Course Description**

This course aims to introduce interested students to cryptographic primitives, demonstrate how cryptographic primitives can be leveraged to construct secure electronic currencies like Bitcoin, and explore howthe core principles can be leveraged in other areas and future pursuits..

**20. LearningObjectives:**

1. To learn the fundamentals of Blockchain.
2. To obtain knowledge about technologies of Blockchain.
3. To incorporate the models of Blockchain- Ethereum.
4. To learn the models of Hyperledger Fabric.

**10. Course Outcomes (COs):**

The students will be able to:-

1. Define and Explain the fundamentals of Cryptocurrency
2. Illustrate the technologies of Cryptocurrency
3. Describe the models of Cryptocurrency
4. Analyze and demonstrate the CryptocurrencY

**11. Unit wise detailed content**

| | | |
|---|---|---|
| **Unit-1** | **Number of lectures = 9** | |

**Introduction to Cryptography**
Digital Signatures, Cryptographic Hash Functions
**Cryptographic Data Structures**
Hash Pointers, Append-Only Ledgers (Block Chains), Merkle Trees

| | | |
|---|---|---|
| **Unit – 2** | **Number of lectures = 9** | |

**Bitcoin's Protocol**
Keys as Identities, Simple Cryptocurrencies, Decentralization through Distributed Consensus Incentives, Proof of Work (Mining), Application-Specic Integrated Circuit (ASIC) Mining and ASIC-resistant Mining, Virtual Mining (Peercoin)

| | | |
|---|---|---|
| **Unit – 3** | **Number of lectures = 9** | |

**Engineering Details**
Bitcoin Blocks, Hot and Cold Storage, Splitting and Sharing Keys, Proof of Reserve, Proof of Liabilities

**Anonymity, Pseudonymity, Unlinkability**
Statistical Attacks (Transaction Graph Analysis), Network-layer De-anonymization, Chaum's Blind Signatures, Single Mix and Mix Chains, Decentralized Mixing, Zero-Knowledge Proof, Cryptocurrencies

| **Unit – 4** | **Number of lectures = 9** | |
|---|---|---|

**Cryptocurrency Technologies**
Smart Property, Ecient micro-payments, Coupling Transactions and Payment (Interdependent Transactions), Public Randomness Source, Prediction Markets, Escrow transactions, Green addresses, Auctions and Markets, Multi-party Lotteries

**12. Brief Description of self-learning / E-learning component**
The students will be encouraged to learn using the SGT E-Learning portal and choose the relevant lectures delivered by subject experts of SGT University.
The link to the E-Learning portal.
https://elearning.sgtuniversity.ac.in/course-category/

**13. Books Recommended**

**Text Books**

- Bitcoin and Cryptocurrency Technologies. Arvind Narayanan, Joseph Bonneau, Edward Felten, Andrew Miller, Steven Goldfeder and Jeremy Clark.

**14. Reference Books**

- Bitcoin: A Peer-to-Peer Electronic Cash System. Satoshi Nakamoto.
- How the Bitcoin protocol actually works. Michael Nielsen.

# Crypto Currency Technologies Lab

| | | | | | | |
|---|---|---|---|---|---|---|
| **1. Name of the Department- Computer Science & Engineering** | | | | | | |
| **2. Course Name** | **Crypto Currency Technologies Lab** | **L** | **T** | | **P** | |
| **3. Course Code** | | **3** | **0** | | **2** | |
| **4. Type of Course (use tick mark)** | | **Core (✓))** | **PE(✓)** | | **OE ()** | |
| **5. Pre-requisite (if any)** | | **6. Frequency (use tick marks)** | Even (✓) | Odd () | Either Sem() | Every Sem () |
| **7. Total Number of Lectures, Tutorials, Practical (assuming 14 weeks of one semester)** | | | | | | |
| **Lectures = 0** | | **Tutorials = 0** | **Practical = 36** | | | |

**8. Course Description**

**11. Learningobjectives:**

1. To understand the mechanism of Blockchain and Cryptocurrency.
2. To understand the functionality of current implementation of blockchain technology.
3. To understand the required cryptographic background.
4. To explore the applications of Blockchain to cryptocurrencies and understanding limitations of current Blockchain.
5. An exposure towards recent research.

**10. Course Outcomes (COs):**

1. To Understand and apply the fundamentals of Cryptography in Cryptocurrency
2. To gain knowledge about various operations associated with the life cycle of Blockchain
3. and Cryptocurrency
4. To deal with the methods for verification and validation of Bitcoin transactions
5. To demonstrate the general ecosystem of several Cryptocurrency
6. To educate the principles, practices and policies associated Bitcoin business

**11. List of Experiments**

1. Naive Blockchain construction,
2. Memory Hard algorithm - Hashcash implementation,
3. Direct Acyclic Graph,
4. Play with Go-ethereum,
5. Smart Contract Construction,
6. Toy application using Blockchain,
7. Mining puzzles

# Data Analytics

**Applied Statistical Analysis**

| | | | | | | |
|---|---|---|---|---|---|---|
| **1. Name of the Department- Computer Science & Engineering** | | | | | | |
| **2. Course Name** | **Applied Statistical Analysis** | **L** | **T** | | **P** | |
| **3. Course Code** | | **3** | **0** | | **2** | |
| **4. Type of Course (use tick mark)** | | **Core (✓)** | **PE(✓)** | | **OE ()** | |
| **5. Pre-requisite (if any)** | | **6. Frequency (use tick marks)** | Even () | Odd (✓) | Either Sem() | Every Sem () |
| **7. Total Number of Lectures, Tutorials, Practical (assuming 12 weeks of one semester)** | | | | | | |
| **Lectures =** | | **Tutorials = 0** | **Practical = 0** | | | |

**8. Course Description**

This course is an introductory to applied statistics for undergraduate students in engineering sciences. Statistical methods are important tools which provide the engineer with both descriptive and analytical methods for dealing with the variability in observed data. It introduces students to cognitive learning in statistics; and develops skills on analyzing the data by using different tests and designing the experiments with several factors.

**21. LearningObjectives:**

1. Learn other types of means, including geometric and power means associated in descriptive statistics
2. Learn how to represent measures of dispersion and asymmetry
3. Calculate the variance, standard deviation, and skewness of data sets
4. Create frequency tables to represent data sets

**10. Course Outcomes (COs):**

The students will be able to:-

1. Identify the role that statistics can play in the engineering problem-solving process, discuss the different methods that engineers use to collect data and, construct and interpret visual data displays
2. Compute and interpret the descriptive statistics, correlation coefficient and rank correlation coefficient, use simple linear regression model to engineering data.
3. Explain various sampling methods, compute and explain point estimators and interval estimators for mean, variance and proportion

**11. Unit wise detailed content**

| | | |
|---|---|---|
| **Unit-1** | **Number of lectures = 9** | |

The Role of Statistics in Engineering : The Engineering Method and Statistical Thinking - Collecting Engineering Data - Basic Principles - Retrospective Study - Observational Study - Designed Experiments - Observing Processes Over Time - Mechanistic and Empirical Models Data Description and Representation: Collection of data- Classification and Tabulation of data - Stem-and-Leaf Diagrams - Frequency Distributions and Histograms - Box Plots - Time Sequence Plots - Probability Plots .

| | | |
|---|---|---|
| **Unit – 2** | **Number of lectures = 9** | |

Descriptive Statistics: Measures of central Tendency-Measures of DispersionSkewness and Kurtosis. Correlation and Regression: Scatter Diagram – Types of Correlation – Karl Pearsons Coefficient of Correlation and Spearmen's Rank Correlations- Method of Least Squares – Linear Regression.

| | | |
|---|---|---|
| **Unit – 3** | **Number of lectures = 9** | |

Sampling: Different types of sampling - Sampling Distributions - Sampling Distribution of Mean. Point Estimation of Parameters: General Concepts of Point Estimation - Unbiased Estimators -Variance of a Point Estimator - Standard Error- Methods of Point Estimation (Method of Moments - Method of Maximum Likelihood). Statistical Intervals for a Single Sample: Confidence Interval on the Mean of a Normal

Distribution with Variance Known - Confidence Interval on the Mean of a Normal Distribution with Variance Unknown - Confidence Interval on the Variance and Standard Deviation of a Normal Distribution - A Large-Sample Confidence Interval for a Population Proportion

| **Unit – 4** | **Number of lectures = 9** | |
|---|---|---|

Tests of Hypotheses for a Single Sample: Tests of Statistical Hypotheses - General Procedure for Hypothesis Testing –Tests on the Mean of a Normal Distribution with Variance Known - Tests on the Mean of a Normal Distribution with Variance Unknown - Tests on the Variance and Standard Deviation of a Normal Distribution. 74 Statistical Inference for Two Samples: Inference For a Difference in Means of Two Normal Distributions with Variances Known - Inference For a Difference in Means of Two Normal Distributions with Variances Unknown -Inference on the Variances of Two Normal Distributions – Inference on Two Population Proportions.

**12. Brief Description of self-learning / E-learning component**

The students will be encouraged to learn using the SGT E-Learning portal and choose the relevant lectures delivered by subject experts of SGT University.
The link to the E-Learning portal.
https://elearning.sgtuniversity.ac.in/course-category/

**13. Books Recommended**

**Text Books**


1. Douglas C. Montgomery and George C. Runger. Applied Statistics and Probability for Engineers, (3rdEdn), John Wiley and Sons, Inc., New York, 2003.
2. Robert H. Carver and Jane Gradwohl Nash. Doing Data Analysis with SPSS Version 18.0, (Indian Edition), Cengage Learning, New Delhi, 2012
3. Richard A. Johnson and C.B.Gupta, Probability and Statistics for Engineers, (7thEdn.), Pearson Education, Indian Impression 2006.


**14. Reference Books**


- Mohammed A.Shayib. Applied Statistics, First Edition. eBook, Bookboon.com 2013.
- Peter R.Nelson, Marie Coffin, Copeland Kanen, A.F. Introductory Statistics for Engineering Experimentation, Elsevier Science and Technology Books, New York, 2003.
- Sheldon M. Ross, Introduction to Probability and Statistics, (3rdEdn), Elsevier Science and Technology Books, New York, 2004.
- T.T.Soong, Fundamentals of Probability and Statistics for Engineers, John Wiley and Sons, Ltd., New York, 2004.
- J.P.Marques de Sá , Applied Statistics using SPSS, STATISTICA, MATLAB and R, (2ndEdn.), Springer Verlag, Heidelberg, 2007.

