Course code	Course Name	L-T-P-Credits	Year of Introduction
IT201	Digital System Design	3-1-0-4	2016

Prerequisite : Nil

Course Objectives

1. To impart an understanding of the basic concepts of Boolean algebra and digital circuit design.
2. To provide familiarity with the design and implementation of different types of practically used combinational and sequential circuits.
3. To provide an introduction to Hardware Description Language
4. To expose the students to basics of arithmetic algorithms

Syllabus

Introduction to Number Systems, Boolean Algebra, Canonical Forms, Logic Gates, Digital Circuit Design - Combination Logic Circuit Design, Sequential Circuit Design, Registers, Counter, Memory modules, Programmable Logical Arrays, Hardware Description Language for Circuit Design, Case study with VHDL, Arithmetic algorithms

Expected Outcomes

Student will be able to:-

1. Apply the basic concepts of Boolean algebra for the simplification and implementation of logic functions using suitable gates namely NAND, NOR etc.
2. Design simple Combinational Circuits such as Adders, Subtractors, Code Convertors, Decoders, Multiplexers, Magnitude Comparators etc.
3. Design Sequential Circuits such as different types of Counters, Shift Registers, Serial Adders, Sequence Generators.
4. Use Hardware Description Language for describing simple logic circuits.
5. Apply algorithms for addition/subtraction operations on Binary, BCD and Floating Point Numbers.

Text Books:

1. Mano M. M., *Digital Logic & Computer Design*, 4/e, Pearson Education, 2013.
2. Charles H Roth ,Jr, Lizy Kurian John, *Digital System Design using VHDL*,2/e, Cengage Learning

References:

1. Tokheim R. L., *Digital Electronics Principles and Applications*, 7/e, Tata McGraw Hill, 2007.
2. Mano M. M. and M. D Ciletti, *Digital Design*, 4/e, Pearson Education, 2008.
3. Rajaraman V. and T. Radhakrishnan, *An Introduction to Digital Computer Design*, 5/e, Prentice Hall India Private Limited, 2012.
4. Leach D, Malvino A P, Saha G, *Digital Principles and Applications, 8/e, McGraw Hill Education, 2015.*
5. Floyd T. L., *Digital Fundamentals*, 10/e, Pearson Education, 2009
6. M. Morris Mano, *Computer System Architecture*, 3/e, Pearson Education, 2007.
7. Harris D. M. and, S. L. Harris, Digital *Design and Computer Architecture*, 2/e, Morgan Kaufmann Publishers, 2013

COURSE PLAN			
Module	**Contents**	**Contact Hours**	**Sem. Exam Marks**
I	Number systems – Decimal, Binary, Octal and Hexadecimal – conversion from one system to another –representation of negative numbers – representation of BCD numbers – character representation – character coding schemes – ASCII – EBCDIC etc Addition, subtraction, multiplication and division of binary numbers (no algorithms). Addition and subtraction of BCD, Octal and Hexadecimal numbers Representation of floating point numbers – precision –addition, subtraction, multiplication and division of floating point numbers	10	**15%**
II	Introduction — Postulates of Boolean algebra – Canonical and Standard Forms — logic functions and gates Methods of minimization of logic functions — Karnaugh map method and Quine- McClusky method Product-of-Sums Simplification — Don't-Care Conditions.	09	**15%**
III	Combinational Logic: combinational Circuits and design procedure — binary adder and subtractor — multi—level NAND and NOR circuits — Exclusive-OR and Equivalence Functions. Implementation of combination logic: parallel adder, carry look ahead adder, BCD adder, code converter, magnitude comparator, decoder, multiplexer, demultiplexer, parity generator.	09	**15%**
IV	Sequential logic circuits: latches and flip-flops – edge triggering and level-triggering — RS, JK, D and T flipflops — race condition — master-slave flip-flop. Clocked sequential circuits: state diagram — state reduction and assignment — design with state equations	07	**15%**
V	Registers: registers with parallel load - shift registers universal shift registers – application: serial adder.	08	**20%**

	Counters: asynchronous counters — binary and BCD ripple counters — timing sequences — synchronous counters — up-down counter, BCD counter, Johnson counter, Ring counter		
VI	Memory and Programmable Logic: Random-Access Memory (RAM)—Memory Decoding—Error Detection and Correction — Read only Memory (ROM), Programmable Logic Array (PLA). *HDL:* fundamentals, combinational logic, adder, multiplexer. Case Study : Implementation of 4-bit adder and 4-bit by 4-bit multiplier using VHDL Arithmetic algorithms: Algorithms for addition and subtraction of binary and BCD numbers, algorithms for floating point addition and subtraction , Booth's Algorithm	**10**	**20%**

QUESTION PAPER PATTERN (End semester examination)

Maximum Marks : 100 Exam Duration: 3 hours

Part A –(Modules I and II) 2 out of 3 questions (uniformly covering the two modules) are to be answered. Each question carries 15 marks and can have a maximum of 4 sub divisions

Part B – (Modules III and IV) 2 out of 3 questions (uniformly covering the two modules) are to be answered. Each question carries 15 marks and can have a maximum of 4 sub divisions

Part C – (Modules V and VI) 2 out of 3 questions (uniformly covering the two modules) are to be answered. Each question carries 20 marks and can have a maximum of 4 sub divisions

Course No.	Course Name	L-T-P - Credits	Year of Introduction
IT202	Algorithm Analysis & Design	4-0-0-4	2016

Prerequisite: CS205 Data structures

Course Objectives

- To develop an understanding about basic algorithms and different problem solving strategies.
- To improve creativeness and the confidence to solve non-conventional problems and expertise for analysing existing solutions.

Syllabus

Properties of an Algorithm- Asymptotic Notations – 'Oh', 'Omega', 'Theta', Worst, Best and Average Case Complexity-Recurrence Relations – Solving Recurrences using Iteration and Recurrence Trees.- Divide and Conquer- Greedy Strategy -Dynamic Programming -Backtracking -Branch and Bound Techniques -Sophisticated Algorithms- Approximation Algorithms -String Matching Algorithms -Lower Bound Theory-randomized algorithm

Expected outcome .

The students will be able to

- Describe the performance analysis of algorithms and asymptotic notations.
- Solve recurrence equations using iteration and recursion tree methods.
- Describe the divide-and-conquer paradigm and explain when an algorithmic design situation calls for it.
- Discuss greedy and dynamic programming in algorithm design and recite algorithms that employ this paradigm.
- Explain backtracking and branch and bound technique used in algorithms
- Interpret the approximation algorithms, randomized algorithms and string matching algorithms

Text Book:

1 Fundamentals of Computer Algorithms – Horowitz and Sahni, Galgotia

References:

1. Computer Algorithms – Introduction to Design and Analysis – Sara Baase & Allen Van Gelder, Pearson Education
2. Data Structures algorithms and applications – Sahni, Tata McGrHill
3. Foundations of Algorithms – Richard Neapolitan, Kumarss N., DC Hearth & Company
4. Introduction to algorithm- Thomas Coremen, Charles, Ronald Rivest -PHI

Course Plan

Module	Contents	Hours	Sem. Exam Marks
I	Introduction and Complexity What is an algorithm – Properties of an Algorithm, Development of an algorithm, Pseudo-code Conventions, Recursive Algorithms – Performance Analysis - Space and Time Complexity –Asymptotic Notations – 'Oh',	10	15%

	'Omega', 'Theta', Worst, Best and Average Case Complexity, Running Time Comparison, Common Complexity Functions - Recurrence Relations – Solving Recurrences using Iteration and Recurrence Trees – Example Problems Profiling - Amortized Complexity.		
II	**Divide and Conquer** - Control Abstraction, Finding Maximum and Minimum,Binary Search, Divide and Conquer Matrix Multiplication, Stressen's Matrix Multiplication, Quick Sort, Merge Sort.	8	15%
FIRST INTERNAL EXAMINATION			
III	**Greedy Strategy**- Control Abstraction, General Knapsack Problem, Minimum Cost Spanning Trees – PRIM's Algorithm, Kruskal's Algorithm, Job sequencing with deadlines.	8	15%
IV	**Backtracking**– State Space Tree - Fixed Tuple and Variable Tuple Formulation - Control Abstraction – Generating Function and Bounding Function - Efficiency of the method - Monte Carlo Method – N-Queens Problem, Sum of Subsets. **Branch and Bound Techniques**– FIFO, LIFO, and LC Control Abstractions, 15-puzzle.	9	15%
SECOND INTERNAL EXAMINATION			
V	**Dynamic Programming**- Principle of Optimality, Multistage Graph Problem, Forward Approach, Backward Approach, All-Pairs Shortest Paths, Traveling Salesman Problem. Sophisticated Algorithms- Approximation Algorithms – Planar Graph Coloring, Vertex cover	10	20%
VI	String Matching Algorithms – Rabin Karp algorithm - Topological Sort - Deterministic and Non-Deterministic Algorithms. Lower Bound Theory- Comparison Trees for Searching and Sorting, lower bound on comparison based algorithms, Sorting, Selection & Merging; Oracles and Adversary Arguments – Merging,Basic concepts of randomized algorithm-Las Vagas algorithm for search.	9	20%
END SEMESTER EXAM			

QUESTION PAPER PATTERN (End semester examination)

Maximum Marks : 100 Exam Duration: 3 Hrs

Part A –(Modules I and II) 2 out of 3 questions (uniformly covering the two module) are to be answered. Each question carries 15 marks and can have a maximum of 4 sub divisions

Part B – (Modules III and IV) 2 out of 3 questions (uniformly covering the two module) are to be answered. Each question carries 15 marks and can have a maximum of 4 sub divisions

Part C – (Modules V and VI) 2 out of 3 questions (uniformly covering the two module) are to be answered. Each question carries 20 marks and can have a maximum of 4 sub divisions

Course code	Course Name	L-T-P	Credits	Year of Introduction
IT203	Data Communication	3-0-0	3	2016

Prerequisite : Nil

Course Objectives

- Build an understanding of the fundamental concepts of data transmission.
- Familiarize the student with the basics of encoding of analog and digital data
- Preparing the student for understanding advanced courses in computer networking

Syllabus

Communication model-. Time Domain and Frequency Domain concepts-- Transmission Impairments- Channel capacity- Transmission media- Synchronous and Asynchronous transmission. Sampling theorem - Encoding digital data into digital signal- Encoding analog data into digital signals-- Encoding analog data into analog signals- Multiplexing- Spread spectrum -Purpose of encoding- Construction of basic source codes:- Error Detecting and correcting codes-encoding and decoding of codes -Basic principles of switching - circuit switching, packet switching, message switching. - Basics of wireless communication

Expected Outcome

After the successful completion of the course students will be able to

- Explain Data Communications concepts and its components.
- Identify the different types of Transmission media and their functions within a network.
- Independently understand encoding, decoding , error correction and error detection in data communication
- To understand switching principles and basics of wireless communication

References

1. Stallings W., Data and Computer Communications, 8/e, Prentice Hall, 2007.
2. Forouzan B. A., Data Communications and Networking, 4/e, Tata McGraw Hill, 2007. 9
3. Tanenbaum A. S and D. Wetherall, Computer Networks, Pearson Education, 2013.
4. Schiller J., Mobile Communications, 2/e, Pearson Education, 2009.
5. Ranjan Bose ,Information Theory, Coding and Cryptography 2nd Edition:, Tata McGraw-Hill, New Delhi, 2008
6. Simon Haykin,Communication Systems: John Wiley & Sons. Pvt. Ltd.
7. Taub & Schilling, Principles of Communication Systems: Tata McGraw-Hill
8. Das, Mullick & Chatterjee, Principles of Digital Communication: Wiley Eastern Ltd.

9. Error Control Coding Fundamentals and Applications: Prentice Hall Inc.

Module	Course Plan	Hours	End-Semester Exam marks
I	Communication model Simplex, half duplex and full duplex transmission. Time Domain and Frequency Domain concepts - Analog & Digital data and signals - Transmission Impairments - Attenuation, Delay distortion, Noise - Different types of noise Channel capacity -Shannon's Theorem - Transmission media- twisted pair, Coaxial cable, optical fiber, terrestrial microwave, satellite microwave.	**7**	**15%**
II	Synchronous and Asynchronous transmission. Sampling theorem - Encoding digital data into digital signal - NRZ, Biphase, Multilevel binary - Encoding digital data into analog signals - ASK, FSK, PSK	**7**	**15%**
FIRST INTERNAL EXAM			
III	Encoding analog data into digital signals - PCM, PM, DM - Encoding analog data into analog signals - AM, FM, PM. Multiplexing - TDM, FDM, WDM & DWDM Encoding techniques, . Spread spectrum-The concept of spread spectrum – frequency hopping spread spectrum – direct sequence spread spectrum – code division multiple access	7	15%
IV	Purpose of encoding, Instantaneous codes, Construction of instantaneous codes. Construction of basic source codes. Huffman coding, Arithmetic coding, ZIP coding. Error Detecting and correcting codes. Error detection - parity check, Forward Error Correction. Block codes, Convolution codes.	**7**	**15%**
SECOND INTERNAL EXAM			
V	Cyclic codes: - Generator polynomial, Generator and Parity check matrices, Encoding of cyclic codes, Syndrome computation and error detection -CRC, VRC. Decoding of cyclic codes, BCH codes, RS codes, Burst error correction.	**7**	**20%**

VI	Hamming codes, Encoding and decoding of systematic and unsystematic codes Basic principles of switching - circuit switching, packet switching, message switching. Basics of wireless communication, Introduction to WiFi, WiMax, GSM, GPRS.	**7**	**20%**
END SEMESTER EXAM			

QUESTION PAPER PATTERN (End semester examination)

Maximum Marks : 100 Exam Duration: 3 Hrs

Part A –(Modules I and II) 2 out of 3 questions (uniformly covering the two module) are to be answered. Each question carries 15 marks and can have a maximum of 4 sub divisions

Part B – (Modules III and IV) 2 out of 3 questions (uniformly covering the two module) are to be answered. Each question carries 15 marks and can have a maximum of 4 sub divisions

Part C – (Modules V and VI) 2 out of 3 questions (uniformly covering the two module) are to be answered. Each question carries 20 marks and can have a maximum of 4 sub divisions

Course No.	Course Name	L-T-P	Credits	Year of Introduction
IT204	Object Oriented Techniques	3-0-0	3	2016

Prerequisite : Nil

Course Objectives

- To build an understanding of basic concepts of object oriented programming techniques
- To develop programming skills in C++ programming language
- To implement object oriented techniques using C++ language features.
- To develop software using object oriented programming paradigms

Syllabus

Characteristics of Object-Oriented Languages- Objects and Classes - Arrays and Strings - Operator Overloading – Overloading Unary Operators - Overloading Binary Operators - Arrays as Class Member Data - Inheritance – Derived Class and Base Class - Class Hierarchies - Public and Private Inheritance - Levels of Inheritance - Multiple Inheritance - Pointers - The Address-of Operator - Pointers and Arrays - Pointers and Functions - Memory Management - Pointers to Objects - Virtual Functions - Late Binding - Friend Functions - Static Functions - Assignment and Copy Initialization - The this Pointer - Streams and Files - Stream Classes - File Pointers - Templates and Exceptions - Function Templates - Class Templates - Exceptions

Expected Outcome

After the successful completion of the course students will be able to

- Explain Object Oriented Programming concepts.
- To understand the special features of C++ Programming language
- To upgrade existing procedure oriented softwares to object oriented based ones

References

1. Lafore R., Object Oriented Programming in C++, Galgotia Publications, 2001.
2. Schildt H., Teach Yourself C++, Tata McGraw Hill, 2000.
3. Hubbard J. R., Schaum's Outline of Programming with C++, McGraw Hill, 2000.
4. Balagurusamy, Object Oriented Programming with C++, Tata McGraw Hill, 2008.
5. Stephen D. R., C. Diggins, J. Turkanis and J. Cogswell, C ++ Cook book, O'Reilly Media, 2013.
6. Oualline S., Practical C++ Programming, 2/e, O'Reilly Media, 2002.
7. Meyers S., Effective C++, Addison Wesley, 2011. Error Control Coding Fundamentals and Applications: Prentice Hall Inc.

Module	Course Plan	Hours	% of Marks in End-Semester Examination
I	Why Do We Need Object-Oriented Programming? - Procedural Languages - The Object-Oriented Approach - Characteristics of Object-Oriented Languages – Objects – Classes – Inheritance – Reusability - Creating New Data Types - Polymorphism and Overloading - C++ and C Objects and Classes - A Simple Class - Classes and Objects - Defining the Class - Using the Class - Calling Member Functions - C++ Objects as Physical Objects - C++ Objects as Data Types – Constructors – Destructors - Objects as Function Arguments - Overloaded Constructors - Member Functions Defined Outside the Class - Objects as Arguments - The Default Copy Constructor - Static Class Data - const and Classes	**7**	**15**
II	Arrays and Strings - Array Fundamentals - Arrays as Class Member Data - Arrays of Objects - The Standard C++ string Class Operator Overloading - Overloading Unary Operators - Overloading Binary Operators - Data Conversion	**6**	**15**
FIRST INTERNAL EXAM			
III	Inheritance - Derived Class and Base Class - Derived Class Constructors - Overriding Member Functions - Which Function Is Used? Class Hierarchies - Public and Private Inheritance - Levels of Inheritance - Multiple Inheritance	7	15
IV	Pointers - Addresses and Pointers - The Address-of Operator & - Pointers and Arrays Pointers and Functions - Memory Management: new and delete - Pointers to Objects	**8**	**15**
SECOND INTERNAL EXAM			
V	Virtual Functions - Friend Functions - Static Functions - Assignment and Copy Initialization - The this Pointer Streams and Files - Stream Classes - Stream Errors - Disk File I/O with Streams - File Pointers - File I/O with Member	**8**	**20**

	Functions		
VI	Templates and Exceptions - Function Templates - Class Templates Exceptions - Exception Syntax - Multiple Exceptions - Exceptions with Arguments	**7**	**20**
END SEMESTER EXAM			

QUESTION PAPER PATTERN (End semester examination)

Maximum Marks : 100 Exam Duration: 3 Hrs

Part A –(Modules I and II) 2 out of 3 questions (uniformly covering the two module) are to be answered. Each question carries 15 marks and can have a maximum of 4 sub divisions

Part B – (Modules III and IV) 2 out of 3 questions (uniformly covering the two module) are to be answered. Each question carries 15 marks and can have a maximum of 4 sub divisions

Part C – (Modules V and VI) 2 out of 3 questions (uniformly covering the two module) are to be answered. Each question carries 20 marks and can have a maximum of 4 sub divisions

Course No.	Course Name	L-T-P	Credits	Year of Introduction
IT231	Digital Circuits Lab	0-0-3	1	2016

Course Objectives

- To familiarise various types of gates
- To realize adders, subtractors, flip flops
- To Realise shift registers and counters.
- To assemble digital circuits using ICs and study the performance.

List of Exercises / Experiments (Minimum of 8 mandatory out of 10)

1. Realization of functions using basic and universal gates.
2. Adders and Subtractors **(Any four**)
   i) Half adder using NAND and NOR only.
   ii) Full adder using NAND and NOR only.
   iii) Full adder using two half adders
   iv) Half subtractor using NAND and NOR only.
   v) Full subtractor using NAND and NOR only.
3. 2/3 bit binary comparator.
4. BCD to Decimal and BCD to 7 segment decoder & display
5. Multiplexers, De-multiplexers using gates and ICs. (74150, 74154)
6. Realization of combinational circuits using MUX & DEMUX.
7. Realization of flip flops using gates. **(Any four)**
   i) RS flip-flops
   ii) T flip-flops
   iii) D flip-flops
   iv) JK flip-flops

v) Master Slave flip-flops

8. Random sequence generator.

9. Realisation of Shift Registers.

10. Counters (using flip flops)

    i) Synchronous counters

    ii) Asynchronous counters

    iii) Ring counter

    iv) Johnson counter

Class Project (Minimum one mandatory per group)

i) Implementation of digital clock

ii) Implementation of digital timer

iii) Implementation of event counter

iv) Implementation of token display

Expected Outcome

From the practical exposure, the students can design digital circuits such as registers, counters, arithmetical circuits, flip flops etc.

References

1. Mano M. M., Digital Logic & Computer Design, 4/e, Pearson Education, 2013.
2. Floyd T. L., Digital Fundamentals, 10/e, Pearson Education, 2009.
3. M. Morris Mano, Computer System Architecture, 3/e, Pearson Education, 2007. Harris D. M. and, S. L. Harris, Digital Design and Computer Architecture, 2/e, Morgan Kaufmann Publishers, 2013
4. Tokheim R. L., Digital Electronics Principles and Applications, 7/e, Tata McGraw Hill, 2007.
5. Mano M. M. and M. D Ciletti, Digital Design, 4/e, Pearson Education, 2008.
6. Rajaraman V. and T. Radhakrishnan, An Introduction to Digital Computer Design, 5/e, Prentice Hall India Private Limited, 2012.
7. Leach D, Malvino A P, Saha G, Digital Principles and Applications, 8/e, McGraw Hill Education, 2015.

Course No.	Course Name	L-T-P	Credits	Year of Introduction
IT232	Object Oriented Programming Lab	0-0-3	1	2016

Prerequisite : IT202 Object oriented techniques

Course Objectives

- Provide hands-on experience to students in implementing object oriented programming concepts

Syllabus

Programs Using Function - Simple Classes for understanding objects, member functions and Constructors - Compile time Polymorphism - Runtime Polymorphism – Pointers – Inheritance - File Handling – Exception handling

Expected Outcome

The students will be able to

- Design, develop and troubleshoot software based on object oriented programming methodologies.

Exercise	Contents
I	Programs Using Functions a. Functions with default arguments b. Implementation of Call by Value, Call by Address and Call by Reference
II	Simple Classes for understanding objects, member functions and Constructors a. Classes with primitive data members b. Classes with arrays as data members c. Classes with pointers as data members – String Class d. Classes with constant data members e. Classes with static member functions
III	Compile time Polymorphism a. Operator Overloading including Unary and Binary Operators. b. Function Overloading
IV	Runtime Polymorphism a. Inheritance – Simple, Multiple, Multi-level, Hierarchical and Hybrid b. Virtual functions c. Virtual Base Classes
V	File Handling a. Sequential access b. Random access
VI	Exception handling a. exception handling mechanisms b.specifying exception

Course No.	Course Name	L-T-P - Credits	Year of Introduction
IT234	Algorithm Design Lab	0-0-3-1	2016

List of Exercises/Experiments :

1. Time Space Trade off implementation
2. Time analysis of different Sorting and Searching Methods.
3. String matching algorithms
4. Graphs traversal using Adjacency List and Adjacency Matrix.
5. Shortest path using Dijikstra's algorithm
6. Implement minimum spanning tree algorithms – Prim's and Kruskal's
7. Dynamic Programming implementation
8. Backtracking method implementation

Sample Lab cycle

- **An experiment to understand the concept of time space trade off**

- **Sorting**

Sorting Time Calculation for 10, 100, 1K, 10K, 100K numbers by varying input patterns. Create three set of input files. i) Sorted Numbers, ii) Reverse Sorted iii) Random Numbers. Plot the graph with input size & time for

Bubble Sort, Insertion Sort, Selection Sort, Quick Sort Vs Randomized Quick Sort, Merge Sort, Heap Sort, by creating a Binary Search Tree, by creating an AVL tree

- **Searching**

Searching Time Calculation for 10, 100, 1K, 10K, 100K numbers by varying input patterns. Plot the graph with input size & time

Sequential Search; Binary Search; Interpolation Search

- **String Matching**

Trivial String Matching ; Rabin- Karp Algorithm

- **Graph Algorithms**

Connected component finding using Adjacency list and Adjacency matrix;
Find shortest path between given source and destination using Dijikstra's algorithm;
Find minimum spanning tree using Kruskal's algorithm;
Find minimum spanning tree using Prim's algorithm

- **Dynamic Programming**

Find optimal ordering of matrix multiplication

- **Backtracking**

8 Queens Problem

Course code	Course Name	L-T-P-Credits	Year of Introduction
IT301	Software Architecture and Design Patterns	3-1-0 - 4	2016

Prerequisite : Nil

Course Objectives

- To introduce to the students the basic knowledge of software, software development process and the concepts of software design principles.
- Gain knowledge on how to design UML diagrams.
- To impart knowledge on the different architectural styles and architectural patterns for the software.

Syllabus

Introduction to the concepts of Software and the software design process, Process models, Importance of software architecture, Software design principles, Introduction to UML diagrams, UML diagram preparation for various case studies. Introduction to Software Architectural styles, Software Architecture patterns, Evaluation of architectural design.

Expected outcome

The students will be able to

i. Design UML diagram for the software.
ii. Identify and apply appropriate architectural styles and architectural design pattern for the software.
iii. Create flexible, reusable and efficient architecture for software.

Reference Books:

1. Eric J. Braude , Software Design, John Wiley and Sons.
2. Erich Gamma, Richard Helm, Ralph Johnson, and John Vlissides : Design Patterns: Elements of Reusable Object-Oriented Software, Addison – Wesley, 1994
3. James Rumbaugh, Object Oriented Modeling and Design, Prentice Hall India
4. Len Bass, Paul Clements, Rick Kazman, Software Architecture in Practice (2nd Ed.), Pearson
5. Mary Shaw & David Garlan, Software Architecture – Perspectives on an emerging discipline, Pearson, 1996
6. Roger S.Pressman, Software Engineering – A Practitioner's approach, 8th edition(2014), McGraw Hill Education

Course Plan

Module	Contents	Hours	Sem. Exam Marks
I	The Nature of Software – Defining software, Software Application domains. Software Engineering. The Software Process, Process Models: - Water fall model, Incremental model, Prototyping model, RAD, Spiral model and Agile Development. (Brief introduction of Agile Development). What is Software Architecture? Why is software architecture important? Role of software architect.	8	15%

II	Software Design principles – Correctness and Robustness – Flexibility, Reusability and Efficiency – Tradeoffs among robustness, flexibility, reusability and efficiency	7	15%
FIRST INTERNAL EXAM			
III	Introduction to UML diagrams – Use case diagrams, Class diagrams, Sequence diagrams, Activity diagrams, State Transition diagram, Deployment diagram.	8	15%
	Case study discussion on UML diagrams – Group presentation by students on different case studies.	4	
IV	Software architectural styles - pipes & filters, layered, event-based, data-centered, interpreter, MVC, message dispatcher, multi-tier distributed	9	15%
SECOND INTERNAL EXAM			
V	What is a design pattern? Creational patterns – Factory, Abstract Factory, Prototype and Singleton. Structural patterns – Composite, Decorator, Adapter, Façade and Flyweight.	9	20%
VI	Behavioral patterns- Chain of responsibility, Command, Interpreter, Mediator, State, Template and Observer. Evaluation of architectural design - ATAM	9	20%
END SEMESTER EXAM			

QUESTION PAPER PATTERN

Maximum Marks: 100 Exam Duration: 3 hours

The question paper shall consist of Part A, Part B and Part C.

Part A shall consist of three questions of 15 marks each uniformly covering Modules I and II. The student has to answer any two questions (15×2=30 marks).

Part B shall consist of three questions of 15 marks each uniformly covering Modules III and IV. The student has to answer any two questions (15×2=30 marks).

Part C shall consist of three questions of 20 marks each uniformly covering Modules V and VI. The student has to answer any two questions (20×2=40 marks).

Note : Each question can have a maximum of 4 subparts, if needed

Course code	Name	L-T-P-Credits	Year of Introduction
IT302	Internet Technology	4-0-0-4	2016

Prerequisite : Nil

Course Objective

- To impart the basics of web page design
- To understand important components of HTML5 documents and use HTML5 to create web pages
- To learn to use JavaScript in Webpages to enhance the functionality and appearance of web pages
- To know XML schema and transformation
- To design dynamic web pages using PHP.