## Applied Statistical Analysis Lab

| | | | | | | |
|---|---|---|---|---|---|---|
| **1. Name of the Department- Computer Science & Engineering** | | | | | | |
| **2. Course Name** | **Applied Statistical Analysis Lab** | **L** | **T** | | **P** | |
| **3. Course Code** | | **3** | **0** | | **2** | |
| **4. Type of Course (use tick mark)** | | **Core (✓)** | **PE(√)** | | **OE ()** | |
| **5. Pre-requisite (if any)** | | **6. Frequency (use tick marks)** | Even () | Odd (√) | Either Sem() | Every Sem () |
| **7. Total Number of Lectures, Tutorials, Practical (assuming 12 weeks of one semester)** | | | | | | |
| **Lectures = 0** | | **Tutorials = 0** | **Practical = 48** | | | |

**8. Course Description**

Applied Statistics for Data Analysis provides students with the basic knowledge of how scientific evidence is classified and how statistical procedures are utilized to analyze data.

**22. Learning Objectives:**

1. Demonstrate their ability to apply statistics in other fields at an appropriate level and demonstrate their ability to apply knowledge acquired from their major to real world models.
2. Demonstrate mastery of data analysis and statistical concepts by communicating critically reasoned analysis through written and oral presentations.
3. Acquire up-to-date skills and/or applications of computer and statistical programming related to future career choices.

**10. Course Outcomes (COs):**

The students will be able to:

1. To familiarize students with computational techniques and software used in the statistical arena. To provide a solid ground in the best practices of collating and disseminating information.
2. To prepare students for undertaking further study.
3. To teach students to construct practical statistical models for several processes in the real-world.

**11. List of Experiments**

1. Construction of Univariate and Bivariate frequency tables with samples of sizes not exceeding 200.
2. Diagrammatic and Graphical representation of data.
3. Computation of Measures of Central tendency, Measures of Dispersion, Skewness and Kurtosis.
4. Computation of Simple Correlation and Regression Coefficients.
5. Fitting of discrete distributions – Binomial, Poisson,
6. Fitting of continuous distributions – Normal distribution
7. Drawing samples of size not exceeding 25 from normal population with known mean and variance using random number tables.
8. Problems based on MLE
9. Problems based on t-distribution, chi-square distribution and F-distribution
10. Test of Independence attributes (m,n≤5)
11. Test for Homogeneity of several population variances.
12. Tests of significance with regard to Single Mean, Two Means,
13. Construction of Confidence intervals for Mean, Variance and Proportion based on Normal, t, Chi-square and F distributions.
14. 14.Analysis of Variance (One way and two-way classifications) 15.Analysis of CRD, RBD, and LSD.

**Data Mining and Predictive Modeling**

| | | | | | | |
|---|---|---|---|---|---|---|
| **1. Name of the Department- Computer Science & Engineering** | | | | | | |
| **2. Course Name** | **Data Mining and Predictive Modeling** | **L** | **T** | | **P** | |
| **3. Course Code** | | **3** | **0** | | **2** | |
| **4. Type of Course (use tick mark)** | | **Core (✓)** | **PE(✓)** | | **OE ()** | |
| **5. Pre-requisite (if any)** | | **6. Frequency (use tick marks)** | Even (✓) | Odd () | Either Sem() | Every Sem () |
| **7. Total Number of Lectures, Tutorials, Practical (assuming 12 weeks of one semester)** | | | | | | |
| **Lectures =** | | **Tutorials = 0** | **Practical = 0** | | | |

**8. Course Description**

Students will learn to identify the ideal analytic tool for their specific needs; understand valid and reliable ways to collect, analyze, and visualize data; and utilize data in decision making for their agencies, organizations or clients.

**23. Learning Objectives:**

1. To learn, how to develop models to predict categorical and continuous outcomes, using such techniques as neural networks, decision trees, logistic regression, support vector machines and Bayesian network models.
2. To know the use of the binary classifier and numeric predictor nodes to automate model selection.
3. To advice on when and how to use each model. Also learn how to combine two or more models to improve prediction

**10. Course Outcomes (COs):**

The students will be able to:-

1. Understand the process of formulating business objectives, data selection/collection, preparation and process to successfully design, build, evaluate and implement predictive models for a various business application.
2. Compare the underlying predictive modeling techniques.
3. Select appropriate predictive modeling approaches to identify cases to progress with.
4. Apply predictive modeling approaches using a suitable package such as SPSS Modeler

**11. Unit wise detailed content**

| **Unit-1** | **Number of lectures = 9** | |
|---|---|---|

Introduction to Data Mining Introduction, what is Data Mining? Concepts of Data mining, Technologies Used, Data Mining Process, KDD Process Model, CRISP – DM, Mining on various kinds of data, Applications of Data Mining, Challenges of Data Mining.

| **Unit – 2** | **Number of lectures = 9** | |
|---|---|---|

Data Understanding and Preparation Introduction, Reading data from various sources, Data visualization, Distributions and summary statistics, Relationships among variables, Extent of Missing Data. Segmentation, Outlier detection, Automated Data Preparation, Combining data files, Aggregate Data, Duplicate Removal, Sampling DATA, Data Caching, Partitioning data, Missing Values.

| **Unit – 3** | **Number of lectures = 9** | |
|---|---|---|

Model development & techniques Data Partitioning, Model selection, Model Development Techniques, Neural networks, Decision trees, Logistic regression, Discriminant analysis, Support vector machine, Bayesian Networks, Linear Regression, Cox Regression, Association rules.

| **Unit – 4** | **Number of lectures = 9** | |
|---|---|---|

Model Evaluation and Deployment Introduction, Model Validation, Rule Induction Using CHAID, Automating Models for Categorical and Continuous targets, Comparing and Combining Models, Evaluation Charts for Model Comparison, MetaLevel Modeling, Deploying Model, Assessing Model Performance, Updating a Model.

**12. Brief Description of self-learning / E-learning component**

The students will be encouraged to learn using the SGT E-Learning portal and choose the relevant lectures delivered by subject experts of SGT University.
The link to the E-Learning portal.
https://elearning.sgtuniversity.ac.in/course-category/

**13. Books Recommended**

**Text Books**

1. Data Mining and Predictive Analytics (Wiley Series on Methods and Applications in Data Mining) 2nd Edition, Wiley; 2nd edition

**14. Reference Books**

- Fundamentals of Machine Learning for Predictive Data Analytics, second edition: Algorithms, Worked Examples, and Case Studies BY John D. Kelleher The MIT Press; 2nd edition
- Data Science for Business: Predictive Modeling, Data Mining, Data Analytics, Data Warehousing, Data Visualization, Regression Analysis, Database Querying, and Machine Learning for Beginners by Herbert Jones Bravex Publications

# Data Mining and Predictive Modeling Lab

| | | | | | | |
|---|---|---|---|---|---|---|
| **1. Name of the Department- Computer Science & Engineering** | | | | | | |
| **2. Course Name** | **Data Mining and Predictive Modeling Lab** | **L** | **T** | | **P** | |
| **3. Course Code** | | **3** | **0** | | **2** | |
| **4. Type of Course (use tick mark)** | | **Core (✓)** | **PE(√)** | | **OE ()** | |
| **5. Pre-requisite (if any)** | | **6. Frequency (use tick marks)** | Even (✓) | Odd () | Either Sem() | Every Sem () |
| **7. Total Number of Lectures, Tutorials, Practical (assuming 12 weeks of one semester)** | | | | | | |
| **Lectures = 0** | | **Tutorials = 0** | **Practical = 48** | | | |

**8. Course Description**

To understand the need for Data Mining and advantages to the business and scientific world. The validating criteria for an outcome to be categorized as Data Mining result will be understood.

**24. Learning Objectives:**

1. Practical exposure on implementation of well known data mining tasks.
2. Exposure to real life data sets for analysis and prediction.
3. Learning performance evaluation of data mining algorithms in a supervised and an unsupervised setting.
4. To learn the algorithms used for various types of Data Mining Problems.

**10. Course Outcomes (COs):**

The students will be able to:

1. The data mining process and important issues around data cleaning, pre-processing and integration.
2. The principle algorithms and techniques used in data mining, such as clustering, association mining, classification and prediction.
3. Handling a small data mining project for a given practical domain.

**11. List of Experiments**

1. Introduction to WEKA
2. Implementation of measures of proximity
3. Introduction to exploratory data analysis using R
4. Implementation of Apriori Algorithm for Association rule mining
5. Learning and implementing k-means clustering
6. Learning Naïve and Decision Tress classifier in WEKA
7. Learning Bayesian modeling and Inference in Netica
8. Implementation of outlier detection algorithms (nearest neighbor and Mahalanobis)
9. Data Mining Project

**12. Brief Description of self-learning / E-learning component**

1. Introduction to Data Mining Pang-Ning Tan, Michael Steinbach, Vipin Kumar, Pearson Education (Addison Wesley), 0-321-32136-7, 2006 2. Data Mining with WEKA. http://www.cs.waikato.ac.nz/ml/weka/

**Data Warehouse & Multidimensional Modeling**

| | | | | | | |
|---|---|---|---|---|---|---|
| **1. Name of the Department- Computer Science & Engineering** | | | | | | |
| **2. Course Name** | **Data Warehouse & Multidimensional Modeling** | **L** | **T** | | **P** | |
| **3. Course Code** | | **3** | **0** | | **2** | |
| **4. Type of Course (use tick mark)** | | **Core (✓)** | **PE(✓)** | | **OE ()** | |
| **5. Pre-requisite (if any)** | | **6. Frequency (use tick marks)** | Even () | Odd (✓) | Either Sem() | Every Sem () |
| **7. Total Number of Lectures, Tutorials, Practical (assuming 12 weeks of one semester)** | | | | | | |
| **Lectures =** | | **Tutorials = 0** | **Practical = 0** | | | |

**8. Course Description**

This course focuses on the fundamentals of data warehousing and multidimensional Modelling. Data warehouse development life cycle, Data warehouse analysis, CUBE, ROLL UP and STAR queries, Data Warehouse Design