Syllabus

Computers and internets –Web basics -HTML5 – Page-Structure elements -cascading style sheets – positioning elements -JavaScript- Control statements –Repetition statement – Mutiple selection statement - Functions – Arrays – Objects- Document object model –Dynamic styles - XML – Web servers – Server side programming

Expected Outcomes

After the course the students would be able to

i. analyze and apply the role of languages like HTML, CSS, XML, Javascript, PHP and the workings of the web and web applications
ii. analyze a web project and identify its elements and attributes in comparison to traditional projects.
iii. analyze and create web pages using HTML, and Cascading Styles sheets.
iv. analyze and build dynamic web pages using JavaScript (client side programming).
v. analyze and create XML documents and XML Schema.
vi. analyze and build interactive web applications using PHP

TEXT BOOK

1. Paul J. Deitel, Harvey M. Deitel, Abbey Deitel, “Internet and World Wide Web How To Program”, 5/E, Pearson Education, 2012.

REFERENCES

1. Robert W. Sebesta, “Programming the World Wide Web”, 8/E, Pearson Education, 2012.
2. Chris Bates, “Web Programming – Building Intranet applications”, Wiley Publications, 3rd Edition, 2009.
3. Jonathan Chaffer, Karl Swedberg, “Learning jQuery: Better interaction Design and Web Development with Simple JavaScript Techniques”, PACKT publishing, 2007
4. www.w3schools.com

COURSE PLAN			
Module	**Contents**	**Hours**	**Sem Exam Marks**
1	Introduction to Computers and the Internet- Web Basics, Introduction to HTML5 - W3C HTML5 Validation Service, Headings, Linking, Images, Special Characters and Horizontal Rules, Lists, Tables, Forms, Internal Linking, meta elements, New HTML5 Form input Types, input and data list elements and autocomplete Attribute, Page-Structure Elements.	6	15%
II	Introduction to Cascading Style Sheets -Inline Styles, Embedded Style Sheets, Conflicting Styles, Linking External Style Sheets, Positioning Elements - Absolute Positioning, z-index, Relative Positioning, span, Backgrounds, Element Dimensions, Box Model and Text Flow, Media Types, Drop-Down Menus	6	15%
FIRST INTERNAL EXAMINATION			
III	JavaScript: Introduction to Scripting - Control Statements - if Selection Statement, if…else Selection Statement, while Repetition Statement, for Repetition Statement, switch Multiple-Selection Statement, do…while Repetition Statement, break and continue Statements, JavaScript: Functions- Function Definitions, Random Number Generation, JavaScript Global Functions, JavaScript: Arrays - Declaring, Allocating and Using Arrays, Passing Arrays to Functions, Sorting Arrays with sort, Searching Arrays with index Of, JavaScript: Objects: Math, String, Date, Boolean and Number, document Object.	6	15%
IV	Document Object Model (DOM): Modeling a Document: DOM Nodes and Trees, Traversing and Modifying a DOM Tree, DOM Collections, Dynamic Styles, Using a Timer and Dynamic Styles to Create Animated Effects, JavaScript Event Handling: load Event, Event mouse move and the event Object, Form Processing with focus and blur, submit and reset, Event Bubbling	6	15%
SECOND INTERNAL EXAMINATION			

V	XML: Introduction, XML Basics, Structuring Data, XML Namespaces, Document Type Definitions (DTDs), W3C XML Schema Documents, XML Vocabularies: MathML, Extensible Style sheet Language and XSL Transformations, Document Object Model (DOM). Ajax-Enabled Rich Internet Applications with XML and JSON: Introduction, Rich Internet Applications (RIAs) with Ajax, Using XML and the DOM , Creating a Full-Scale Ajax-Enabled Application	9	20%
VI	Web Servers: Introduction, HTTP Transactions, Multitier Application Architecture, Client-Side Scripting versus Server-Side Scripting, Accessing Web Servers. Server Side Programming with PHP - Introduction, converting Between Data Types, Arithmetic Operators, Initializing and Manipulating Arrays, String Comparisons, String Processing with Regular Expressions, Form Processing and Business Logic, Using PHP to Process HTML5 Forms, Accessing MySQL Database with PHP, Using Cookies, Dynamic Content	9	20%
END SEMESTER EXAM			

QUESTION PAPER PATTERN

Maximum Marks: 100 Exam Duration: 3 hours

The question paper shall consist of Part A, Part B and Part C.

Part A shall consist of three questions of 15 marks each uniformly covering Modules I and II. The student has to answer any two questions (15×2=30 marks).

Part B shall consist of three questions of 15 marks each uniformly covering Modules III and IV. The student has to answer any two questions (15×2=30 marks).

Part C shall consist of three questions of 20 marks each uniformly covering Modules V and VI. The student has to answer any two questions (20×2=40 marks).

Note : Each question can have a maximum of 4 subparts, if needed

Course No.	Course Name	L-T-P - Credits	Year of Introduction
IT303	Theory of Computation	3-0-0-3	2016

Pre-requisites: Nil

Course Objectives

- To study computing machines and their capabilities
- To impart the basic concepts of theory of automata, languages and computation.
- To develop a model for that computers manipulate the data.
- To develop understanding about machines for sequential recognition and computation
- To understand and classify formal languages and grammars

Syllabus

Introduction: Formal representation of languages – Chomsky Classification, Introduction to Automata theory, NFA , DFA, Regular Expressions,–Conversion of NFA to DFA – Finite automata with output-Moore and Mealy machines– Finite Automation with $\in$-Transitions Minimisation of DFA-DFA to Regular Expressions conversion, Applications of finite automata , Context Free Grammar – Derivation trees, ambiguity, simplification of CFLs, normal forms of CFGs. PDA – formal definition, examples of PDA, Deterministic PDA. Pumping lemma for CFGs, closure properties of CFLs, decision algorithms for CFGs. Turing machines, formal definition of Turing Machine, language acceptability by TM, examples of TM. Variants of TMs – multitape TM, Non-deterministic TM, offline TMs, equivalence of single tape and multitape TMs. Module – IV Recursive and recursively enumerable languages – properties recursive and r.e. languages. Decidability - decidable and undecidable problems, Universal Turing Machine, halting problem, reducibility

Expected outcome .

- The student will be able to model different automata that accepts appropriate languages.

Text Book:

1. Hopcroft J. E., J. D. Ullman and R. Motwani, Introduction to Automata Theory, Languages and Computation, Pearson Education, 2008
2. Misra and Chandrasekharan, Theory of Computation, Prentice Hall

References:

1. John Martin, Introduction to Language and Theory of Computation, TMH
2. K.V.N. Sunitha and N Kalyani, Formal languages and Automata Theory Tata McGraw Hill, NewDelhi,
3. Michael Sipser, Introduction to the Theory of Computation, Thomson Learning
4. Moret B. M., The Theory of Computation, Pearson Education
5. Peter Linz, An Introduction to Formal Languages and Automata Narosa Publucation

Course Plan

Module	Contents	Hours	Sem. Exam Marks
I	Introduction: Formal representation of languages – Chomsky Classification, Introduction to Automata theory, Alphabets and Languages, language operations: Concatenation, sub string Kleene closure, Reversal, Finite state systems, Transition diagram and table	6	15%
II	Finite automata, Finite state automata – description of finite automata, language acceptability, designing finite automata, NFA, -. Difference between NFA&DFA finite automata with epsilon	8	15%

	moves, equivalence of NFA and DFA –Conversion of NFA to DFA - Minimisation of DFA-, Applications of finite automata, , Finite Automata with output. Moore and Meelay Machines.		
FIRST INTERNAL EXAMINATION			
III	Regular Expressions – Properties of Regular sets , Ardens theorem- DFA to Regular Expressions conversion,DFA construction for given regular expression ,Pumping Lemma , closure properties.	6	15%
IV	Context Free Grammar – Derivation trees, ambiguity, simplification of CFLs, normal forms of CFGs: Chomsky and Greibach NFs. PDA – formal definition, examples of PDA, , language acceptability ,Deterministic PDA. Pumping lemma for CFGs. Applications of PDA and CFLs	8	15%
SECOND INTERNAL EXAMINATION			
V	Turing machines - Chomsky classification of languages, formal definition of Turing Machine, language acceptability by TM, examples of TM. Variants of TMs – multitape TM, multiple tracks ,checking off symbols , Subroutines, Non-deterministic TM, offline TMs, Universal Turing Machine, equivalence of single tape and multitape TMs.	8	20%
VI	Linear bounded automata, Recursive and recursively enumerable languages – properties recursive and r.e. languages. Decidability - decidable and undecidable problems, tractable and intractable problems, halting problem, reducibility. Church Thesis	6	20%
END SEMESTER EXAM			

QUESTION PAPER PATTERN

Maximum Marks: 100 Exam Duration: 3 hours

The question paper shall consist of Part A, Part B and Part C.

Part A shall consist of three questions of 15 marks each uniformly covering Modules I and II. The student has to answer any two questions (15×2=30 marks).

Part B shall consist of three questions of 15 marks each uniformly covering Modules III and IV. The student has to answer any two questions (15×2=30 marks).

Part C shall consist of three questions of 20 marks each uniformly covering Modules V and VI. The student has to answer any two questions (20×2=40 marks).

Note : Each question can have a maximum of 4 subparts, if needed

Course code	Course Name	L-T-P - Credits	Year of Introduction
IT304	Data Warehousing and Mining	3-0-0-3	2016

Prerequisite: CS208 Principles of data base design

Course Objectives

- To understand Data Mining, its origin, taxonomy and applications
- To understand types of data and to improve the quality of data and efficiency and the ease of the mining process.
- To understand the supervised learning that is Classification, its applications and approaches
- To understand how to identify associations among objects and to learn various algorithms to find them
- To understand methods and need for finding complex Association Rules
- To learn the unsupervised learning to identify the relation among the objects and to understand applications and algorithms for Clustering

Syllabus

Data Mining, Applications, Data Mining Models, Data Warehousing and OLAP, Challengs, Tools, Data Mining Principles, Data Preprocessing: Data Preprocessing Concepts, Data Visualization, Data Sets and Their Significance, Classification Models, Multi Resolution Spatial Data Mining, Classifiers, Association Rules Mining, Cluster Analysis, Practical Data Mining Tools, Advanced Data Mining Techniques, Web Mining, Text Mining, CRM Applications and Data Mining, Data warehousing.

Expected outcome .

- The student will understand the concept of data mining, association rule mining and data classification methods

Text Book:

1. Jaiwei Han, Micheline Kamber, “Data Mining Concepts and Techniques”, Elsevier, 2006.
2. M. Sudeep Elayidom, “Data Mining and Warehousing”, 1st Edition, 2015 Cengage Learning India Pvt. Ltd.

References:

1. Pang-Ning Tan, Michael Steinbach, “Introduction to Data Mining”, Addison Wesley, 2006.
2. Dunham M H, “Data Mining: Introductory and Advanced Topics”, Pearson Education, New Delhi, 2003.
3. Mehmed Kantardzic, “Data Mining Concepts, Methods and Algorithms”, John Wiley and Sons, USA, 2003.

Course Plan

Module	Contents	Hours	Sem. Exam Marks
I	Data Mining: Concepts: Concepts, Data Mining Applications, Data Mining Stages, Data Mining Models, Data Warehousing and OLAP, Need for Data Warehousing, Challenges, Application of Data Mining Principles, Machine Learning and Statistics, Ethics of Data Mining, Popular Tools. OLTP Vs DWH, Applications of DWH	8	15%
II	Data Preprocessing: Data Preprocessing Concepts, Data Cleaning, Handling Missing Data, Data Transformation and Discretization, Data Visualization. UCI Data Sets and Their Significance	6	15%
	FIRST INTERNAL EXAMINATION		
III	Classification Models: Introduction to Classification Models,	6	15%

	Decision Tree, Neural Networks		
IV	Naive Bayes Classifier, Support Vector Machines. Prediction Models, Issues regarding classification and prediction.	7	15%
SECOND INTERNAL EXAMINATION			
V	Association Rules Mining: Concepts, Apriori Algorithm. Cluster Analysis: Introduction, Concepts, K-Means Clustering, Density-Based Clustering, Weighted Graph Partitioning, Hypergraph Partitioning,	8	20%
VI	Practical Data Mining Tools: Weka, R Package for Data Mining. Advanced Data Mining Techniques: Introduction, Web Mining- Web Content Mining, Web Structure Mining, Web Usage Mining. Text Mining, CRM Applications and Data Mining, CRM Data Mining Models. Data Warehousing with Oracle BI	7	20%
END SEMESTER EXAM			

QUESTION PAPER PATTERN

Maximum Marks: 100 Exam Duration: 3 hours

The question paper shall consist of Part A, Part B and Part C.

Part A shall consist of three questions of 15 marks each uniformly covering Modules I and II. The student has to answer any two questions (15×2=30 marks).

Part B shall consist of three questions of 15 marks each uniformly covering Modules III and IV. The student has to answer any two questions (15×2=30 marks).

Part C shall consist of three questions of 20 marks each uniformly covering Modules V and VI. The student has to answer any two questions (20×2=40 marks).

Note : Each question can have a maximum of 4 subparts, if needed

Course No.	Course Name	L-T-P - Credits	Year of Introduction
IT305	Operating systems	3-0-0:3	2016

Pre-requisites: C202 Computer Organization and Architecture

Course Objectives

- To provide basic knowledge of computer operating system structures and functioning.
- To understand the fundamental concepts, processes and communication
- To understand and analyse implementation of: process synchronization
- To know design issues associated with operating systems
- To familiarise with memory management including virtual memory

Syllabus

Introduction: Operating Systems-different types, System kernel, Shell, Processes- . Process Scheduling methods, Inter process Communication, Memory management : fixed &variable partitions - - paging & segmentation - virtual memory concepts - demand paging - page replacement - Device management : disk scheduling algorithms - sector queuing -device drivers. Dead locks - conditions for deadlock - prevention - avoidance - detection – recovery from dead lock -bankers' algorithm. - resource trajectories –starvation, File system concepts – Access methods – Directory structure – Directory implementation – Linear list, Hash table

Expected outcome .

- The student will understand the functions of operating System, system interactions with other parts of computer.

Text Books:

1. Andrew S. Tanenbaum, "Modern Operating Systems", Prentice Hall
2. J. L. Peterson and A. Silberschatz , Operating System Concepts, Addison Wesley.