**25. Learning Objectives:**

1. Understand the fundamentals of Data Warehousing
2. Learn modelling of data warehousing
3. Understand the concepts of Multi-Dimensional Modeling and learn the Methodology
4. Learn Non-Temporal Design of R-OLAP

**10. Course Outcomes (COs):**

The students will be able to:-

1. To comprehend the overall architecture of a data warehouse and techniques and methods for data gathering and data pre-processing
2. To learn practical, efficient and statistically sound techniques, capable of solving real• world issues
3. To understand the query processing

**11. Unit wise detailed content**

| **Unit-1** | **Number of lectures = 9** | |
|---|---|---|

Introduction: Multidimensional Data Management, Multidimensional History, Related Terminology

| **Unit – 2** | **Number of lectures = 9** | |
|---|---|---|

Fundamental Concepts : Cubes ,Dimensions, Facts, Measures, Relational Representations, Star Schemas, Snowflake Schemas, Data Warehouses And Data Marts, Multidimensional Modelling Process, Analysis And Querying ,Roll Up, Drill Down, Drill Out, Slicing And Dicing, Drill Across, Pivot Tables, Ranking, MultiDimensional Querying in MDX and SQL, Graphical Querying and Visualizations .

| **Unit – 3** | **Number of lectures = 9** | |
|---|---|---|

Advance Concepts : Slowly Changing Dimensions, The Problem, Solutions, Other Special Kinds Of Dimensions, Mini dimensions, Outriggers, Degenerate Dimensions, Junk Dimensions, Time Dimensions, Data Quality Dimensions, Advanced Hierarchies, Parent-Child Hierarchies, Unbalanced Hierarchies, Non Covering Hierarchies , Non –Strict Hierarchies, Multiple Hierarchies And Parallel Hierarchies.

| Unit – 4 | Number of lectures = 9 | |
|---|---|---|
| Implementation Issues :Materialized Views, Indexing, Indexing Overview, Bitmap Indices, Join Indices, Query Processing, OLAP Implementations, Extract-Transform-Load. | | |

**12. Brief Description of self-learning / E-learning component**

The students will be encouraged to learn using the SGT E-Learning portal and choose the relevant lectures delivered by subject experts of SGT University.
The link to the E-Learning portal.
https://elearning.sgtuniversity.ac.in/course-category/

**13. Books Recommended**

**Text Books**

- Christian S. Jensen, Christian Thomsen, and Professor Torben Pedersen, "Multidimensional Databases and Data Warehousing", Morgan & Claypool Publisher, 2010.

**14. Reference Books**

- Ralph Kimball, Margy Ross, "The Data Warehouse Toolkit: The Definitive Guide", 3rd• Edition, John Wiley & Sons, 2013.
- Len Silverston, Paul Agnew, "The Data Model Resource Book: Volume 3: Universal Patterns• for Data Modeling", John Wiley & Sons., 2009.

## Data Warehouse & Multidimensional Modeling Lab

| | | | | | | |
|---|---|---|---|---|---|---|
| **1. Name of the Department- Computer Science & Engineering** | | | | | | |
| **2. Course Name** | **Data Warehouse & Multidimensional Modeling Lab** | **L** | **T** | | **P** | |
| **3. Course Code** | | **3** | **0** | | **2** | |
| **4. Type of Course (use tick mark)** | | **Core (✓)** | **PE(√)** | | **OE ()** | |
| **5. Pre-requisite (if any)** | | **6. Frequency (use tick marks)** | Even () | Odd (√) | Either Sem() | Every Sem () |
| **7. Total Number of Lectures, Tutorials, Practical (assuming 12 weeks of one semester)** | | | | | | |
| **Lectures = 0** | | **Tutorials = 0** | **Practical = 48** | | | |

**8. Course Description**

The main objective of this lab is to impart the knowledge on how to implement classical models and algorithms in data warehousing and data mining and to characterize the kinds of patterns that can be discovered by association rule mining, classification and clustering.

**9. LearningObjectives:**

1. Differentiate OnLine Transaction Processing and OnLine Analytical processing
2. Learn Multidimensional schemas suitable for data warehousing
3. Understand various data mining functionalities
4. Inculcate knowledge on data mining query languages

**10. Course Outcomes (COs):**

The students will be able to:

1. Design a data mart or data warehouse for any organization
2. Develop skills to write queries using DMQL
3. Extract knowledge using data mining techniques
4. Adapt to new data mining tools.

**11. List of Experiments**

1. Implementation of OLAP operations
2. Implementation of Varying Arrays
3. Implementation of Nested Tables
4. Demonstration of any ETL tool
5. Write a program of Apriori algorithm using any programming language.
6. Create data-set in .arff file format. Demonstration of preprocessing on WEKA data-set.
7. Demonstration of Association rule process on data-set contact lenses.arff /supermarket (or any other data set) using apriori algorithm.
8. Demonstration of classification rule process on WEKA data-set using j48 algorithm.
9. Demonstration of classification rule process on WEKA data-set using Naive Bayes algorithm.
10. Demonstration of clustering rule process on data-set iris.arff using simple k-means

**12. Brief Description of self-learning / E-learning component**


- Jiawei Han, Micheline Kamber " Data Mining: Concepts and Techniques" 3rd edition ,Morgan Kaufmann, 2012
- Ramesh Sharda, Dursun Delen, David King Business Intelligence, 2/E; Efraim Publisher Turban,pearson Education, 2011
- Berry, Gordon S. Linoff, "Data Mining Techniques: For Marketing, Sales, and Customer Relationship Management", John Wiley & Sons Inc publishers, 3 rd Edition, 2011.

**Business Intelligence**

| | | | | | | |
|---|---|---|---|---|---|---|
| **1. Name of the Department- Computer Science & Engineering** | | | | | | |
| **2. Course Name** | **Business Intelligence** | **L** | **T** | | **P** | |
| **3. Course Code** | | **3** | **0** | | **0** | |
| **4. Type of Course (use tick mark)** | | **Core (✓)** | **PE(✓)** | | **OE ()** | |
| **5. Pre-requisite (if any)** | | **6. Frequency (use tick marks)** | Even (✓) | Odd () | Either Sem() | Every Sem () |
| **7. Total Number of Lectures, Tutorials, Practical (assuming 12 weeks of one semester)** | | | | | | |
| **Lectures =** | | **Tutorials = 0** | **Practical = 0** | | | |

**8. Course Description**

Business Intelligence (BI) refers to technologies, applications, and practices for the collection, integration, analysis, and presentation of business information. The purpose of business intelligence is to support better business decision making.

**26. LearningObjectives:**

1. Enable all participants to recognise, understand and apply the language, theory and models of the field of business analytics
2. Foster an ability to critically analyse, synthesise and solve complex unstructured business problems
3. Encourage an aptitude for business improvement, innovation and entrepreneurial action

**10. Course Outcomes (COs):**

The students will be able to:-

1. Understand and critically apply the concepts and methods of business analytics
2. Identify, model and solve decision problems in different settings
3. Interpret results/solutions and identify appropriate courses of action for a given managerial situation whether a problem or an opportunity
4. Create viable solutions to decision making problems

**11. Unit wise detailed content**

| | | |
|---|---|---|
| **Unit-1** | **Number of lectures = 9** | |

Introduction to Business Intelligence BI concept, BI architecture, BI in today's perspective, BI Process, Applications of BI like Financial analysis, statistical analysis, sales analysis, CRM, result pattern and ranking analysis, Balanced Scorecard, BI in Decision Modelling: Optimization, Decision making under uncertainty. Ethics and business intelligence.

| | | |
|---|---|---|
| **Unit – 2** | **Number of lectures = 9** | |

Data Science The concept, process and typical tools in data science. Example of different algorithms i.e segmentation, classification, validation, regressions, recommendations. Exercises using Excel and R to work on histograms, regression, clustering and text analysis. Co-relation between Algorithm and Code in data science

| | | |
|---|---|---|
| **Unit – 3** | **Number of lectures = 9** | |

Data Visualization and Dashboard Design Responsibilities of BI analysts by focusing on creating data visualizations and dashboards. Importance of data visualization, types of basic and composite charts.

Performance Dashboard Measuring, Monitoring and management of Business, KPIs and dashboard, the types of dashboards, the common characteristics of Enterprise dashboard, design of enterprise dashboards, and the common pitfalls of dashboard design

| Unit – 4 | Number of lectures = 9 | |
|---|---|---|
| Modelling and Analysis Exploring Excel Modeling capabilities to solve business problems, summarize and present selected data, introduction to business metrics and KPIs, creating cubes using Microsoft Excel<br>Future of Business Intelligence Emerging Technologies, Machine Learning, Predicting the Future with the help of Data Analysis, BI Search & Text Analytics – Advanced Visualization – Rich Report, Future beyond Technology. | | |

**12. Brief Description of self-learning / E-learning component**

The students will be encouraged to learn using the SGT E-Learning portal and choose the relevant lectures delivered by subject experts of SGT University.
The link to the E-Learning portal.
https://elearning.sgtuniversity.ac.in/course-category/

**13. Books Recommended**

**Text Books**

1. Efraim Turban, Ramesh Sharda, Dursun Delen, "Decision Support and Business Intelligence Systems", 9th Edition, Pearson 201
2. "Business Intelligence – Grundlagen und praktische Anwendungen: Eine Einführung in die IT" by Hans-Georg Kemper and Henning Baars

**14. Reference Books**


- David Loshin Morgan, Kaufman, "Business Intelligence: The Savvy Manager"s Guide", Second Edition, 2012.
- Larissa T. Moss, S. Atre, "Business Intelligence Roadmap: The Complete Project Lifecycle of Decision Making", Addison Wesley, 2003
- Carlo Vercellis, "Business Intelligence: Data Mining and Optimization for Decision Making", Wiley Publications, 2009.

**R programming**

| | | | | | | |
|---|---|---|---|---|---|---|
| **1. Name of the Department- Computer Science & Engineering** | | | | | | |
| **2. Course Name** | **R programming** | **L** | **T** | | **P** | |
| **3. Course Code** | | **3** | **0** | | **2** | |
| **4. Type of Course (use tick mark)** | | **Core (✓)** | **PE(✓)** | | **OE ()** | |
| **5. Pre-requisite (if any)** | | **6. Frequency (use tick marks)** | Even () | Odd (✓) | Either Sem() | Every Sem () |
| **7. Total Number of Lectures, Tutorials, Practical (assuming 12 weeks of one semester)** | | | | | | |
| **Lectures =** | | **Tutorials = 0** | **Practical = 0** | | | |

**8. Course Description**

This course will cover basic concepts and techniques in R programming such as recognizing and changing data types, reading in and writing out data, indexing, loops, creating functions, iterations, manipulating data and creating plots.

**9.Learning Objectives:**

1. Understand the basics concepts of R programming
2. Understand the use of R for Big Data analytics
3. Learn to apply R programming for Text processing
4. Able to appreciate and apply the R programming from a statistical perspective

**10. Course Outcomes (COs):**

The students will be able to:-

1. Understand the fundamental syntax of R through readings, practice exercises, demonstrations, and writing R code.
2. Apply critical programming language concepts such as data types, iteration, control structures, functions, and boolean operators by writing R programs and through examples
3. Import a variety of data formats into R using RStudio
4. Prepare or tidy datas for in preparation for analysis • Query data using SQL and R

**11. Unit wise detailed content**

| **Unit-1** | **Number of lectures = 9** | |
|---|---|---|

**Introduction:**

Introducing to R – R Data Structures – Help functions in R – Vectors – Scalars – Declarations – recycling – Common Vector operations – Using all and any – Vectorized operations – NA and NULL values – Filtering – Vectorised if-then else – Vector Equality – Vector Element names

| **Unit – 2** | **Number of lectures = 9** | |
|---|---|---|

**Matrices, Arrays And Lists:**

Creating matrices – Matrix operations – Applying Functions to Matrix Rows and Columns – Adding and deleting rows and columns – Vector/Matrix Distinction – Avoiding Dimension Reduction – Higher Dimensional arrays – lists – Creating lists – General list operations – Accessing list components and values – applying functions to lists – recursive lists

| **Unit – 3** | **Number of lectures = 9** | |
|---|---|---|

**Data Frames:**

Creating Data Frames – Matrix-like operations in frames – Merging Data Frames – Applying

functions to Data frames – Factors and Tables – factors and levels – Common functions used with factors – Working with tables - Other factors and table related functions - Control statements – Arithmetic and Boolean operators and values – Default values for arguments - Returning Boolean values – functions are objects – Environment and Scope issues – Writing Upstairs - Recursion – Replacement functions – Tools for composing function code – Math and Simulations in R

| **Unit – 4** | **Number of lectures = 9** | |
|---|---|---|

**OOP:**

S3 Classes – S4 Classes – Managing your objects – Input/Output – accessing keyboard and monitor – reading and writing files – accessing the internet – String Manipulation – Graphics – Creating Graphs – Customizing Graphs – Saving graphs to files – Creating three-dimensional plots

**Interfacing:**

Interfacing R to other languages – Parallel R – Basic Statistics – Linear Model – Generalized Linear models – Non-linear models – Time Series and Auto-correlation – Clustering

**12. Brief Description of self-learning / E-learning component**

The students will be encouraged to learn using the SGT E-Learning portal and choose the relevant lectures delivered by subject experts of SGT University.

The link to the E-Learning portal.

https://elearning.sgtuniversity.ac.in/course-category/

**13. Books Recommended**

**Text Books**

- Norman Matloff , "The Art of R Programming: A Tour of Statistical Software Design", No Starch Press, 2011
- Jared P. Lander, "R for Everyone: Advanced Analytics and Graphics", Addison-Wesley Data & Analytics Series, 2013.

**14. Reference Books**

- Mark Gardener, " Beginning R – The Statistical Programming Language", Wiley, 2013
- Robert Knell, "Introductory R: A Beginner's Guide to Data Visualisation, Statistical Analysis and Programming in R", Amazon Digital South Asia Services Inc, 2013.

**R programming Lab**

| | | | | | | |
|---|---|---|---|---|---|---|
| **1. Name of the Department- Computer Science & Engineering** | | | | | | |
| **2. Course Name** | **R programming Lab** | **L** | **T** | | **P** | |
| **3. Course Code** | | **3** | **0** | | **2** | |
| **4. Type of Course (use tick mark)** | | **Core (✓)** | **PE(√)** | | **OE ()** | |
| **5. Pre-requisite (if any)** | | **6. Frequency (use tick marks)** | Even () | Odd (√) | Either Sem() | Every Sem () |
| **7. Total Number of Lectures, Tutorials, Practical (assuming 12 weeks of one semester)** | | | | | | |
| **Lectures = 0** | | **Tutorials = 0** | **Practical = 48** | | | |

**8. Course Description**

This course provides the knowledge to Install and use R for simple programming tasks, extended R libraries and packages. Which helps to Develop R Programs using Looping Constructs and R mathematical functions that can be used for data exploration in R.

**27. Learning Objectives:**

1. Install and use R for simple programming tasks.
2. Extend the functionality of R by using add-on packages
3. Extract data from files and other sources and perform various data manipulation tasks on them.

**10. Course Outcomes (COs):**

The students will be able to:

1. Master the use of the R interactive environment
2. Expand R by installing R packages.
3. Develop Loop constructs in R.
4. Use R for descriptive statistics.

**11. List of Experiments**

1. Installing R and packages in R
2. Programs on data types in R
3. Built-in Functions in R
4. Creating and manipulating a vector in R.
5. Creating matrix and manipulating matrix in R.
6. Creating and operations on Factors in R.
7. Operations on Data Frames in R.
8. Operations on Lists in R.
9. Programs on Operators in R.
10. Comparison of Matrices and Vectors in R.
11. Programs on If – else statements in R.
12. Programs on For Loops in R.
13. Programs on While Loops in R.
14. Customizing and Saving to Graphs in R.
15. PLOT Function in R to customize graphs.
16. 3D PLOT in R to customize graphs.

TEXT BOOKS:

The Art of R Programming, Norman Matloff, Cengage Learning
R for Everyone, Lander, Pearson

REFERENCE BOOKS:

R Cookbook, PaulTeetor, Oreilly.

R in Action, Rob Kabacoff, Manning.

**Social, Web & Mobile Analytics**

| | | | | | | |
|---|---|---|---|---|---|---|
| **1. Name of the Department- Computer Science & Engineering** | | | | | | |
| **2. Course Name** | **Social, Web & Mobile Analytics** | **L** | **T** | | **P** | |
| **3. Course Code** | | **3** | **0** | | **2** | |
| **4. Type of Course (use tick mark)** | | **Core (✓)** | **PE(✓)** | | **OE ()** | |
| **5. Pre-requisite (if any)** | | **6. Frequency (use tick marks)** | Even (✓) | Odd () | Either Sem() | Every Sem () |
| **7. Total Number of Lectures, Tutorials, Practical (assuming 12 weeks of one semester)** | | | | | | |
| **Lectures =** | | **Tutorials = 0** | **Practical = 0** | | | |

**8. Course Description**

The course will introduce tools such as engagement analytics, sentiment analysis, topic modeling, social network analysis, identification of influencers and evaluation of social media strategy

**28. Learning Objectives:**

1. Apply multiple quantitative and qualitative methods (e.g., clickstream analysis, A/B testing, surveys, social network analysis) to analyze we bsite traffic and social media initiatives
2. Understand sources and limitations of web-based data
3. Use key web metrics to assess goals and return on investment (ROI)
4. Perform social network analysis to identify important social actors, subgroups (i.e., clusters), and network properties in social media sites such as Twitter, Facebook, and YouTube
5. Use appropriate information visualization technique to gain insights into large datasets

**10. Course Outcomes (COs):**

The students will be able to:-

1. Apply best practices in Search Engine Optimization
2. Apply ethical principles to the use of web and social media data
3. Become familiar with core research communities, publications, and conferences focused on web and social media analytics and the research questions they are engaged in
4. Understand how web and social media analysis can be used to address original research questions in information technology and social science domains

**11. Unit wise detailed content**

| | | |
|---|---|---|
| **Unit-1** | **Number of lectures = 9** | |

**Introduction to Web & Social Analytics:**Overview of web & social media (Web sites, web apps, mobile apps and social media), Impact of social media on business, Social media environment, , How to leverage social media for better services, Usability, user experience, customer experience, customer sentiments, web marketing, conversion rates, ROI, brand reputation, competitive advantages Need of using analytics, Web analytics technical requirements., current analytics platforms, OpenSourcevs licensed platform, choosing right specifications & optimal solution, Web analytics and a Web analytics 2.0 framework (clickstream, multiple outcomes

| | | |
|---|---|---|
| **Unit – 2** | **Number of lectures = 9** | |

**Relevant Data And its Collection using statistical Programming language R:** Data (Structured data, unstructured data, metadata, Big Data and Linked Data), Participating with people centric approach, Data analysis basics (types of data, metrics and data, descriptive statistics, comparing, Basic overview of R R-Data Types, R-Decision Making, R-Loops, R-functions, R-Strings, Arrays, R-Lists, R-Data Frame, R-CSV Files, R-Pie Charts, R-Bar charts, R-Barplots. Basic Text Mining in R and word cloud.

| | | |
|---|---|---|
| **Unit – 3** | **Number of lectures = 9** | |

**KPI/Metrics:**Understand the discipline of social analytics, Aligning social objectives with business goals, Identify common social business objectives, developing KPIs; Standard vs Critical metrics. PULSE metrics (Page views, Uptime, Latency, Seven-day active users) on business and technical Issues, HEART metrics (Happiness, Engagement, Adoption, Retention, and Task success) on user behaviour issues; Bounce rate, exit rate, conversion rate, engagement, Syllabus of VII & VIII Semester B.E. / Computer Science &Engg. strategically aligned KPIs, Measuring Macro & micro conversions, On-site web analytics, off-site web analytics, the goal-signal-metric process. Case study on Ready-made tools for Web and social media analytics (Key Google Analytics metrics, dashboard, social reports, Tableau Public and KNIME

| **Unit – 4** | **Number of lectures = 9** | |
|---|---|---|

**Mining Twitter and Mining Facebook:**Why Is Twitter All the Rage?Exploring Twitter's API, Fundamental Twitter Terminology, Creating a Twitter API Connection, Exploring Trending Topics, Searching for Tweets, Analyzing the 140 Character, Extracting Tweet Entities, Analyzing Tweets and Tweet Entities with Frequency Analysis, Computing the Lexical Diversity of Tweets, Examining Patterns in Retweets, Visualizing Frequency Data with Histograms. Analyzing Fan Pages, Examining Friendships, and More Overview, Exploring Facebook's Social Graph API, Understanding the Social Graph API, Understanding the Open Graph Protocol, Analyzing Social Graph Connections, Analyzing Facebook Pages, Examining Friendships.