References:

1. D M Dhamdhere, "*Operating Systems A Concept-based Approach"*, Tata McGraw Hill, New Delhi, 2nd Edition, 2010.
2. William Stallings, Operating Systems,6th Edition,Pearson,2009,ISBN 978-81-317-2528-3
3. Garry Nutt, "Operating Systems – A Modern perspective ", Third Edition, Pearson Education

Course Plan

Module	Contents	Hours	Sem. Exam Marks
I	Introduction: Operating Systems – Batch, Multi programmed, Time-sharing and Real time systems –System calls – System Programs — Simple structure, Layered approach – Kernel, Shell.	6	15%
II	Processes-. Process Scheduling - Round Robin Scheduling – Priority scheduling -multiple queues - Shortest Job First - Guaranteed scheduling - Two- level scheduling. Preemptive scheduling, Dispatcher –Multiple-processor scheduling.	8	15%
	FIRST INTERNAL EXAMINATION		
III	Inter process Communication -Race Conditions - Critical Sections – Mutual Exclusion - Busy Waiting - Sleep And Wakeup - Semaphores - Event Counters - Monitors - Message Passing	6	15%

IV	Memory management : Basics - swapping - fixed partitions - variable partitions - overlay - paging - segmentation - segmented paging - virtual memory concepts - demand paging - page replacement - space allocation policies - dynamic linking ,Thrashing	7	15%
SECOND INTERNAL EXAMINATION			
V	Device management : Physical characteristics – disk scheduling algorithms - sector queuing -device drivers. Dead locks : Deadlock characteristics -conditions for deadlock- prevention - avoidance - detection – recovery from dead lock - bankers algorithm.- resource trajectories - starvation.	8	20%
VI	File System: File concept – Access methods – Directory structure – Directory implementation – Linear list, Hash table – Case study: Linux system.	7	20%
END SEMESTER EXAM			

QUESTION PAPER PATTERN

Maximum Marks: 100 Exam Duration: 3 hours

The question paper shall consist of Part A, Part B and Part C.

Part A shall consist of three questions of 15 marks each uniformly covering Modules I and II. The student has to answer any two questions (15×2=30 marks).

Part B shall consist of three questions of 15 marks each uniformly covering Modules III and IV. The student has to answer any two questions (15×2=30 marks).

Part C shall consist of three questions of 20 marks each uniformly covering Modules V and VI. The student has to answer any two questions (20×2=40 marks).

Note : Each question can have a maximum of 4 subparts, if needed

Course code	Course Name	L-T-P - Credits	Year of Introduction
IT306	Distributed Systems	3-0-0-3	2016

Pre-requisites: IT305 Operating Systems

Course Objectives:

- To understand the concepts that underlie distributed computing systems along with design and implementation issues.
- To study the key mechanisms and models for distributed systems.

Syllabus

Introduction to distributed systems, inter process communication, distributed files systems, Name service, Time and global states, election algorithms, distributed files systems and case study.

Expected Outcome:

The students will

i. gain a clear understanding of the concepts that underlie distributed computing systems along with design and implementation issues.
ii. use key mechanisms and models for distributed systems including logical clocks, causality, vector timestamps, and election algorithms.

Text Books:

1. George Coulouris, Jean Dollimore, Tim Kindberg, "Distributed Systems: Concepts and Design", Pearson 2009, 4th Edition.

References:

1. Andrew S Tanenbaum and Marteen Van Steen, "Distributed Systems Principles and Paradigms", Pearson Education / Prentice Hall of India , New Delhi, 2002.
2. Pradeep K Sinha, "Distributed Operating Systems: Concepts and Design", Prentice Hall of India, New Delhi, 2004.
3. Mukesh Singhal, Niranjan G Shivarathri, "Advanced Concepts in Operating systems", Tata Mc Graw Hill Ltd.
4. Tanenbaum A S, " Modern Operating System", 3/e, PHI

Course Plan

Module	Contents	Hours	Sem. Exam Marks
I	Characterization of Distributed Systems-Introduction-Examples-Resource Sharing and the Web-Challenges. System Models-Architectural-Fundamental. Inter process Communication-Introduction-API for Internet protocols-External data representation and marshalling--Client-server communication-Group communication-Case study: Inter process Communication in UNIX.	7	15%

II	Distributed Objects and Remote Invocation-Introduction-Communication between distributed objects-Remote procedure calls-Events and notifications-Case study: Java RMI. Operating System Support-Introduction-OS layer-Protection-Processes and threads- Communication and invocation OS architecture.	7	15%
FIRST INTERNAL EXAMINATION			
III	Distributed File Systems-Introduction-File service architecture-Case Study: Sun Network File System-Enhancements and further developments. Name Services-Introduction-Name Services and the Domain Name System-Directory Services-Case Study: Global Name Service	7	15%
IV	Time and Global States-Introduction-Clocks, events and process states-Synchronizing physical clocks-Logical time and logical clocks-Global states-Distributed debugging.	5	15%
SECOND INTERNAL EXAMINATION			
V	Coordination and Agreement-Introduction-Distributed mutual exclusion – Elections ¬ Multicast communication-Consensus and related problems.	8	20%
VI	Distributed Shared Memory-Introduction-Design and implementation issues-Sequential consistency and Ivy case study Release consistency and Munin case study-Other consistency models. CORBA Case Study- Introduction-CORBA RMI-CORBA services.	8	20%
END SEMESTER EXAM			

QUESTION PAPER PATTERN

Maximum Marks: 100 Exam Duration: 3 hours

The question paper shall consist of Part A, Part B and Part C.

Part A shall consist of three questions of 15 marks each uniformly covering Modules I and II. The student has to answer any two questions (15×2=30 marks).

Part B shall consist of three questions of 15 marks each uniformly covering Modules III and IV. The student has to answer any two questions (15×2=30 marks).

Part C shall consist of three questions of 20 marks each uniformly covering Modules V and VI. The student has to answer any two questions (20×2=40 marks).

Note : Each question can have a maximum of 4 subparts, if needed

Course code	Course Name	L-T-P - Credits	Year of Introduction
IT307	Computer Networks	3-0-0-3	2016

Prerequisite: Nil

Course Objectives

- To understand the concepts of Computer networks, its applications, types and Network Software & Hardware.
- To know the various Data Link Layer protocols.
- To study the congestion control algorithms in Network Layer
- To understand the application layer protocols HTTP, FTP, SMTP, P2P, DNS

Syllabus

Computer Networks, Types of Networks, Reference Models, Transmission Media, Network Hardware, Error Detection and Correction methods, Elementary Data Link Layer Protocols, Medium Access Control protocols, Ethernet, Network routing algorithms, Congestion control mechanisms in network layer, Transport layer services, Socket, UDP, TCP – Connection management, Congestion Control, Application layer protocols – HTTP, FTP, SMTP, DNS, P2P.

Expected outcome .

- The students will be able to use different types of computer networks to interconnect a distributed community of computers and various interfacing standards and protocols.

Text Book:

1. 1. Andrew S. Tanenbaum, "Computer Networks", Prentice Hall, 4th Edition, 2003 (Module 1 to 5)
2. James F Kurose, Keith W Ross, Computer Networking: A top Down Approach featuring the Internet, Pearson Education, 3rd Edition. (Module 6)

References:

1. Behrouz A. Forouzan, TCP/IP Protocol Suite, Fourth Edition, Mc Graw Hill
2. Behrouz A. Forouzan, Data Communication and Networking, Fourth Edition, Mc Graw Hill

Course Plan

Module	Contents	Hours	Sem. Exam Marks
I	**Introduction:** - Types of Computer Networks, Network Software - Protocol Hierarchies, Connection oriented and Connection less hierarchies, Reference Models - ISO-OSI Reference Model, TCP/IP Reference Model – Comparison of OSI and TCP/IP reference models. **Physical Layer:** - Guided Transmission Media– Twisted Pair, Coaxial and Fiber Optics, Wireless Transmission- Radio and Microwave transmission, Communication Satellites – GEO, MEO, LEO. Comparison of Network hardware - Repeaters, Routers, Bridges, Gateways, Hub and Cable Modem.	6	15%
II	**Data Link Layer:** - Data link Layer design issues-Error Detection and correction – Elementary Data link protocols-Sliding window protocols- Basic Concept, One Bit Sliding window protocol, Concept of Go Back n and Selective repeat.	6	15%

FIRST INTERNAL EXAMINATION			
III	**Medium Access Control:-** Static & Dynamic channel allocation in LAN, Multiple access protocols – ALOHA – Pure ALOHA – Slotted ALOHA – Carrier Sense Multiple Access protocols – persistent and non-persistent CSMA – CSMA with collision detection – Ethernet- Ethernet Cabling, Encoding, Frame Format, Binary Exponential Back Off Algorithm, Comparison of Fast and Gigabit Ethernet.	8	15%
IV	**Network layer:** -Network Layer Design Issues, Routing Algorithm – Optimality principle - Flooding - Distance vector routing – Link state routing –Multicast Routing - Congestion Control Algorithms – General principles – Congestion prevention policies – Choke packets – Random Early Detection- Quality of Service requirements- Buffering, Traffic shaping – Leaky bucket algorithm.	8	15%
SECOND INTERNAL EXAMINATION			
V	**Transport Layer:** - Transport Service – The services provided to upper layers, Transport Service primitives, Berkley Sockets. Elements of transport protocols, UDP- Segment Structure, Remote Procedure Call. TCP – Service model, TCP Protocol, TCP Segment Header, Connection establishment and Release, Transmission Policy, Congestion Control	7	20%
VI	**Application Layer**: - **HTTP-** Overview, Persistent and non persistent Connections, Message formats, Concept of Cookies and Web Cache **-FTP - Electronic Mail** – SMTP, Mail message formats, POP3, IMAP – **DNS-** Services provided by DNS, Overview of how DNS works, DNS Caching, Message format - **P2P File sharing**	7	20%
END SEMESTER EXAM			

QUESTION PAPER PATTERN

Maximum Marks: 100 Exam Duration: 3 hours

The question paper shall consist of Part A, Part B and Part C.

Part A shall consist of three questions of 15 marks each uniformly covering Modules I and II. The student has to answer any two questions (15×2=30 marks).

Part B shall consist of three questions of 15 marks each uniformly covering Modules III and IV. The student has to answer any two questions (15×2=30 marks).

Part C shall consist of three questions of 20 marks each uniformly covering Modules V and VI. The student has to answer any two questions (20×2=40 marks).

Note : Each question can have a maximum of 4 subparts, if needed

Course code	Course Name	L-T-P- Credits	Year of Introduction
IT331	Microcontroller Lab	0-0-3-1	2016

Prerequisite: CS305 Microprocessors & microcontrollers

Course Objectives

- To study assembly language programming in 8051.
- To study interfacing of various peripherals using 8051.
- To design and develop applications using 8051.

List of Exercises / Experiments (Minimum of 9 mandatory out of 11)

Programming experiments using 8051 Trainer Kit.

1. Familiarization of 8051 Microcontroller Kit
2. Addition and Subtraction of 16 bit numbers.
3. Multiplication and division of 8 bit numbers.
4. Sorting, Factorial of a number.
5. LCM and HCF of two 8 bit numbers
6. Square, Square root, Fibonacci series.

Interfacing experiments

7. DAC interface
8. Display interface.
9. Realization of Boolean expression using port.
10. Frequency measurement by counting the number of pulses in a fixed amount of time.
11. Frequency measurement by measuring the time period between two consecutive pulses.

Class Project (Minimum one mandatory per group)

1. Liquid /Level indicator with Alarm using 8051 microcontroller
2. Interfacing Keyboard with 8051 microcontroller
3. Digital Clock with 8051 microcontroller

Expected Outcome

- The students will be able to develop a system using 8051 microcontroller

References

- Muhammad Ali Mazidi, The 8051 microcontroller and Embedded System
- Kenneth Ayala, The 8051 Microcontroller
- 3Scott, The_8051_Microcontroller.

Websites:

www.8051projects.info
www.engineersgarage.com
www.mikroe.com
www.8052.com

For development tools:

www.keil.com
www.atmel.com

Course code	Course Name	L-T-P- Credits	Year of Introduction
IT333	Database Lab	0-0-3-1	2016

Prerequisite: CS208 Principles of database design

Course Objectives

- To provide a hands on experience in database management concepts.
- To provide a strong formal foundation in database concepts, technology and practice to the students.
- To present SQL and procedural interfaces to SQL comprehensively.
- To declare and enforce integrity constraints on a database using a state-of-the-art RDBMS.

List of Exercises / Experiments (Minimum of 8 mandatory out of 10)

1. Familiarization of creation of databases and SQL commands (DDL, DML and DCL).
2. Suitable exercises to practice SQL commands may be given for Insert, Update, Delete etc
3. Write SQL procedure for an application which uses exception handling.
4. Write SQL procedure for an application with cursors.
5. Write SQL for implementing Nested Queries.
6. Write SQL for implementing Join Queries.
7. Write a DBMS program to prepare reports for an application using functions.
8. Write SQL block containing triggers.
9. Write SQL block containing stored procedures.
10. Develop a menu driven, GUI-based database application in any one of the domains such as Banking, Billing, Library management, Payroll, Insurance, Inventory, Healthcare etc. integrating all the features specified in the above exercises.

Class Project (Minimum one mandatory per group)

i) Implementation of Library Management System, Payroll processing .
ii) Implementation of Hospital Management System
iii) Implementation of Student Management Systems
iv) Implementation of any Reservation Systems (Bus, Train, Railway etc…)

Expected Outcome

- The students will be able to design , understand , appreciate and effectively explain the underlying concepts of database technologies and thereby design and implement a database schema for a given problem-domain.

References

1. Abraham Silberschatz, Henry F. Korth and S. Sudarshan, Database System Concepts, McGraw-Hill Education (Asia), Fifth Edition, 2006.
2. Atul Kahate, Introduction to Database Management Systems, Pearson ...
3. C. J. Date, A. Kannan and S. Swamynathan, An Introduction to Database Systems, Pearson Education, Eighth Edition, 2009.
4. Patrick O'Neil and Elizabeth O'Neil, Database Principles, Programming and Performance, Harcourt Asia Pte. Ltd., First Edition, 2001.
5. Peter Rob and Carlos Coronel, Database Systems Design, Implementation and Management, Thomson Learning-Course Technology, Seventh Edition, 2007.
6. Ramez Elmasri , Shamkant B. Navathe, Fundamentals of Database Systems (7th Edition) , Pearson Education Ltd.
7. Shio Kumar Singh, Database Systems Concepts, Designs and Application, Pearson Education, Second Edition, 2011.

Course code	Course Name	L-T-P-Credits	Year of Introduction
IT334	Computer Networks Lab	0-0-3-1	2016

Prerequisite : IT307 Computer networks

Course Objectives

- To implement important computer networking protocols.
- To manage Layer2 switching service.
- To configure Virtual LANs and access control list.
- To troubleshoot an internetwork.

List of Exercises / Experiments (Minimum of 9 mandatory out of 11)

INTERNETWORKING BASICS

1. Familiarization of Internetworking - Network Cables- Colour coding - Crimping. Internetworking Operating Systems- Configurations.

IP ROUTING

2. Implementing static routing.
3. Implementing dynamic routing using RIP.
4. Implementing dynamic routing using OSPF.
5. Implementing dynamic routing using EIGRP.

SWITCHING SERVICES

VIRTUAL LANS

6. Layer 2 Switching configuration -VLAN configuration.
7. VTP Configuration, VTP pruning.
8. Implement inter-VLAN routing.

SECURITY

9. Access Control List
    a. Standard Access Lists.
    b. Extended Access Lists.

MANAGING A INTERNETWORK

10. Backup and restoring IOS.
11. Familiarization of network simulators.

Class Project (Minimum one mandatory per group)

i. Implementation of an organizations network with security using any routing protocols.
ii. Implementation of network using VLAN and configure inter-vlan communication

Expected Outcome

The students will be able to

i. configure a network using routing protocols and VLAN
ii. manage a internetwork

References

1. CCNA –Cisco Certified Network Associate. Study Guide ,Todd Lammle, CCSI, Wiley India Edition-Sixth Edition

Course code	Course Name	L-T-P- Credits	Year of Introduction
IT361	Graph Theory	3-0-0-3	2016

Prerequisite: Nil

Course Objectives

1. To understand and apply the fundamental concepts in graph theory
2. To apply graph theory based tools in solving practical problems
3. To improve the proof writing skills.

Syllabus

Simple graphs, Sub graphs, Trees, Cayley's Formula, Connectivity, Euler and Hamiltonian graphs, Matching, Independent sets, Clique, Vertex Colouring, Planar Graphs, Directed Graphs, Network flow and cuts.

Expected outcome .

- The students will be able to apply principles and concepts of graph theory in practical situations

References:

1. Bondy,J. A. and Murty,U.S.R., 'Graph Theory with Applications', Springer, 2008.
2. Diestel, R. *Graph Theory (Graduate Texts in Mathematics).* New York, NY: Springer-Verlag, 1997. ISBN: 3540261834
3. N. Alon and J. Spenser, "Probabilistic Methods", John Wiley and Sons, 2nd edition, 2000.

Bollobás, B. *Modern Graph Theory (Graduate Texts in Mathematics).* New York, NY: Springer-Verlag, 1998. ISBN: 0387984917.

Course Plan

Module	Contents	Hours	Sem. Exam Marks
I	GRAPHS AND SUBGRAPH - Graphs and Simple Graphs, Graph Isomorphism, The Incidence and Adjacency Matrices, Subgraphs, Vertex Degrees, Paths and Connection, Cycles, Applications – The Shortest Path Problem, Sperner's Lemma .	5	15%
	TREES - Cut Edges and Bonds, Cut Vertices, Cayley's Formula, Applications - The Connector Problem	4	
II	CONNECTIVITY - Blocks, Applications-Construction of Reliable Communication Networks Euler Tours, Hamilton Cycles, Applications-The Chinese Postman Problem, The Travelling Salesman Problem	5	15%
	FIRST INTERNAL EXAMINATION		
III	MATCHINGS - Matchings and Coverings in Bipartite Graphs Perfect Matchings, Applications - The Personnel Assignment Problem, The Optimal Assignment Problem.	4	15%
	INDEPENDENT SETS AND CLIQUES - Independent Sets, Ramsey's Theorem, TurAn's Theorem, Applications - Schur's Theorem, A Geometry Problem.	4	
IV	VERTEX COLOURINGS - Chromatic Number, Brooks' Theorem, Hajos' Conjecture, Chromatic Polynomials, Girth and Chromatic Number, Applications - A Storage Problem	5	15%
	SECOND INTERNAL EXAMINATION		
V	Planar Graphs - Plane and Planar Graphs, Dual Graphs, Euler's Formula, Bridges, Muratowski's Theorem, The Five-Colour Theorem and the Four-Colour Conjecture, Nonharniltonian Planar Graphs, Applications - A Planarity Algorithm	5	20%

VI	DIRECTED GRAPHS - Directed Graphs, Directed Paths, Directed Cycles, Applications - A Job Sequencing Problem, Designing an Efficient Computer Drum, Making a Road System One-way, Ranking the Participants in a Tournament	4	20%
	NETWORKS - Flows , Cuts, The Max-Flow Min-Cut Theorem, Applications - Menger's Theorems, Feasible Flows	4	
END SEMESTER EXAM			

QUESTION PAPER PATTERN

Maximum Marks: 100 Exam Duration: 3 hours

The question paper shall consist of Part A, Part B and Part C.

Part A shall consist of three questions of 15 marks each uniformly covering Modules I and II. The student has to answer any two questions (15×2=30 marks).

Part B shall consist of three questions of 15 marks each uniformly covering Modules III and IV. The student has to answer any two questions (15×2=30 marks).

Part C shall consist of three questions of 20 marks each uniformly covering Modules V and VI. The student has to answer any two questions (20×2=40 marks).

Note : Each question can have a maximum of 4 subparts, if needed

Course code	Course Name	L-T-P - Credits	Year of Introduction
IT362	Information Retrieval	3-0-0-3	2017

Pre-requisites: CS205 Data structures

Course Objectives

- To provide with foundation knowledge in information retrieval.
- To equip with sound skills to solve computational search problems.

Syllabus

Introduction to the Concepts of Information Retrieval, Retrieval models, Searching the web and Parallel and Distributed Information Retrieval systems.

Expected outcome .

The students will be able to

i. use different information retrieval techniques in various application areas
ii. apply IR principles to locate relevant information large collections of data and analyse performance of retrieval systems when dealing with unmanaged data sources
iii. implement retrieval systems for web search tasks.

Text Books:

1. C. Manning, P. Raghavan, and H. Schütze, "Introduction to Information Retrieval", Cambridge University Press, 2008.
2. C.J. Van Rijsbergen , Information Retrieval:, http://www.dcs.gla.ac.uk/Keith/Preface.html
3. Ricardo Baexa-Yates and Berthier Ribeiro-Neto, "Modern Information Retrieval", Addison Wesley Longman, 1999.

References:

1. Bruce Croft, Donald Metzler and Trevor Strohman, "Search Engines: Information Retrieval in Practice", 1st Edition Addison Wesley, 2009.
2. Manu Konchady, "Building Search Applications: Lucene, Ling Pipe", First Edition, Gate Mustru Publishing, 2008.
3. Mark Levene, "An Introduction to Search Engines and Web Navigation", 2nd Edition Wiley, 2010.
4. Ophir Frieder, "Information Retrieval: Algorithms and Heuristics: The Information Retrieval Series", 2nd Edition, Springer, 2004.
5. Stefan Buettcher, Charles L. A. Clarke, Gordon V. Cormack, "Information Retrieval: Implementing and Evaluating Search Engines", The MIT Press, 2010.

Course Plan

Module	Contents	Hours	Sem. Exam Marks
I	Introduction – Information versus Data Retrieval. Modeling of Information retrieval. Boolean Model, Vector Model, Probabilistic Model, Set Theoretical Models, Structured Text Retrieval Models.	7	15%
II	Classification, Measures of Association, Cluster Hypothesis, Single Link Clusters, File Structures, Inverted Files, Index Sequential Files, Ring Structures, Doubly Chained Trees, Hash Addressing.	7	15%
	FIRST INTERNAL EXAMINATION		
III	Evaluation, Relevance, Precision and Recall, Interpolation, Averaging techniques, The Swets Model.	7	15%
IV	Search Engines, Boolean Search, Matching Functions, Serial Search, Cluster Representatives, Cluster based retrieval.	7	15%
	SECOND INTERNAL EXAMINATION		
V	Web search basics – Web characteristics - crawling and indexes – Features of a crawler – Crawler architecture – DNS	7	20%

	resolution – The URL frontier – Distributing indexes – Connectivity servers.		
VI	Link Analysis – The Web as a graph – Anchor text and the web graph, PageRank – Markov chains, Page Rank computation, Topic-specific Page Rank, Hubs and authorities.	7	20%
END SEMESTER EXAM			

QUESTION PAPER PATTERN

Maximum Marks: 100 Exam Duration: 3 hours

The question paper shall consist of Part A, Part B and Part C.

Part A shall consist of three questions of 15 marks each uniformly covering Modules I and II. The student has to answer any two questions (15×2=30 marks).

Part B shall consist of three questions of 15 marks each uniformly covering Modules III and IV. The student has to answer any two questions (15×2=30 marks).

Part C shall consist of three questions of 20 marks each uniformly covering Modules V and VI. The student has to answer any two questions (20×2=40 marks).

Note : Each question can have a maximum of 4 subparts, if needed

Course code	Course Name	L-T-P - Credits	Year of Introduction
IT363	Unix Shell Programming	3-0-0-3	2016

Pre-requisites: IT 201 *Operating Systems*

Course Objectives

- To learn the architecture UNIX and important features of UNIX.
- To familiarize the basic commands used in UNIX.
- To describe the TCP/IP networking tools used in UNIX.
- To familiarize the text processing utilities grep, sed, awk.
- To discuss the shell programming concept.
- To develop programs using shell script.

Syllabus

Introduction to UNIX, Architecture, features, Basic commands, utilities, editors, UNIX file system, UNIX shells, Pipes, tee command, filters, process in Unix, TCP/IP networking tools, usage o grep and sed, programming with awk, shell programming basics, shell programming constructs, advanced concepts in shell programming

Expected outcome .

- To familiarize the UNIX operating system and the utilities for solving computing problems in a shell programming environment.

Text Book:

1. Sumitabha Das , "Unix the ultimate guide", TMH. 2nd Edition.
2. Behrouz A. Forouzan, Richard F. Gilberg," Unix and shell Programming.", Cengage Learning

References:

1. Kernighan and Pike, "Unix programming environment", PHI. / Pearson Education
2. Graham Glass, King Ables," Unix for programmers and users", 3rd edition, Pearson Education
3. Maurice J. Bach, "The Design of the Unix Operating System", First Edition, Pearson Education, 1999

Course Plan

Module	Contents	Hours	Sem. Exam Marks
I	Introduction to Unix:- Architecture of Unix, Features of Unix , Introduction to unix file system, Basic Unix Commands – General-purpose utilities, vi editor	6	15%
II	The Unix file system – Parent-Child relationship – File types - File operations - File Permissions – File Ownership –File modification and access times – Directories – Directory permissions – File System and Inodes – Links and symbolic links – locating Files.	6	15%
	FIRST INTERNAL EXAMINATION		
III	Introduction to Shells – Shell as command Processor – quotes, escape characters, wild cards – Redirection – pipes –tee command –variables –command substitution – filters	6	15%
IV	Concepts of process in Unix – process creation – process status – Background and foreground Jobs – Job Execution with low priority – Signals – Termination of process – Job control	8	15%

	TCP/IP Networking tools – talk, mesg, finger, telnet, rlogin, ftp, rcp, rsh – security for the Berkeley r-Utilities.		
SECOND INTERNAL EXAMINATION			
V	Filters using regular expressions – grep –sed – programming with awk – preliminaries, formatted output, variables, number processing, comparison operators, BEGIN and END sections, arrays, control flows, looping and functions.	8	20%
VI	Shell Programming – Shell variables – Shell scripts – positional parameters – Exit status of a command – logical operator – script termination – conditional branching – looping – sleep and wait - set and let commands – redirection – Exporting shell variables – Arrays – String handling – Conditional Parameter Substitution – Shell functions –eval and exec statements.	8	20%
END SEMESTER EXAM			

QUESTION PAPER PATTERN

Maximum Marks: 100 Exam Duration: 3 hours

The question paper shall consist of Part A, Part B and Part C.

Part A shall consist of three questions of 15 marks each uniformly covering Modules I and II. The student has to answer any two questions (15×2=30 marks).

Part B shall consist of three questions of 15 marks each uniformly covering Modules III and IV. The student has to answer any two questions (15×2=30 marks).

Part C shall consist of three questions of 20 marks each uniformly covering Modules V and VI. The student has to answer any two questions (20×2=40 marks).

Note : Each question can have a maximum of 4 subparts, if needed

Course code	Course Name	L-T-P-Credits	Year of Introduction
IT364	Software Project Management	3-0-0-3	2016

Course Objectives

- To develop awareness regarding the theoretical and methodological issues related to software project management.
- To develop software projects based on current technologies.

Syllabus

Introduction to software engineering- Phases in Software development. Process models- prescriptive process models- Specialised process models- The unified process- Agile development- Agile development models. Project management concepts. Process and project metrics- Estimation for software projects- Software project estimation, decomposition techniques. Empirical estimation models- Task set- Scheduling. Risk management- The RMMM Plan. Software Configuration Management - The SCM Repository - The SCM Process. Software quality assurance- Formal Approaches to SQA. Statistical Software Quality Assurance- Six Sigma for Software Engineering. Software Reliability. The ISO 9000 Quality Standards. The SQA Plan. Software process improvement- The CMMI, SPI Return on Investment. SPI trends.

Expected Outcome

After the successful completion of the course students will be able to

i. Identify the theoretical and methodological issues involved in modern software engineering project management
ii. Develop the transferable skills in logical analysis, communication and project management necessary for working within a team.
iii. Translate a specification to a design, and identify the components to build the architecture for a given problem, using an appropriate software engineering methodology.
iv. Select and use project management frameworks that ensure successful outcomes.
v. Develop software projects based on current technologies, by managing resources economically and keeping ethical values.

References

1. Roger S. Pressman, Software Engineering, 8/e, McGraw Hill, 2014.
2. Ian Sommervile, Software Engineering, 7/e, University of Lancastor, Pearson Education, 2004.
3. Bob Huges, Mike Cotterell, Rajib Mall, Software Project Management, 8/e, McGraw Hill, 2015.
4. Walker Royce, Software Project Management : A Unified Frame Work, Pearson Education.