**12. Brief Description of self-learning / E-learning component**

The students will be encouraged to learn using the SGT E-Learning portal and choose the relevant lectures delivered by subject experts of SGT University.
The link to the E-Learning portal.
https://elearning.sgtuniversity.ac.in/course-category/

**13. Books Recommended**

**Text Books**


- Matthew A. Russell, Mining of Social web, O'Reilly; 2 edition (8 October 2013), ISBN-13: 978-1449367619.
- Charu C Agarwal, Social Network Data Analytics, Springer; 2011 edition (1 October 2014), 978-1489988935


**14. Reference Books**


- Hand, Mannila, and Smyth. Principles of Data Mining. Cambridge, MA: MIT Press, 2001. ISBN: 026208290X.
- AvinashKaushik, Web Analytics 2.0: The Art of Online Accountability and Science of Customer Centricity, John Wiley & Sons; Pap/Cdr edition (27 Oct 2009)
- Tom Tullis, Bill Albert, Measuring the User Experience: Collecting, Analyzing, and Presenting Usability Metrics, Morgan Kaufmann; 1 edition (28 April 2008).
- Jim Sterne, Social Media Metrics: How to Measure and Optimize Your Marketing Investment, John Wiley & Sons (16 April 2010) Brian Clifton, Advanced Web Metrics with Google Analytics, John Wiley & Sons; 3rd Edition edition (30 Mar 2012

**Social, Web & Mobile Analytics Lab**

| | | | | | | |
|---|---|---|---|---|---|---|
| **1. Name of the Department- Computer Science & Engineering** | | | | | | |
| **2. Course Name** | **Social, Web & Mobile Analytics Lab** | **L** | **T** | | **P** | |
| **3. Course Code** | | **3** | **0** | | **2** | |
| **4. Type of Course (use tick mark)** | | **Core (✓)** | **PE(√)** | | **OE ()** | |
| **5. Pre-requisite (if any)** | | **6. Frequency (use tick marks)** | Even (✓) | Odd () | Either Sem() | Every Sem () |
| **7. Total Number of Lectures, Tutorials, Practical (assuming 12 weeks of one semester)** | | | | | | |
| **Lectures = 0** | | **Tutorials = 0** | **Practical = 48** | | | |

**8. Course Description**

The aim of this course unit is to showcase the opportunities that exist today to leverage the power of the Web and social media; to develop students' expertise in assessing web marketing initiatives, evaluating web optimisation efforts, and measuring user experience

**29. Learning Objectives:**

1. Students will be able to understand social media, web and social media analytics,
2. Student will usability, user experience, and customer experience

**10. Course Outcomes (COs):**

The students will be able to:

1. Be able to understand usability metrics, web and social media metrics
2. Be able to identify key performance indicators for a given goal, identify data relating to the metrics and key performance indicators
3. Be able to analyse and interpret the data generated from usability testing, questionnaire surveys, or collected from Web and social media tracking tools

**11. List of Experiments**

1. Introduction Web and social media (Web sites, web apps, mobile apps and social media)•

Usability, user experience, customer experience, customer sentiments, web marketing,• conversion rates, ROI, brand reputation, competitive advantages Web analytics and a Web analytics 2.0 framework (clickstream, multiple outcomes• analysis, experimentation and testing, voice of customer, competitive intelligence, Insights)

2. Background Data (Structured data, unstructured data, metadata, Big Data and Linked Data)• Lab testing and experiment design (selecting participants, within-subjects or between• subjects study, counterbalancing, independent and dependent variable; A/B testing, multivariate testing, controlled experiments) Data analysis basics (types of data, metrics and data, descriptive statistics, comparing• means, correlations, nonparametric tests, presenting data graphically)

3. Measuring user experience Usability metrics (performance metrics, issues-based metrics, self-reported metrics)• Planning and performing a usability study (study goals, user goals, metrics and• evaluation methods, participants, data collection, data analysis) Typical types of usability studies and their corresponding metrics (comparing alternative• designs, comparing with competition, completing a task or transaction, evaluating the impact of subtle changes)

4. Web metrics and web analytics PULSE metrics (Page views, Uptime, Latency, Seven-day active users) on business and• technical issues; HEART metrics (Happiness, Engagement, Adoption, Retention, and Task success) on user• behaviour issues; On-site web analytics, off-site web analytics, the goal-signal-metric process•

5. Social media analytics Social media analytics (what and why)• Social media KPIs (reach and

engagement)• Performing social media analytics (business goal, KPIs, data gathering, analysis, measure• and feedback)

6. Data analysis language and tools Ready-made tools for Web and social media analytics (Key Google Analytics metrics,• dashboard, social reports ) Statistical programming language (R), its graphical development environment (Deducer)• for data exploration and analysis, and its social media analysis packages (RGoogleTrends, twitteR)

7. Cases and examples User experience measurement cases• Web analytics cases• 8. Group work and hands on practice Usability study planning and testing; and data analysis using software tools (Google• Analytics, Google Sites, R and Deducer

**References:**

Avinash Kaushik, Web Analytics 2.0: The Art of Online Accountability and Science of Customer Centricity, John Wiley & Sons; Pap/Cdr edition (27 Oct 2009)

Tom Tullis, Bill Albert, Measuring the User Experience: Collecting, Analyzing, and Presenting Usability Metrics, Morgan Kaufmann; 1 edition (28 April 2008)

Jim Sterne, Social Media Metrics: How to Measure and Optimize Your Marketing Investment, John Wiley & Sons (16 April 2010) (B) Brian Clifton, Advanced Web

# Cyber Security & Forensics

**Cryptography Fundamentals**

| | | | | | | |
|---|---|---|---|---|---|---|
| **Name of the Department- Computer Science and Engineering** | | | | | | |
| **Course Name** | **Cryptography Fundamentals** | **L** | **T** | | **P** | |
| **Course Code** | | **3** | **0** | | **2** | |
| **Type of Course (use tick mark)** | | **Core (✓)** | **PE(✓)** | | **OE ()** | |
| **Pre-requisite (if any)** | | **Frequency (use tick marks)** | Even () | Odd (✓) | Either Sem () | Every Sem () |
| **Total Number of Lectures, Tutorials, Practical (assuming 12weeks of one semester)** | | | | | | |
| **Lectures = 36** | | **Tutorials = 0** | **Practical = 0** | | | |

**Course Description**

The course covers theory and practice of computer security, focusing in particular on the security aspects of the web and Internet. System security issues, such as viruses, intrusion, and firewalls, will also be covered.

**Learning objectives:**

1. Explain the importance and application of each of confidentiality, integrity, authenticationand availability
2. Understand various cryptographic algorithms.
3. Understand the basic categories of threats to computers andnetworks
4. Describe public-keycryptosystem.
5. To defend the security attacks.

**Course Outcomes (COs):**

On completion of this course, the students will be able to

1. Identify basic security attacks and services
2. Use symmetric and asymmetric key algorithms for cryptography
3. Analyze Key Management techniques and importance of number Theory.
4. Understanding of Authentication functions the manner in which Message Authentication Codes and Hash Functions works..

**Unit wise detailed content**

| | | |
|---|---|---|
| **Unit-1** | **Number of lectures = 08** | **Title of the unit: Attacks on Computers and Computer Security** |

Introduction: The need for security, Security approaches, Principles of security, Types of Security attacks.Introduction to Number Theory**:** Divisibility and the Division Algorithm, The Euclidean Algorithm, Modular Arithmetic, Prime Numbers and The Chinese Remainder Theorem.

| | | |
|---|---|---|
| **Unit – 2** | **Number of** | **Title of the unit: Symmetric key Ciphers** |
| | **lectures = 10** | |

Cryptography: Concepts and Techniques: Introduction, Plain text and Cipher text, Substitution Techniques, Transposition Techniques, Stenography.
Block Cipher principles &Algorithms: Stream Ciphers vs. Block Ciphers,Feistel networks,Data Encryption Standard (DES),International Data Encryption Algorithm (IDEA)Basics of finite fields,Advanced Encryption Standard (AES), Principles of Pseudorandom Number Generation: PRNGs, TRNGs.

| **Unit – 3** | **Number of lectures = 08** | **Title of the unit:Asymmetric key Ciphers** |
|---|---|---|

Asymmetric key Ciphers: Symmetric vs. Asymmetric Cryptography, Principles of public key cryptosystems, RSA Algorithm, Diffie-Hellman Key Exchange, Elliptic Curve Cryptography.
Key Management and Distribution: Key Establishment Using Symmetric-Key and Asymmetric Techniques, Distribution of Public Keys.

| **Unit – 4** | **Number of lectures = 10** | **Title of the unit: Data Integrity Algorithms** |
|---|---|---|

Applications of Cryptographic Hash Functions: Security Requirements of Hash Functions, Hash Algorithms (MD5 and SHA-1), Principles of Message Authentication Codes, HMAC, CMAC Principles of Digital Signatures, Elgamal Digital Signature Scheme, Digital Signature Algorithm (DSA).

**Brief Description of self-learning / E-learning component**
The students will be encouraged to learn using the SGT E-Learning portal and choose the relevant lectures delivered by subject experts of SGT University.

The link to the E-Learning portal.

https://elearning.sgtuniversity.ac.in/course-

category/Journal papers; Patents in the respective

field.