Course Plan

Module	Contents	Hours	Sem. Exam Marks
I	Introduction to software engineering- scope of software engineering, historical aspects, economic aspects, maintenance aspects, specification and design aspects, team programming aspects. Layered technology, processes, methods and tools.	3	15%

	Phases in Software development.		
	Process models- prescriptive process models- waterfall model, incremental models, evolutionary models, and concurrent models. Specialised process models- component based development, formal methods model, aspect oriented software development. The unified process, personal and team process models.	**4**	
II	Agile development- agility, agile process. Extreme programming- XP Values, The XP Process, Industrial XP, The XP Debate. Agile development models- Adaptive Software Development (ASD), Scrum, Dynamic Systems Development Method (DSDM), Crystal, Feature Driven Development (FDD), Lean Software Development (LSD), Agile Modeling (AM) , Agile Unified Process (AUP).	**4**	**15%**
	Project management concepts- the management spectrum, people, product, process, and project.	**3**	
FIRST INTERNAL EXAM			
III	Process and project metrics- software measurement- size oriented, function oriented, LOC and function point, metrics for software quality- measuring quality, defect removal efficiency, integrating metrics within the software process.	4	20%
	Estimation for software projects- project planning, software scope, resources. Software project estimation, decomposition techniques- Software Sizing, Problem-Based Estimation, Process-Based Estimation.	3	
IV	Empirical estimation models- structure of estimation models, COCOMO II model. Estimation for agile development. Make/buy decision.	**4**	**15%**
	Project scheduling- relationship between people and effort, effort distribution. Task set, defining a task network. Scheduling- timeline chart, tracking the schedule. Earned value analysis.	**3**	
SECOND INTERNAL EXAM			
V	Risk management- risk strategies, software risks, risk identification, risk projection, risk refinement, Risk Mitigation, Monitoring, and Management. The RMMM Plan.	**4**	**20%**
	Software Configuration Management - An SCM Scenario, Elements of a Configuration Management System, Baselines, Software Configuration Items. The SCM Repository - The Role of the repository, General Features and Content, SCM Features. The SCM Process- Identification of Objects in the Software Configuration, Version Control, Change Control, and	**4**	

	Configuration Audit, Status Reporting.		
VI	Software quality assurance- Background Issues, Elements of Software Quality Assurance. SQA Tasks, Goals, and Metrics. Formal Approaches to SQA. Statistical Software Quality Assurance- A Generic Example, Six Sigma for Software Engineering. Software Reliability -Measures of Reliability and Availability, Software Safety. The ISO 9000 Quality Standards. The SQA Plan.	**3**	**20%**
	Software process improvement- Approaches to SPI, Maturity Models. The SPI Process- Assessment and Gap Analysis, Education and Training, Selection and Justification, Installation/Migration, Evaluation, Risk Management for SPI, Critical Success Factors. The CMMI, The People CMM. Other SPI Frameworks. SPI Return on Investment. SPI trends.	**3**	
END SEMESTER EXAM			

QUESTION PAPER PATTERN

Maximum Marks: 100 Exam Duration: 3 hours

The question paper shall consist of Part A, Part B and Part C.

Part A shall consist of three questions of 15 marks each uniformly covering Modules I and II. The student has to answer any two questions (15×2=30 marks).

Part B shall consist of three questions of 15 marks each uniformly covering Modules III and IV. The student has to answer any two questions (15×2=30 marks).

Part C shall consist of three questions of 20 marks each uniformly covering Modules V and VI. The student has to answer any two questions (20×2=40 marks).

Note : Each question can have a maximum of 4 subparts, if needed

Course code	Course Name	L-T-P-Credits	Year of Introduction
IT365	Computer Architecture & Parallel Processing	3-0-0-3	2016

Prerequisite: Nil

Course Objectives

- To understand issues and techniques in improving performance of processors
- To understand the concepts of pipelining
- To familiarize with the properties of superscalar processors
- To understand the multiprocessor systems, multi core systems and the concept of cache coherence

Syllabus

Classes of parallelism and parallel architecture, computer architecture- design issues, Performance measurements, quantitative principles of computer design, Instruction level parallelism -concepts and challenges, Data dependencies and hazards, Basic compiler techniques for exposing ILP.Dynamic Scheduling- Tomasulo's approach, Hardware based speculation, ILP using multiple issue and static scheduling, ILP using dynamic scheduling-case study- Intel Core i7. Data level parallelism-Vector Architecture, Graphic processing unit, Centralized shared memory architecture, Multiprocessor cache coherence - Distributed shared memory, Schemes for enforcing coherence Interconnection Network Design, Designing Multicore Architectures -- Unique challenges in multicore architectures

Expected Outcome

The students will be to

1. Know design issues of processors and performance measurement of processors
2. Apply instruction level parallelism and data Level Parallelism
3. Understand Multiprocessor systems, cache coherence and Interconnection networks

Text Books

1. D.E. Culler, J.P. Singh, and A. Gupta. Parallel Computer Architecture - A Hardware/Software Approach. Morgan Kaufmann Publishers, 2010.
2. Hennessy J. L., D. Patterson, “Computer Architecture – A quantitative Approach”, 5/e, Morgan Kauffman 2012.

References

1. Kai Hwang, “Advanced Computer Architecture Parallelism, Scalability, Programmability”, Tata McGraw-Hill, 2003.
2. Research papers from top conferences such as ISCA, HPCA, MICRO, and ASPLOS.
3. S.W. Keckler, K. Olukotun, and H.P. Hofstee. Multicore Processors and Systems. Springer, 2009.
4. W.J. Dally and B. Towles. Principles and Practices of Interconnection Networks. Morgan Kaufmann Publishers, 2003.
5. WWW Computer Architecture page. http://www.cs.wisc.edu/arch.

Course Plan

Module	Contents	Hours	Sem. Exam Marks

I	Computer architecture - design issues-Memory wall, Power Wall , Frequency Wall Classes of parallelism and parallel architecture,	**4**	**15%**
	Performance measurements, Pipelining- Scalar and super scalar processors- Instruction level parallelism -concepts and challenges, ILP Wall	**4**	
II	Data hazards, Structural Hazards, Branch Hazards, Branch Prediction schemes	**4**	**15%**
	Basic compiler techniques for exposing instruction-level parallelism.	**4**	
FIRST INTERNAL EXAM			
III	Dynamic Scheduling- Tomasulo's approach, Hardware based speculation.	4	15%
	ILP using multiple issue and static scheduling, ILP using dynamic scheduling, multiple issue and speculation.	**4**	
IV	Case study- Intel Core i7.	**4**	**15%**
	Data level parallelism-Vector architecture-Vector instruction types, Vector-Access memory schemes , Graphic processing units.	**4**	
SECOND INTERNAL EXAM			
V	Centralized shared memory architecture. Multiprocessor cache coherence Distributed shared memory and Directory based coherence.	**4**	**20%**
	Interconnection Network Design -- Interconnection topologies, routing techniques, flow control mechanisms, router architecture, arbitration logic	**4**	
VI	Designing Multicore Architectures -- Unique challenges in multicore architectures,	**4**	**20%**
	Multicore memory hierarchy organization, dealing with performance volatility, multicore memory traffic reduction techniques.	**4**	
END SEMESTER EXAM			

QUESTION PAPER PATTERN

Maximum Marks: 100 Exam Duration: 3 hours

The question paper shall consist of Part A, Part B and Part C.

Part A shall consist of three questions of 15 marks each uniformly covering Modules I and II. The student has to answer any two questions (15×2=30 marks).

Part B shall consist of three questions of 15 marks each uniformly covering Modules III and IV. The student has to answer any two questions (15×2=30 marks).

Part C shall consist of three questions of 20 marks each uniformly covering Modules V and VI. The student has to answer any two questions (20×2=40 marks).

Note : Each question can have a maximum of 4 subparts, if needed

Course code	Course Name	L-T-P - Credits	Year of Introduction
IT366	Advanced Database Management Systems	3-0-0-3	2016

Pre-requisites: CS208 Principles of database design

Course Objectives

- To enable design of high-quality relational databases and database applications.
- To develop skills in advanced visual & conceptual modelling and database design..
- To make aware of emerging database trends as they apply to semi-structured data, the internet, and object-oriented databases.

Syllabus

Distributed Databases, Object Oriented Databases, Emerging Systems, Data mining and dataware housing, Database Design Issues, Current Issues.

Expected outcome .

The students will be able

- To develop skills in advanced visual & conceptual modelling and database design..
- To develop an appreciation of emerging database trends as they apply to semi-structured data, the internet, and object-oriented databases

Text Book:

- R. Elmasri, S.B. Navathe, "Fundamentals Of Database Systems", Pearson Education, 2004

References:

1. Abdullah Uz Tansel Et Al, "Temporal Databases: Theory, Design and Principles", Benjamin Cummings Publishers, 1993.
2. C.S.R Prabhu, "Object-Oriented Database Systems", Prentice Hall Of India, 1998.
3. Carlo Zaniolo, Stefano Ceri, Christos Faloustsos, R.T.Snodgrass, V.S.Subrahmanian, "Advanced Database Systems", Morgan Kaufman, 1997.
4. Elisa Bertino, Barbara Catania, Gian Piero Zarri, "Intelligent Database Systems", Addison-Wesley, 2001.
5. Henry F Korth, Abraham Silberschatz, S. Sudharshan, "Database System Concepts", Fourth Edition, McGraw Hill, 2002.
6. N.Tamer Ozsu, Patrick Valduriez, "Principles Of Distributed Database Systems", Prentice Hall International Inc., 1999.
7. Raghu Ramakrishnan, Johannes Gehrke, "Database Management Systems", McGraw Hill, Third Edition 2004.

Course Plan

Module	Contents	Hours	Sem. Exam Marks
I	**Distributed Databases** Distributed Databases Vs Conventional Databases – Architecture – Fragmentation– Query Processing – Transaction Processing – Concurrency Control – Recovery.	6	15%
II	**Object Oriented Databases** Introduction to Object Oriented Data Bases - Approaches - Modelling and Design- Persistence – Query Languages - Transaction - Concurrency – Multi VersionLocks - Recovery.	8	15%
FIRST INTERNAL EXAMINATION			

III	**Emerging Systems** Enhanced Data Models - Client/Server Model - Web Databases – Mobile Databases.	6	15%
IV	**Data mining and data ware housing.** Data mining introduction-concepts-association-classification-clustering-applications Datawarehousing-introduction-architecture-characteristics-modeling and building data warehouse	6	15%
SECOND INTERNAL EXAMINATION			
V	**Database Design Issues** ER Model - Normalization - Security - Integrity - Consistency - Database Tuning- Optimization and Research Issues – Design of Temporal Databases – Spatial Databases	8	20%
VI	**Current Issues** Rules - Knowledge Bases - Active And Deductive Databases - Parallel Databases– Multimedia Databases – Image Databases – Text Database	8	20%
END SEMESTER EXAM			

QUESTION PAPER PATTERN

Maximum Marks: 100 Exam Duration: 3 hours

The question paper shall consist of Part A, Part B and Part C.

Part A shall consist of three questions of 15 marks each uniformly covering Modules I and II. The student has to answer any two questions (15×2=30 marks).

Part B shall consist of three questions of 15 marks each uniformly covering Modules III and IV. The student has to answer any two questions (15×2=30 marks).

Part C shall consist of three questions of 20 marks each uniformly covering Modules V and VI. The student has to answer any two questions (20×2=40 marks).

Note : Each question can have a maximum of 4 subparts, if needed

Course code	Course Name	L-T-P-Credits	Year of Introduction
IT367	Computer Graphics & Multimedia	3-0-0-3	2016

Prerequisite : Nil

Course Objectives

- To build an understanding of the fundamental concepts of Computer Graphics & Multimedia
- To familiarize with the working principles of various display technologies.
- To prepare for understanding advanced courses in Computer Graphics.

Syllabus

Graphics Systems, Line & Circle generation Algorithms, Compression techniques in Multimedia, Display Technologies, Transformations in 2D and 3D, Matrix representation of transformations, Clipping Algorithms, Hidden surface removal techniques, Digital Image processing**.**

Expected Outcome

The students will be able to

i. Explain the techniques used for display in CRT, LCD, LED displays.
ii. Identify the intermediate points needed to plot a line, given only its end points.
iii. Write the matrix corresponding to various 2D & 3D transformations.
iv. Find the vertices of the clipped polygon against a rectangular window by applying the learned polygon clipping algorithm.
v. Write an algorithm for finding & labeling different regions in a digital image.

References

1. Donald Hearn, Pauline Baker, " *Computer Graphics – C Version*", Pearson Education.
2. Steinmetz R. & Nahrstedt K., "*Multimedia: Computing, Communications and Applications*", Pearson Education.
3. David F. Rogers, "*Procedural Elements for Computer Graphics*", Tata McGraw-Hill
4. Foley, van Dam, Feiner & Hughes, "*Computer Graphics Principles & Practice*", Pearson Education.
5. William M. Newman, Robert F. Sproull, "*Principles of Interactive Computer Graphics*" , Tata McGraw-Hill.
6. David F. Rogers, J. Alan Adams, "*Mathematical Elements for Computer Graphics*", Tata McGraw-Hill.
7. Tay Vaughan, "Multimedia: Making it Work", Tata McGraw-Hill.

Module	Course Plan	Hours	Sem. Exam Marks
I	Graphics Systems – Raster Scan & Random Scan systems. Output Primitives – Line Drawing Algorithms (DDA, Bresenham), Circle generation algorithm. Filled Area Primitives – Scan Fill, Flood Fill, Boundary Fill. Inside outside tests.	**7**	**15%**
II	Multimedia: Data Compression- Source, Entropy & Hybrid Coding, Basic compression techniques, JPEG, H.261, MPEG, DVI.	**7**	**15%**
FIRST INTERNAL EXAM			
III	Display Technologies: Working principle behind CRT, LCD, Plasma, LED, OLED, AMOLED, E-Paper displays.	**6**	**15%**

IV	2-Dimensional Geometric Transformations (Basic Transforamtions, Reflection & Shear), Homogenous Matrix representation of transformations. Composite Transformations.	**7**	**15%**
SECOND INTERNAL EXAM			
V	2-D Clipping- Point Clipping, Cohen-Sutherland Line Clipping Algorithm, Sutherland-Hodgeman Polygon Clipping Algorithm. 3-Dimensional Geometric Transformations -Basic Transforamtions, Composite 3 D transformations.	**8**	**20%**
VI	Visible Surface Detection Methods: Back Face Detection, Depth Buffer, A-Buffer, Scan line, Depth sorting methods. Digital Image Processing: Histogram, Equalisation, Image Segmentation, Region Labeling.	**7**	**20%**
END SEMESTER EXAM			

QUESTION PAPER PATTERN

Maximum Marks: 100 Exam Duration: 3 hours

The question paper shall consist of Part A, Part B and Part C.