**Books Recommended**


i. W. Stallings, Cryptography and Network Security: Principles and Practice, 7th Ed. Pearson Publishers, 2017. (ISBN No.: 978-0-13-44446-11)

ii. Cryptography and Network Security : Atul Kahate, Mc Graw Hill Edition

iii. Understanding Cryptography: Christof Paarand Jan Pelzl,Springer Heidelberg Dordrecht London New York,ISBN 978-3-642-04100-6.

iv. D. R. Stinson, Cryptography: Theory and Practice, 3rd Ed. Boca Raton, FL: Chapman & Hall/CRC, 2005. (ISBN No.: 978-1-58-488508-5)

v. Information Security, Principles and Practice: Mark Stamp, Wiley India.

vi. Principles of Computer Security: WM.Arthur Conklin, Greg White, TMH

vii. Introduction to Network Security: Neal Krawetz, CENGAGE Learning

**Cryptography Fundamental Lab**

<table>
<tr><td colspan="8">1. Name of the Department- Computer Science & Engineering</td></tr>
<tr><td>2. Course Name</td><td colspan="2">Cryptography Fundamental Lab</td><td>L</td><td colspan="2">T</td><td colspan="2">P</td></tr>
<tr><td>3. Course Code</td><td colspan="2"></td><td>3</td><td colspan="2">0</td><td colspan="2">2</td></tr>
<tr><td colspan="2">4. Type of Course (use tick mark)</td><td>Core (✓)</td><td colspan="2">PE (✓)</td><td colspan="2">OE ()</td></tr>
<tr><td>5. Pre-requisite (if any)</td><td colspan="2"></td><td>6. Frequency (use tick marks)</td><td>Even()</td><td>Odd (✓)</td><td>Either Sem()</td><td>Every Sem ()</td></tr>
<tr><td colspan="8">7. Total Number of Lectures, Tutorials, Practical (assuming 14 weeks of one semester)</td></tr>
<tr><td colspan="3">Lectures = 0</td><td>Tutorials = 0</td><td colspan="4">Practical = 36</td></tr>
<tr><td colspan="8">Course Description: Cryptography is the practice of techniques used to protect the secure transmission of information. This course is an excellent starting point to understand what is cryptography, learn how cryptography is used, and understand hash, symmetric, and asymmetric cryptographic algorithms.</td></tr>
<tr><td colspan="8">12. Learningobjectives:<br>1. Explain the importance and application of each of confidentiality, integrity, authenticationand availability<br>2. Understand various cryptographic algorithms.<br>3. Understand the basic categories of threats to computers andnetworks<br>4. Describe public-keycryptosystem.</td></tr>
<tr><td colspan="8">10. Course Outcomes (COs):</td></tr>
<tr><td colspan="8">1. Understand security concepts and type of attacks and network security algorithms.<br>2. Apply symmetric and asymmetric key cryptography technique to encrypt and decrypt text.<br>3. Apply the knowledge of symmetric key algorithm.<br>4. Apply Cryptography Hash Function for message authentication and to solve other applications.<br>5. Understand the concept of security with different key management things.</td></tr>
<tr><td colspan="8">11. List of Experiments</td></tr>
<tr><td colspan="8">1. Write a program to perform encryption and decryption for Ceaser cipher.<br>2. Write a program to implement Rail fence Cipher technique.<br>3. Write a program to implement the DES algorithm logic.<br>4. User A want to send message “welcome to SGT University” to user B by using AES algorithms encrypt it and decrypt it at receiver end.<br>5. Write a program to implement RSA algorithm.<br>6. Implement the Diffie-Hellman Key Exchange mechanism using HTML and JavaScript.<br>7. Write a program to implement Secure Hash Algorithm.<br>8. Calculate the message digest of a text using the MD5 algorithm in JAVA.<br>9. Write a program to implement digital Signature.</td></tr>
</table>

**Network Security**

| | | | | | | |
|---|---|---|---|---|---|---|
| **1. Name of the Department- Computer Science & Engineering** | | | | | | |
| **2. Course Name** | **Network Security** | **L** | **T** | | **P** | |
| **3. Course Code** | | **3** | **0** | | **2** | |
| **4. Type of Course (use tick mark)** | | **Core (✓)** | **PE(✓)** | | **OE ()** | |
| **5. Pre-requisite (if any)** | | **6. Frequency (use tick marks)** | Even (✓) | Odd () | Either Sem() | Every Sem () |
| **7. Total Number of Lectures, Tutorials, Practical (assuming 12 weeks of one semester)** | | | | | | |
| **Lectures = 36** | | **Tutorials = 0** | **Practical = 0** | | | |

**8. Course Description**

This course covers the underlying principles and techniques for network and communication security. Practical examples of security problems and principles for countermeasures are given. The course also surveys cryptographic and other tools used to provide security and reviews how these tools are utilized in protocols and applications.

**30. LearningObjectives:**

1. To understand basics of Network Security.
2. To be able to secure a message over insecure channel by various means
3. To learn about how to maintain the Confidentiality, Integrity and Availability of a data.

**10. Course Outcomes (COs):**

The students will be able to:-

1. Develop Concept of Security needed in Communication of data through computers and networks along with Various Possible Attacks.
2. Understand Various Encryption mechanisms for secure transmission of data and management of key required for required for encryption.
3. Understand authentication requirements and study various authentication mechanisms

**11. Unit wise detailed content**

| **Unit-1** | **Number of lectures = 9** | |
|---|---|---|

Introduction to security attacks - services and mechanism - introduction to cryptography - Conventional Encryption: Conventional encryption model - classical encryption techniques - substitution ciphers and transposition ciphers – cryptanalysis – steganography - stream and blockciphers - Modern Block Ciphers: Block ciphers principals - Shannon's theory of confusion anddiffusion - fiestal structure - data encryption standard(DES) - strength of DES - differential and linearcrypt analysis of DES - block cipher modes of operations - triple DES – AES.

| **Unit – 2** | **Number of lectures = 9** | |
|---|---|---|

Confidentiality using conventional encryption - traffic confidentiality - key distribution - random number generation - Introduction to graph - ring and field - prime and relative prime numbers - modular arithmetic - Fermat's and Euler's theorem - primality testing - Euclid's Algorithm - Chinese Remainder theorem - discrete algorithms.

Principles of public key crypto systems - RSA algorithm - security of RSA - key management – Diffle-Hellman key exchange algorithm - introductory idea of Elliptic curve cryptography – Elgamel encryption - Message Authentication and Hash Function: Authentication requirements - authentication functions - message authentication code - hash functions - birthday attacks – security of hash functions and MACS.

| **Unit – 3** | **Number of lectures = 9** | |
|---|---|---|

MD5 message digest algorithm - Secure hash algorithm (SHA) Digital Signatures: Digital Signatures - authentication protocols - digital signature standards (DSS) - proof of digital signature algorithm - Authentication Applications: Kerberos and X.509 - directory authentication service - electronic mail security-pretty good privacy (PGP) - S/MIME.

| **Unit – 4** | **Number of lectures = 9** | |
|---|---|---|

Web Security: Secure socket layer and transport layer security - secure electronic transaction (SET) - System Security: Intruders - Viruses and related threads - firewall design principals – trusted systems. IP Security: Architecture - Authentication header - Encapsulating security payloads - combining security associations - key management.

**12. Brief Description of self-learning / E-learning component**

The students will be encouraged to learn using the SGT E-Learning portal and choose the relevant lectures delivered by subject experts of SGT University.
The link to the E-Learning portal.
https://elearning.sgtuniversity.ac.in/course-category/

**13. Books Recommended**

**Text Books**

- William Stallings, "Crpyptography and Network security Principles and Practices", Pearson/PHI
- Cryptography and Network Security: Principles and Practice, 6th Edition, William Stallings, 2014, Pearson, ISBN13:9780133354690.
-

**14. Reference Books**

- Charles P. Pfleeger, Shari Lawrence Pfleeger – Security in computing – Prentice Hall of India.
- W. Mao, "Modern Cryptography – Theory and Practice", Pearson Education

| | | | | | | |
|---|---|---|---|---|---|---|
| **1. Name of the Department- Computer Science & Engineering** | | | | | | |
| **2. Course Name** | **Network Security Lab** | **L** | **T** | | **P** | |
| **3. Course Code** | | **3** | **0** | | **2** | |
| **4. Type of Course (use tick mark)** | | **Core (✓)** | **PE ()** | | **OE ()** | |
| **5. Pre-requisite (if any)** | | **6. Frequency (use tick marks)** | Even (✓) | Odd () | Either Sem() | Every Sem () |
| **7. Total Number of Lectures, Tutorials, Practical (assuming 14 weeks of one semester)** | | | | | | |
| **Lectures = 0** | | **Tutorials = 0** | **Practical = 36** | | | |

**Course Description:** This course allows the students to explore the practical elements of networks security and related design, and deployment decisions. Student will be able to Identify the security issues in the network and resolve it.

**13. Learningobjectives:**

1. Exhibit knowledge to secure corrupted systems, protect personal data, and secure computer networks in an Organization. Practice with an expertise in academics to design and implement security solutions.
2. Understand key terms and concepts in Cryptography, Governance and Compliance.
3. Develop cyber security strategies and policies
4. Understand principles of web security and to guarantee a secure network by monitoring and analyzing the nature of attacks through cyber/computer forensics software/tools

**10. Course Outcomes (COs):**

1. Analyze and evaluate the cyber security needs of an organization.
2. Determine and analyze software vulnerabilities and security solutions to reduce the risk of exploitation.
3. Measure the performance and troubleshoot cyber security systems.

**11. List of Experiments**

1. Write a C program that contains a string (char pointer) with a value ‘Hello world’. The program should XOR each character in this string with 0 and displays the result.
2. Write a C program that contains a string (char pointer) with a value ‘Hello world’. The program should AND or and XOR each character in this string with 127 and display the result.
3. Write a Java program to perform encryption and decryption using the following algorithms a. Ceaser cipher b. Substitution cipher c. Hill Cipher
4. Write a C/JAVA program to implement the DES algorithm logic.
5. Write a C/JAVA program to implement the Blowfish algorithm logic.
6. Write a C/JAVA program to implement the Rijndael algorithm logic.
7. Write the RC4 logic in Java Using Java cryptography; encrypt the text “Hello world” using Blowfish. Create your own key using Java key tool.
8. Write a Java program to implement RSA algorithm.
9. Implement the Diffie-Hellman Key Exchange mechanism using HTML and JavaScript.
10. Calculate the message digest of a text using the SHA-1 algorithm in JAVA.
11. Calculate the message digest of a text using the MD5 algorithm in JAVA

**Android Security**

| | | | | | | |
|---|---|---|---|---|---|---|
| **1. Name of the Department- Computer Science & Engineering** | | | | | | |
| **2. Course Name** | **Android Security** | **L** | **T** | | **P** | |
| **3. Course Code** | | **3** | **0** | | **2** | |
| **4. Type of Course (use tick mark)** | | **Core (✓)** | **PE(✓)** | | **OE ()** | |
| **5. Pre-requisite (if any)** | Computer Basics | **6. Frequency (use tick marks)** | Even () | Odd (✓) | Either Sem() | Every Sem () |
| **7. Total Number of Lectures, Tutorials, Practical (assuming 12 weeks of one semester)** | | | | | | |
| **Lectures = 36** | | **Tutorials = 0** | **Practical = 0** | | | |

**8. Course Description**

The Android operating system has several built-in security features to protect application users from attackers (e.g., network sniffers, malicious app writers, device thieves, and more). This course teaches important information about the Android platform but also focuses on these defensive programming techniques which developers must know in order to write secure apps..