Part A shall consist of three questions of 15 marks each uniformly covering Modules I and II. The student has to answer any two questions (15×2=30 marks).

Part B shall consist of three questions of 15 marks each uniformly covering Modules III and IV. The student has to answer any two questions (15×2=30 marks).

Part C shall consist of three questions of 20 marks each uniformly covering Modules V and VI. The student has to answer any two questions (20×2=40 marks).

Note : Each question can have a maximum of 4 subparts, if needed

Course code	Course Name	L-T-P - Credits	Year of Introduction
IT368	INFORMATION THEORY AND CODING	3-0-0-3	2016

Pre-requisites: NIL

Course Objectives

- To provide basic concepts of Information Theory
- To understand the design and analysis of coding/decoding scheme for digital Communication application

Syllabus

Information theory, discrete channels, continuous channels, source coding, Codes for error detection and correction, Convolution codes, Interleaving techniques, ARQ

Expected outcome .

- The student will understand the design and analysis of coding/decoding scheme for digital communication application

References:

1. Ranjan Bose ,Information Theory, Coding and Cryptography 2nd Edition:, Tata McGraw-Hill, New Delhi, 2008
2. Simon Haykin, Communication Systems: John Wiley & Sons. Pvt. Ltd.
3. Taub & Schilling, Principles of Communication Systems: Tata McGraw-Hill
4. Das, Mullick & Chatterjee, Principles of Digital Communication: Wiley Eastern Ltd.
5. Shu Lin & Daniel J. Costello Jr, Error Control Coding Fundamentals and Applications: Prentice Hall Inc.
6. Bernard Sklar, Digital Communications Fundamentals and Applications, Prentice Hall, 2/e, 2001

Course Plan

Module	Contents	Hours	Sem. Exam Marks
I	**Information theory**: - Concept of amount of information - units, Entropy -marginal, conditional and joint entropies - relation among entropies Mutual information, information rate, channel capacity, redundancy and efficiency of channels.	5	15%
II	**Discrete channels**: - Symmetric channels, Binary Symmetric Channel, Binary Erasure Channel, Cascaded channels, repetition of symbols, Binary unsymmetric channel, Shannon theorem.	5	15%
	FIRST INTERNAL EXAMINATION		
III	**Continuous channels**: - Capacity of band limited Gaussian channels, Shannon-Hartley theorem, Trade off between band width and signal to noise ratio, Capacity of a channel with infinite band width, Optimum modulation system.	8	15%
IV	**Source coding**: - Encoding techniques, Purpose of encoding, Instantaneous codes, Construction of instantaneous codes, Kraft's inequality, Coding efficiency and redundancy, Noiseless coding theorem. Construction of basic source codes: - Shannon-Fano algorithm, Huffman coding, Arithmetic coding, ZIP coding.	8	15%
	SECOND INTERNAL EXAMINATION		

V	**Codes for error detection and correction**: - Parity check coding, Linear block codes,Error detecting and correcting capabilities, Generator and Parity check matrices, Standard array and Syndrome decoding, Hamming codes, Encoding and decoding of systematic and unsystematic codes. Cyclic codes: - Generator polynomial, Generator and Parity check matrices, Encoding of cyclic codes, Syndrome computation and error detection, Decoding of cyclic codes, BCH codes, RS codes, Burst error correction.	8	20%
VI	**Convolutional codes**: - Encoding- State, Tree and Trellis diagrams, Maximum likelihood decoding of convolutional codes -Viterby algorithm, Sequential decoding - Stackalgorithm. **Interleaving techniques**: - Block and convolutional interleaving, Coding andinterleaving applied to CD digital audio system -CIRC encoding and decoding,interpolation and muting. **ARQ**: - Types of ARQ, Performance of ARQ, Probability of error and throughput.	8	20%
END SEMESTER EXAM			

QUESTION PAPER PATTERN

Maximum Marks: 100 Exam Duration: 3 hours

The question paper shall consist of Part A, Part B and Part C.

Part A shall consist of three questions of 15 marks each uniformly covering Modules I and II. The student has to answer any two questions (15×2=30 marks).

Part B shall consist of three questions of 15 marks each uniformly covering Modules III and IV. The student has to answer any two questions (15×2=30 marks).

Part C shall consist of three questions of 20 marks each uniformly covering Modules V and VI. The student has to answer any two questions (20×2=40 marks).

Note : Each question can have a maximum of 4 subparts, if needed

Course code	Course Name	L-T-P - Credits	Year of Introduction
IT401	Embedded Systems	4-0-0-4	2016

Prerequisite: Nil

Course Objectives

- To understand the fundamental concepts in Embedded Systems, Real Time Operating Systems, Arduino and Raspberry Pi
- To impart Embedded System Design Techniques

Syllabus

Introduction to Embedded Systems, Embedded Systems – The Hardware Point of View, Sensors, ADCs and Actuators, Examples of Embedded Systems, Buses and Protocols, Software Development Tools, Real Time Operating Systems, ARM Processor, Hardware Accelerators, Embedded System Design Techniques, Introduction to Arduino Environment, Introduction to Raspberry Pi

Expected outcome .

- The students will acquire conceptual understanding in embedded systems, real time operating systems, Arduino, Raspberry Pi and the ability to apply them in practical situations.

References:

1. Lyla B Das, “Embedded Systems : An Integrated Approach”, Pearson Education, 2013
2. Matt Richardson, Shawn Wallace, “Getting Started With Raspberry Pi”, O'Reilly, 2013
3. Michael Margolis,”Arduino Cookbook”, O'Reilly, 2011
4. Peter Barry, Patrick Crowley, “Modern Embedded Computing”, Morgan Kaufmann
5. Wayne Wolf, “Computers as Components : Principles of Embedded Computing System Design”, Elsevier

Course Plan

Module	Contents	Hours	Sem. Exam Marks
I	Introduction to Embedded Systems, Embedded Systems – The Hardware Point of View: Microcontroller Unit, 8 bit MCU, Memory for Embedded System, Low Power Design Sensors, ADCs and Actuators-Temperature Sensors, Light Sensors, Range Sensors, Humidity Sensors, Other Sensors, Analog to Digital Converters, Actuators.	8	15%
II	Examples of Embedded Systems – Mobile Phone, Automotive Electronics, RFID, Wireless Sensor Networks, Robotics, Biomedical Applications, Brain Machine Interface, Buses and Protocols – Defining Buses and Protocols, On-board buses for Embedded Systems, External Buses, Automotive Buses	8	15%
FIRST INTERNAL EXAMINATION			
III	Raspberry Pi – Introduction, Python and Raspberry Pi, Arduino and Raspberry Pi, Basic Input and Output	9	15%
IV	Embedded Sytem Design Techniques – Design Methodologies, Requirements Analysis, Specifications, System Analysis and Architecture Design, Quality Assurance, Design Examples	9	15%
SECOND INTERNAL EXAMINATION			

V	Arduino – Introduction, Arduino Software Development, Interaction of Arduino board With Computers and Other Devices, Programming with Arduino	10	20%
VI	Software Development Tools, Real Time Operating Systems – Operating Systems, Scheduling Policies, Inter process Communication Mechanisms, Power Optimization Strategies for Processes ARM Processor- Processor and Memory Organization, Data Operations, Flow of Control	10	20%
END SEMESTER EXAM			

QUESTION PAPER PATTERN

Maximum Marks: 100 Exam Duration: 3 hours

The question paper shall consist of Part A, Part B and Part C.

Part A shall consist of three questions of 15 marks each uniformly covering Modules I and II. The student has to answer any two questions (15×2=30 marks).

Part B shall consist of three questions of 15 marks each uniformly covering Modules III and IV. The student has to answer any two questions (15×2=30 marks).

Part C shall consist of three questions of 20 marks each uniformly covering Modules V and VI. The student has to answer any two questions (20×2=40 marks).

Note : Each question can have a maximum of 4 subparts, if needed

Course code	Course Name	L-T-P - Credits	Year of Introduction
IT402	Cryptography & Cyber Security	3-0-0-3	2016

Prerequisite: CS201 Discrete computational structures

Course Objectives

- To understand the mathematics behind Cryptography.
- To understand the security concerns and vulnerabilities
- To familiarize with different types of cryptosystems
- To create an awareness for the design of various cryptographic primitives
- To analyze different types of attacks on various cryptosystems.

Syllabus

Basics of Algebra and number theory – Security goals, services and mechanisms – cryptography-traditional and modern secret key ciphers –data encryption standard – advanced encryption standard –public key crypto systems- digital signature – IP security

Expected outcome .

The students will be able

- To learn the importance of number theory in designing crypto systems;
- To design public and private key cryptosystems;
- To do cryptanalysis of various cryptosystems.

Text Books:

1. Behrouz A. Forouzan and Debdeep Mukhopadhyay, Cryptography & Network Security, Second Edition, Tata McGraw Hill, New Delhi, 2010
2. Douglas R. Stinson, "Cryptography: Theory and Practice", Third Edition, CRC Press.
3. William Stallings, "Cryptography and Network Security – Principles and Practices", Pearson Education, Fourth Edition, 2006.

References:

1. Atul Kahate, "Cryptography and Network Security", 2nd Edition, Tata McGraw Hill, 2003.
2. Bernard Menezes, Network Security and Cryptography-Cengage Learning India, 2011
3. Bruce Schneier, "Applied Cryptography: Protocols, Algorthms, and Source Code in C", Second Edition, John Wiley and Sons Inc, 2001.
4. Thomas Mowbray, "Cybersecurity : Managing Systems Conducting Testing, and Investigating Intrusions", John Wiley, 2013
5. Wenbo Mao, " Modern Cryptography- Theory & Practice", Pearson Education, 2006.

Course Plan

Module	Contents	Hours	Sem. Exam Marks
I	**Basics of Algebra and Number Theory**: Integer Arithmetic- Modular Arithmetic- Algebraic structures – Prime Numbers - Fermat's and Euler's Theorem – Factorization - Chinese Remainder Theorem - Linear and Quadratic Congruence - Discrete Logarithms.	7	15%
II	Introduction to Security:-Security Goals – Security services (Confidentiality, Integrity, Authentication, Non-repudiation, Access control) – Security Mechanisms (Encipherment, Data Integrity, Digital Signature, Authentication Exchange, Traffic Padding, Routing Control, Notarization, Access control) -	7	15%

	Security Principles. Introduction to Cryptography:- Kerckhoff's Principle -Classification of Cryptosystems- Cryptanalytic attacks- Cipher Properties (Confusion, Diffusion).		
FIRST INTERNAL EXAMINATION			
III	Traditional Secret Key Ciphers:- Substitution Ciphers (mono alphabetic ciphers, poly alphabetic ciphers)-Transposition Ciphers-Stream and Block Ciphers. Modern Secret Key Ciphers:- Substitution Box-Permutation Box-Product Ciphers	7	15%
IV	Data Encryption Standard (DES) (Fiestel and Non-Fiestel Ciphers, Structure of DES, DES Attacks, 2-DES, 3-DES) - Advanced Encryption Standard (AES) (Structure, Analysis)- Cryptographic Hash Functions– Properties - Secure Hash Algorithm-Message Authentication Code (MAC).	7	15%
SECOND INTERNAL EXAMINATION			
V	Public Key Cryptosystems (PKC): - Types of PKC –Trapdoor - one way functions -RSA Cryptosystem (Integer Factorisation Trapdoor**,** Key Generation, Encryption, Decryption) - El Gamal Cryptosystem (Discrete Logarithm Trapdoor**,** Key Generation, Encryption, Decryption) - Diffie-Hellman Key Exchange Protocol, Man in the Middle attack on Diffie-Hellman Protocol.	7	20%
VI	Digital Signature:-Signing – Verification - Digital signature forgery (Existential forgery, Selective forgery, Universal forgery) - RSA Digital Signature Scheme - ElGamal Signature Scheme - IP Security Overview, IP Security Architecture, Authentication Header, Encapsulating Security Payload-Intruders, Intrusion Detection, Distributed Denial of Service attacks	7	20%
END SEMESTER EXAM			

QUESTION PAPER PATTERN

Maximum Marks: 100 Exam Duration: 3 hours

The question paper shall consist of Part A, Part B and Part C.

Part A shall consist of three questions of 15 marks each uniformly covering Modules I and II. The student has to answer any two questions (15×2=30 marks).

Part B shall consist of three questions of 15 marks each uniformly covering Modules III and IV. The student has to answer any two questions (15×2=30 marks).

Part C shall consist of three questions of 20 marks each uniformly covering Modules V and VI. The student has to answer any two questions (20×2=40 marks).

Note : Each question can have a maximum of 4 subparts, if needed

Course code	Course Name	L-T-P - Credits	Year of Introduction
IT403	Mobile Computing	3-0-0-3	2016

Prerequisite :Nil

Course Objectives

- Learn the basics of Mobile computing.
- Learn networking concepts relevant to modern wireless systems.
- Learn emerging mobile computing ideas and best practices.
- Get hands-on knowledge practice with mobile computing

Syllabus

Introduction - issues in mobile computing, Wireless Communication Technologies, Third Generation (3G) Mobile Services, GSM, GPRS-Mobile Network Layer, Mobile Transport Layer, Mobile Ad hoc Networks (MANETs),Routing algorithms, security in MANETs. Security in MANETs, Protocols and Tools : Wireless Application Protocol-WAP, Mobile Application Development (Android) M-commerce

Expected outcome .