**31. LearningObjectives:**

1. Appreciate the risks to Android applications.
2. Understand the structure of Android package files.
3. Understand the Android security model and the protections provided by the Android OS.
4. Apply defensive programming techniques for common Android vulnerabilities.

**10. Course Outcomes (COs):**

The students will be able to:-

1. Describe different components of Android applications
2. Identify possible vulnerabilities
3. Secure coding examples

**11. Unit wise detailed content**

| **Unit-1** | **Number of lectures = 9** | |
|---|---|---|

**Introduction to Mobile Security**

Building Blocks – Basic security and cryptographic techniques, Security of GSM Networks, Security of UMTS Networks, LTE Security, WiFi and Bluetooth Security, SIM/UICC Security Mobile Malware and App Security

| **Unit – 2** | **Number of lectures = 9** | |
|---|---|---|

Security Model

Android Security Model, IOS Security Model, Security Model of the Windows Phone, SMS/MMS, Mobile Geolocation and Mobile Web Security, Security of Mobile VoIP Communications

| **Unit – 3** | **Number of lectures = 9** | |
|---|---|---|

**Introduction to Android APP Development**
Architecture, Code Layout, SDK review

Understand the structure of Android package files.

Explore the role of security in the software development life cycle and how best to create secure applications.

| **Unit – 4** | **Number of lectures = 9** | |
|---|---|---|

Appreciate the risks to Android applications.

Understand the Android security model and the protections provided by the Android OS.

Apply defensive programming techniques for common Android vulnerabilities.

**12. Brief Description of self-learning / E-learning component**

The students will be encouraged to learn using the SGT E-Learning portal and choose the relevant lectures delivered by subject experts of SGT University.
The link to the E-Learning portal.
https://elearning.sgtuniversity.ac.in/course-category/

**13. Books Recommended**

**Text Books**

- Mobile Application Security, Himanshu Dviwedi, Chris Clark and David Thiel, 1st Edition

**14. Reference Books**

- Security of Mobile Communications, Noureddine Boudriga, 2009

# Android Security Lab

| | | | | | | |
|---|---|---|---|---|---|---|
| **1. Name of the Department- Computer Science & Engineering** | | | | | | |
| **2. Course Name** | **Android SecurityLab** | **L** | **T** | | **P** | |
| **3. Course Code** | | **3** | **0** | | **2** | |
| **4. Type of Course (use tick mark)** | | **Core (✓)** | **PE()** | | **OE ()** | |
| **5. Pre-requisite (if any)** | | **6. Frequency (use tick marks)** | Even | Odd (✓) | Either Sem() | Every Sem () |
| **7. Total Number of Lectures, Tutorials, Practical (assuming 14 weeks of one semester)** | | | | | | |
| **Lectures = 0** | | **Tutorials = 0** | **Practical = 36** | | | |

**8. Course Description**

**14. Learningobjectives:**

1. Exposed to technology and business trends impacting mobile applications.
2. Competent with the characterization and architecture of mobile applications.
3. Competent with designing and developing mobile applications using one application development framework.

**10. Course Outcomes (COs):**

1. a clear understanding of the subject related concepts and of contemporary issues
2. an ability to design a component or a product applying all the relevant standards and with realistic constraints
3. a clear understanding of professional and ethical responsibility
4. an ability to use the social media effectively for productive use

**11. List of Experiments**

1. Demonstrate android security features by building App
2. Changing / granting permission with android manifest
3. Create Application for Call function security
4. Create Application for media access security
5. Create Application for Network access security
6. Create Application for file access security
7. Develop a password protected app
8. Create Application forWiFi and Bluetooth security

**Disaster Recovery And Business Continuity Management**

| | | | | | | |
|---|---|---|---|---|---|---|
| **1. Name of the Department- Computer Science & Engineering** | | | | | | |
| **Course Name** | **Disaster Recovery And Business Continuity Management** | **L** | **T** | **P** | | |
| **2. Course Code** | | **3** | **0** | **0** | | |
| **3. Type of Course (use tick mark)** | | **Core (✓)** | **PE(✓)** | **OE ()** | | |
| **Pre-requisite (if any)** | **Basic Environmental Knowledge** | **6. Frequency (use tick marks)** | Even (✓) | Odd () | Either Sem() | Every Sem () |
| **4. Total Number of Lectures, Tutorials, Practical (assuming 12 weeks of one semester)** | | | | | | |
| **Lectures = 36** | | **Tutorials =** | | | | |

**5. Brief Syllabus**

This course focuses on two aspects of Cyber Security: analysis and assessment of risk plus how to minimize it, and, how to extract and use digital information from a wide range of systems and devices. The course is structured so that all students cover the same introductory material, but then choose to specialize in either Cyber Security or Digital Forensics. Any aforesaid science graduate who requires keen interest & knowledge of IT programming languages with basic knowledge of math beyond calculus.

**6. Learning objectives:**

1. analysis and assessment of risk plus how to minimize it
2. how to extract and use digital information from a wide range of systems and devices.
3. Learn Cyber Security or Digital Forensics.

**7. Course Outcomes (COs):**

1. Understand the concept of business continuity
2. Learn the importance of a BCP(business continuity planing)
3. See how load balancing maintains business continuity
4. Discover how a DCP(Disaster recover plan) is a second line of defense
5. Learn how to choose the right fail over solution

**8. Unit wise detailed content**

| | | |
|---|---|---|
| **9. Unit-1** | **Number of lectures = 10** | **Title of the unit: Introduction** |

Introduction to Business Continuity Management (BCM) and Disaster Recovery (DR) -Terms and definitions - BCM principles - BCM life cycle - (BCM program management, Understanding the organization - Determining business continuity strategy, Developing and implementing a BCM response, BCM exercising, Maintaining and reviewing BCM arrangements, Embedding BCM in the organization's culture)- BCM in business: Benefits and consequence - Contemporary landscape: Trends and directions.

| | | |
|---|---|---|
| **10. Unit – 2** | **Number of lectures = 10** | **Title of the unit: Business Impact Analysis** |

BCM and DR–The relationship with Risk Management - Risk Management concepts and framework - Concepts of threat, vulnerabilities and hazard - Risk Management process - Risk assessment, risk

control options analysis, risk control implementation, risk control decision, and risk reporting - Business Impact Analysis (BIA) concept, benefits and responsibilities - BIA methodology - Assessment of financial and operational impacts, identification of critical IT systems and applications, identifications of recovery requirements and BIA reporting - Relationship between BIA and Risk Management.

| **11. Unit - 3** | **Number of lectures = 8** | **Title of the unit: Business Continuity Strategy and Business Continuity Plan (BCP) Development** |
|---|---|---|

Business continuity strategy development framework - Cost-benefit assessment - Site assessment and selection - Selection of recovery options - Strategy considerations and selection - Linking strategy to plan - Coordinating with External Agencies -Business continuity plan contents - Information Systems aspects of BCP - Crisis Management - Emergency response plan and crisis communication plan - Awareness, training and communication - Plan activation - Business Continuity Planning Tools.

| **12. Unit - 4** | **Number of lectures = 8** | **Title of the unit: Business Continuity Plan Testing and Maintenance** |
|---|---|---|

Test plan framework - Types of testing – Business Continuity Plan Testing - Plan maintenance requirements and parameters - Change management and control -Business Continuity Plan Audits. Disaster Recovery – Definitions - Backup and recovery - Threat and risk assessment - Site assessment and selection - Disaster Recovery Road map - Disaster Recovery Plan (DRP)preparation - Vendor selection and implementation - Difference between BCP and DRP - Systems and communication security during recovery and repair.

**13. Brief Description of self-learning / E-learning component**

The students will be encouraged to learn using the SGT ELearning portal and choose the relevant lectures delivered by subject experts of SGT University.

The link to the E-Learning portal.

https://elearning.sgtuniversity.ac.in/course-category/Journal papers; Patents in the respective field.

**14. Books Recommended**

**Text Book:**

- The Disaster Recovery Handbook by Michael Wallace (Author) and Lawrence Webber (Author) (2010), AMACOM

**Reference Books:**

- William H. Dennen and Bruce R. Moore, WCB Publishers, Iowa.
- John M. Wallace and Peter V. Hobbs, Atmospheric Science: An Introductory Survey, Academic Press, New York,
- Egbort Bocker and Rienk Van Grondille, Environmental Physics, John Wiley and Sons Ltd
- Barbar W. Murk et. al., Environmental Geology, John Wiley and Sons, New York

**Digital Watermarking and Steganography**

| | | | | | | |
|---|---|---|---|---|---|---|
| **1. Name of the Department- Computer Science & Engineering** | | | | | | |
| **2. Course Name** | **Digital Watermarking and Steganography** | **L** | **T** | | **P** | |
| **3. Course Code** | | **3** | **0** | | **2** | |
| **4. Type of Course (use tick mark)** | | **Core (✓)** | **PE(✓)** | | **OE ()** | |
| **5. Pre-requisite (if any)** | NIL | **6. Frequency (use tick marks)** | Even () | Odd (✓) | Either Sem () | Every Sem () |
| **7. Total Number of Lectures, Tutorials, Practical (assuming 12 weeks of one semester)** | | | | | | |
| **Lectures = 36** | | **Tutorials = 0** | **Practical = 0** | | | |

**8. Course Description**

Digital watermarking technology can be used to guarantee authenticity and can be applied as proof that the content has not been altered since insertion. To provide a comprehensive overview on different aspects of mechanisms and techniques for information security.

**32. Learning Objectives:**

1. To learn about the watermarking models and message coding
2. To learn about watermark security and authentication.
3. To learn about stegnography. Perceptual models

**10. Course Outcomes (COs):**

The students will be able to:-

1. Know the History and importance of watermarking and steganography
2. Analyze Applications and properties of watermarking and steganography
3. Demonstrate Models and algorithms of watermarking.
4. Possess the passion for acquiring knowledge and skill in preserving authentication of Information
5. Identify theoretic foundations of steganography and steganalysis

**11. Unit wise detailed content**

| **Unit-1** | **Number of lectures = 9** | |
|---|---|---|

Introduction: Information Hiding, Steganography and Watermarking – History of watermarking – Importance of digital watermarking – Applications – Properties – Evaluating watermarking systems. Watermarking models & message coding: Notation – Communications – Communication based models – Geometric models – Mapping messages into message vectors – Error correction coding – Detecting multi-symbol watermarks.

| **Unit – 2** | **Number of lectures = 9** | |
|---|---|---|

Watermarking with side information & analyzing errors: Informed Embedding – Informed Coding – Structured dirty-paper codes - Message errors – False positive errors – False negative errors – ROC curves – Effect of whitening on error rates.

| **Unit – 3** | **Number of lectures = 9** | |
|---|---|---|

Perceptual models: Evaluating perceptual impact – General form of a perceptual model – Examples of perceptual models – Robust watermarking approaches - Redundant Embedding, Spread Spectrum Coding, Embedding in Perceptually significant coefficients
Watermark security & authentication: Security requirements – Watermark security and cryptography – Attacks – Exact authentication – Selective authentication – Localization – Restoration.

| **Unit – 4** | **Number of lectures = 9** | |
|---|---|---|

Steganography: Steganography communication – Notation and terminology – Informationtheoretic foundations of steganography – Practical steganographic methods – Minimizing the embedding impact – Steganalysis

**12. Brief Description of self-learning / E-learning component**

The students will be encouraged to learn using the SGT E-Learning portal and choose the relevant lectures delivered by subject experts of SGT University.
The link to the E-Learning portal.
https://elearning.sgtuniversity.ac.in/course-category/

**13. Books Recommended**

**Text Books**

- Ingemar J. Cox, Matthew L. Miller, Jeffrey A. Bloom, Jessica Fridrich, Ton Kalker. "Digital Watermarking and Steganography", Margan Kaufmann Publishers, New York, 2018.

**14. Reference Books**

- Michael Arnold, Martin Schmucker, Stephen D. Wolthusen, "Techniques and Applications of Digital Watermarking and Contest Protection", Artech House, London, 2013.
- Juergen Seits, "Digital Watermarking for Digital Media", IDEA Group Publisher, New York, 2015.
- Peter Wayner, "Disappearing Cryptography – Information Hiding: Steganography & Watermarking", Morgan Kaufmann Publishers, New York, 2012.

**Digital Watermarking and Steganography Lab**

| | | | | | | |
|---|---|---|---|---|---|---|
| **1. Name of the Department- Computer Science & Engineering** | | | | | | |
| **2. Course Name** | **Digital Watermarking and Steganography Lab** | **L** | **T** | | **P** | |
| **3. Course Code** | | **3** | **0** | | **2** | |
| **4. Type of Course (use tick mark)** | | **Core (✓))** | **PE(✓)** | | **OE ()** | |
| **5. Pre-requisite (if any)** | | **6. Frequency (use tick marks)** | Even | Odd (✓) | Either Sem() | Every Sem () |
| **7. Total Number of Lectures, Tutorials, Practical (assuming 14 weeks of one semester)** | | | | | | |
| **Lectures = 0** | | **Tutorials = 0** | **Practical = 36** | | | |
| **8. Course Description** | | | | | | |

**15. Learningobjectives:**

1. To learn about the watermarking models and message coding
2. To learn about watermark security and authentication.
3. To learn about stegnography. Perceptual models

**10. Course Outcomes (COs):**

Students will be able to:

1. Analyze Applications and properties of watermarking and steganography
2. Demonstrate Models and algorithms of watermarking
3. Possess the passion for acquiring knowledge and skill in preserving authentication of Information

**11. List of Experiments**

1. Write a code to implement watermarking in the document.
2. Write a code to remove watermarking from the document
3. Write a code to hide the data in image
4. Write a code to hide the photo in plain sight
5. Write a code to hide to implement Information hiding
6. Implement the Hiding the text in image using stegnography S-Tool
7. Write a code to retrieve the hidden image from data
8. Write a code to retrieve the hidden text from image
9. Write a code to extract photo from plainsight
10. Write a code to implement encryption using stegnography

**Biometrics**

| | | | | | | |
|---|---|---|---|---|---|---|
| **1. Name of the Department- Computer Science & Engineering** | | | | | | |
| **2. Course Name** | Biometrics | **L** | **T** | | **P** | |
| **3. Course Code** | | **3** | **0** | | **2** | |
| **4. Type of Course (use tick mark)** | | **Core (✓)** | **PE(✓)** | | **OE ()** | |
| **5. Pre-requisite (if any)** | NIL | **6. Frequency (use tick marks)** | Even (✓) | Odd () | Either Sem () | Every Sem () |
| **7. Total Number of Lectures, Tutorials, Practical (assuming 12 weeks of one semester)** | | | | | | |
| **Lectures = 36** | | **Tutorials = 0** | **Practical = 0** | | | |

**8. Course Description**

Biometric recognition, or simply biometrics, is the science of establishing the identity of a person based on physical or behavioral attributes. In this course we will cover the three primary modalities of biometric recognition, namely fingerprint, face, and iris.

**33. Learning Objectives:**

1. To develop a fundamental knowledge in the phases of biometric system for identification and verification tasks.
2. To quantitatively and qualitatively evaluate the strength and weaknesses of several biometric modalities from measures, such as error metrics, usability, and public perception, and apply these skills to emerging biometric technologies.

**10. Course Outcomes (COs):**

The student should be able to:

1. Demonstrate knowledge engineering principles underlying biometric systems.
2. Analyze design basic biometric system applications.

**11. Unit wise detailed content**

| | | |
|---|---|---|
| **Unit-1** | **Number of lectures = 9** | |

Introduction - Biometric fundamentals – Biometric technologies – Biometrics vs traditional techniques – Characteristics of a good biometric system – Benefits of biometrics – Key biometric processes: verification, identification and biometric matching – Performance measures in biometric systems.

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|---|---|---|
| **Unit – 2** | **Number of lectures = 9** | |

Physiological Biometrics - Leading technologies: Finger-scan – Facial-scan – Irisscan – Voice-scan – components, working principles, competing technologies, strengths and weaknesses – Other physiological biometrics: Hand-scan, Retinascan – components, working principles, competing technologies, strengths and weaknesses – Automated fingerprint identification systems. Behavioural Biometrics: Leading technologies: Signature-scan – Keystrokescan – components, working principles, strengths and weaknesses.

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|---|---|---|
| **Unit – 3** | **Number of lectures = 9** | |

Standards in Biometrics - Assessing the Privacy Risks of Biometrics – Designing Privacy - Sympathetic Biometric Systems – Need for standards – different biometric standards - Categorizing biometric applications.

Multi biometrics and multi factor biometrics - two-factor authentication with passwords - tickets and tokens – executive decision - implementation plan.

| **Unit – 4** | **Number of lectures = 9** | |
|---|---|---|

Signature and handwriting technology - Technical description – classification – keyboard / keystroke dynamics- Voice – data acquisition - feature extraction - characteristics - strengths – weaknesses-deployment.

**12. Brief Description of self-learning / E-learning component**

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The link to the E-Learning portal.
https://elearning.sgtuniversity.ac.in/course-category/

**13. Books Recommended**

**Text Books**

- Anil K. Jain, Patrick Flynn, and Arun A. Ross, "Handbook of Biometrics", Springer, 2018.

**14. Reference Books**

- L C Jain, I Hayashi, S B Lee, U Halici, Intelligent Biometric Techniques in Fingerprint and Face Recognition CRC Press, 2014.
- John R. Vacca, "Biometric Technologies and Verification Systems", Elsevier Inc, 2017

**Biometrics Lab**

| | | | | | | |
|---|---|---|---|---|---|---|
| **1. Name of the Department- Computer Science & Engineering** | | | | | | |
| **2. Course Name** | **Biometrics Lab** | **L** | **T** | | **P** | |
| **3. Course Code** | | **2** | **0** | | **2** | |
| **4. Type of Course (use tick mark)** | | **Core (✓)** | **PE(✓)** | | **OE ()** | |
| **5. Pre-requisite (if any)** | | **6. Frequency (use tick marks)** | Even (✓) | Odd () | Either Sem() | Every Sem () |
| **7. Total Number of Lectures, Tutorials, Practical (assuming 14 weeks of one semester)** | | | | | | |
| **Lectures = 0** | | **Tutorials = 0** | **Practical = 36** | | | |
| **8. Course Description** | | | | | | |
| **16. Learningobjectives:**<br>1. To learn to implement Image Enhancement and Segmentation.<br>2. To learn to implement Image Acquisition and Feature Extraction -Fingerprint<br>3. To learn to implement Image Acquisition and Feature Extraction - Face and Iris .<br>4. To learn to implement 3D Biometric and Mobile Biometrics. | | | | | | |
| **10. Course Outcomes (COs):** | | | | | | |
| Students will be able to:<br>1. Design and Apply Image Enhancement and Segmentation.<br>2. Design and Apply Image Acquisition and Feature Extraction -Fingerprint<br>3. Design and Apply Image Acquisition and Feature Extraction - Face and Iris .<br>4. Design and Apply 3D Biometric and Mobile Biometrics. | | | | | | |
| **11. List of Experiments** | | | | | | |
| 1. Image Enhancement<br>2. Image Segmentation<br>3. Image Acquisition -Fingerprint<br>4. Feature Extraction – Fingerprint<br>5. Image Acquisition – Face<br>6. Feature Extraction – Face<br>7. Image Acquisition – Iris<br>8. Feature Extraction - Iris<br>9. 3D Biometric – Palmprint<br>10. Mobile biometrics | | | | | | |