The students will be able to

i. gain a sound understanding of the key components and technologies involved
ii. get hands-on experiences in setting up wired as well as wireless networks.
iii. describe the major techniques involved in mobile communication.
iv. Design and implement mobile network systems

References:

1. C.K.Toh, AdHoc Mobile Wireless Networks-, First Edition Pearson Education.
2. Jochen Schiller, Mobile Communications, Second Edition, Pearson Education
3. Kaveh Pahlavan, Prasanth Krishnamoorthy, Principles of Wireless Networks,Pearson Education
4. Shu Lin, Daniel J Costello, Error Control Coding Fundamentals and Applications: Prentice Hall Inc, 1983
5. William Stallings, Wireless Communications and Networks, Pearson Education.

Course Plan

Module	Contents	Hours	Sem. Exam Marks
I	Introduction - issues in mobile computing, Wireless Communication Technologies- Celluar Wireless networks ,Wireless(802.11), TCP/IP in the mobile setting , Geolocation and Global Positioning System (GPS) Third Generation (3G) Mobile Services: Introduction to International Mobile Telecommunications 2000 (IMT 2000) vision, Wideband Code Division Multiple Access (W-CDMA), and CDMA 2000, Quality of services in 3G.	7	15%
II	GSM- System Architecture-Protocols-Connection Establishment-Frequency Allocation-Routing-Handover-Security, GPRS	7	15%
	FIRST INTERNAL EXAMINATION		
III	Mobile Network Layer : Mobile IP (Goals, assumptions, entities and terminology, IP packet delivery, agent advertisement and discovery, registration, tunneling and encapsulation, optimizations), Dynamic Host Configuration Protocol (DHCP).	7	15%

IV	Mobile Transport Layer : Traditional TCP, Indirect TCP, Snooping TCP, Mobile TCP, Fast retransmit/fast recovery, Transmission /time-out freezing, Selective retransmission, Transaction oriented TCP.	7	15%
SECOND INTERNAL EXAMINATION			
V	Mobile Ad hoc Networks (MANETs): Overview, Properties of a MANET, spectrum of MANET applications, routing and various routing algorithms, security in MANETs.	7	20%
VI	Protocols and Tools : Wireless Application Protocol-WAP. (Introduction, protocol architecture, and treatment of protocols of all layers) Mobile Application Development(Android) M-commerce	7	20%
END SEMESTER EXAM			

QUESTION PAPER PATTERN

Maximum Marks: 100 Exam Duration: 3 hours

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Part A shall consist of three questions of 15 marks each uniformly covering Modules I and II. The student has to answer any two questions (15×2=30 marks).

Part B shall consist of three questions of 15 marks each uniformly covering Modules III and IV. The student has to answer any two questions (15×2=30 marks).

Part C shall consist of three questions of 20 marks each uniformly covering Modules V and VI. The student has to answer any two questions (20×2=40 marks).

Note : Each question can have a maximum of 4 subparts, if needed

Course code	Course Name	L-T-P - Credits	Year of Introduction
IT404	Data Analytics	3-0-0-3	2016

Prerequisite: CS208 Principles of database design

Course Objectives

- To understand the data analysis techniques
- To understand the concepts behind the descriptive analytics and predictive analytics of data
- To familiarize with Big Data and its sources
- To familiarize data analysis using R programming
- To understand the different visualization techniques in data analysis

Syllabus

Data Analysis, Analysis Vs Reporting, Different Statistical Techniques of Data Analysis, Descriptive Analytics, Regressive Models, Neural Networks. Descriptive Analytics- Association and Sequential Rules, Big Data and its characteristics, Data Analysis using R language, Data visualization techniques.

Expected outcome .

- The student will understand the techniques to analyze different types of data, characterize it and can apply them to make decision modeling process more intelligent

Text Book:

1. EMC Education Services, Data Science and Big Data Analytics: Discovering, Analyzing, Visualizing and Presenting Data. John Wiley & Sons, 2015.
2. Jaiwei Han, Micheline Kamber, “Data Mining Concepts and Techniques”, Elsevier, 2006.
3. Michael Berthold, David J. Hand, Intelligent Data Analysis, Springer, 2007.

References:

Applications", John Wiley & Sons, 2014

1. Bart Baesens," Analytics in a Big Data World: The Essential Guide to Data Science and its Business Intelligence and Analytic Trends”, John Wiley & Sons, 2013
   Challenges and Future Prospects, Springer, 2014.
2. Michael Minelli, Michele Chambers, Ambiga Dhiraj , “Big Data, Big Analytics: Emerging Min Chen, Shiwen Mao, Yin Zhang, Victor CM Leung ,Big Data: Related Technologies,

Course Plan

Module	Contents	Hours	Sem. Exam Marks
I	Introduction to Data Analysis - Evolution of Analytic scalability, analytic processes and tools, Analysis vs reporting - Modern data analytic tools. Statistical concepts: Sampling distributions, re-sampling, statistical inference, prediction error.	8	15%
II	Predictive Analytics – Regression, Decision Tree, Neural Networks. Dimensionality Reduction - Principal component analysis	6	15%
FIRST INTERNAL EXAMINATION			

III	Descriptive Analytics - Mining Frequent itemsets - Market based model – Association and Sequential Rule Mining - Clustering Techniques – Hierarchical – K- Means	6	15%
IV	Introduction to Big data framework - Fundamental concepts of Big Data management and analytics - Current challenges and trends in Big Data Acquisition	7	15%
SECOND INTERNAL EXAMINATION			
V	Data Analysis Using R - Introduction to R, R Graphical User Interfaces, Data Import and Export, Attribute and Data Types, Descriptive Statistics, Exploratory Data Analysis, Visualization Before Analysis, Dirty Data, Visualizing a Single Variable, Examining Multiple Variables, Data Exploration Versus Presentation, Statistical Methods for Evaluation	8	20%
VI	Popular Big Data Techniques and tools- Map Reduce paradigm and the Hadoop system- Applications Social Media Analytics- Recommender Systems- Fraud Detection.	7	20%
END SEMESTER EXAM			

QUESTION PAPER PATTERN

Maximum Marks: 100 Exam Duration: 3 hours

The question paper shall consist of Part A, Part B and Part C.

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Part B shall consist of three questions of 15 marks each uniformly covering Modules III and IV. The student has to answer any two questions (15×2=30 marks).

Part C shall consist of three questions of 20 marks each uniformly covering Modules V and VI. The student has to answer any two questions (20×2=40 marks).

Note : Each question can have a maximum of 4 subparts, if needed

Course code	Course Name	L-T-P - Credits	Year of Introduction
IT405	Internetworking with TCP/IP	3-0-0-3	2016

Prerequisite : Nil

Course Objectives

- To understand the fundamental concepts in Internetworking, Internet Addressing, IP, UDP, and TCP Protocols, Routing Architecture, Network Virtualization and Software Defined Networking

Syllabus

Introduction and Overview, Overview of Underlying Network Technologies, Internetworking Concept and Architectural Model, Protocol Layering, Internet Addressing, Mapping Internet Addresses To Physical Addresses, Internet Protocol: Connectionless Datagram Delivery, Internet Protocol: Forwarding IP Datagrams, Internet Protocol: Error And Control Messages (ICMP), User Datagram Protocol, Reliable Stream Transport Service, Routing Architecture: Cores, Peers, And Algorithms, Routing Among Autonomous Systems, Routing Within An Autonomous System, Internet Multicasting, Label Switching, Flows, And MPLS , Packet Classification, Mobility And Mobile IP, Network Virtualization: VPNs, NATs, And Overlays, Bootstrap And Auto configuration, Voice And Video Over IP, Network Management, Software Defined Networking.

Expected outcome .

i. Conceptual understanding of Internetworking ,Internet Addressing, IP, UDP, and TCP Protocols, Routing Architecture, Network Virtualization and Software Defined Networking

ii. Ability to apply the net working technologies in practical situations

References:

1. Douglas E Comer, "Internetworking with TCP/IP Principles, Protocol, and Architecture" , Volume I, 6th Edition, Pearson Education, 2013
2. William Stallings, "Data and Computer Communications", 9th Edition, Pearson Education, 2011

Course Plan

Module	Contents	Hours	Sem. Exam Marks
I	Introduction and Overview, Overview Of Underlying Network Technologies, Internetworking Concept And Architectural Model, Protocol Layering Internet Addressing, Mapping Internet Addresses To Physical Addresses (ARP), Internet Protocol: Connectionless Datagram Delivery (IPv4, Ipv6) CIDR Sub netting	10	15%
II	Internet Protocol: Forwarding IP Datagrams, Internet Protocol: Error And Control Messages (ICMP), User Datagram Protocol (UDP)	4	15%
	FIRST INTERNAL EXAMINATION		
III	Reliable Stream Transport Service (TCP) Routing Architecture: Cores, Peers, And Algorithms, Routing Among Autonomous Systems (BGP), Routing Within An	10	15%

	Autonomous System (RIP, RIPng, OSPF, IS-IS)		
IV	Internet Multicasting , Label Switching, Flows, And MPLS, Packet Classification	5	15%
SECOND INTERNAL EXAMINATION			
V	Mobility And Mobile IP, Network Virtualization: VPNs, NATs, And Overlays Bootstrap And Auto configuration (DHCP, NDP, Ipv6-ND), Voice And Video Over IP (RTP, RSVP, QoS)	7	20%
VI	Software Defined Networking (SDN, OpenFlow)	6	20%
END SEMESTER EXAM			

QUESTION PAPER PATTERN

Maximum Marks: 100 Exam Duration: 3 hours

The question paper shall consist of Part A, Part B and Part C.

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Part B shall consist of three questions of 15 marks each uniformly covering Modules III and IV. The student has to answer any two questions (15×2=30 marks).

Part C shall consist of three questions of 20 marks each uniformly covering Modules V and VI. The student has to answer any two questions (20×2=40 marks).

Note : Each question can have a maximum of 4 subparts, if needed

Course code	Course Name	L-T-P - Credits	Year of Introduction
IT407	Knowledge Engineering	3-0-0-3	2016

Prerequisites: CS205 Data structures.

Course Objectives

To enable the students:

- To get introduced to the basic knowledge representation, problem solving, and learning methods of Artificial Intelligence.
- To solve problems in Artificial Intelligence using Python.
- To familiarize with Fuzzy Logic and knowledge processing in expert systems.

Syllabus

Introduction to the Concepts of Artificial Intelligence, Search Space, Knowledge Representation, Learning Techniques, Fuzzy systems and expert systems.

Expected outcome .

The students will

i. know the fundamental concepts of Artificial Intelligence such as knowledge representation, problem solving, fuzzy set and expert systems

ii. will be able to implement search methods using Python.

Text Books:

1. Elaine Rich and Kevin Knight, "Artificial Intelligence", Tata McGraw-Hill Publishing Company Ltd., New Delhi, Third Edition, ISBN: 13:978-0-07-008770-5, 2010.
2. Stuart Russell, Peter Norvig, "Artificial Intelligence- A modern approach", Pearson Education Asia, Second Edition, ISBN:81-297-0041-7

References:

1. Akshar Bharati, Vineet Chaitanya, Rajeev Sangal, "Natural Language Processing: A Paninian Perspective", Prentice Hall India Ltd., New Delhi, 1996, ISBN 10: 8120309219
2. Amit Konar, Artificial Intelligence and Soft Computing, CRC Press.
3. Dan W.Patterson, "Introduction to Artificial Intelligence and Expert Systems", Prentice Hall India Ltd., New Delhi, 2009, ISBN: 81-203-0777-1.
4. Rajendra Akerkar, Introduction to Artificial Intelligence, PHI Learning Pvt. Ltd., 2005, ISBN: 81-203- 2864-7.

Course Plan

Module	Contents	Hours	Sem. Exam Marks
I	**Problems and Search:** What is Artificial Intelligence, The AI Problems, Defining the Problem as a State Space Search, Problem Characteristics Searching strategies – Generate and Test, Heuristic Search Techniques- Hill climbing– issues in hill climbing. **Python**-Introduction to Python- Lists Dictionaries & Tuples in Python- Python implementation of Hill Climbing.	7	15%
II	**Search Methods** - Best First Search - Implementation in Python - OR Graphs, The A * Algorithm, Problem Reduction- AND-OR Graphs, The AO* algorithm, Constraint Satisfaction. MINIMAX search procedure, Alpha–Beta pruning.	7	15%
FIRST INTERNAL EXAMINATION			

III	**Knowledge representation** - Using Predicate logic - representing facts in logic, functions and predicates, Conversion to clause form, Resolution in propositional logic, Resolution in predicate logic, Unification. Representing Knowledge Using Rules: Procedural Versus Declarative knowledge, Logic Programming, Forward versus Backward Reasoning.	7	15%
IV	**Learning:** What is learning, Rote learning, Learning by Taking Advice, Learning in Problem-solving, Learning from example: induction, Explanation-based learning.	7	15%
SECOND INTERNAL EXAMINATION			
V	**Connectionist Models:** Hopfield Networks, Learning in Neural Networks, Applications of Neural Networks, Recurrent Networks. Connectionist AI and Symbolic AI	7	20%
VI	**Expert System** –Representing and using Domain Knowledge – Reasoning with knowledge– Expert System Shells –Support for explanation- examples –Knowledge acquisition-examples.	7	20%
END SEMESTER EXAM			

QUESTION PAPER PATTERN

Maximum Marks: 100 Exam Duration: 3 hours

The question paper shall consist of Part A, Part B and Part C.

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Part B shall consist of three questions of 15 marks each uniformly covering Modules III and IV. The student has to answer any two questions (15×2=30 marks).

Part C shall consist of three questions of 20 marks each uniformly covering Modules V and VI. The student has to answer any two questions (20×2=40 marks).

Note : Each question can have a maximum of 4 subparts, if needed

Course code	Course Name	L-T-P-Credits	Year of Introduction
IT409	Web Application Development	3-0-0-3	2016

Course Objectives

- To give insights of the Internet programming for designing and implementation
- To develop code to handle exceptions and validate data for file and database storage.
- To know usage of recent platforms used in developing web applications such as J2EE, XML ...etc.
- To impart the idea about java beans.

Syllabus

Introduction - Web architecture - web application lifecycle - XML and J2EE.Servlets, Servlets with JDBC, JDBC: Architecture - JDBC API, Java Server Pages - Using JavaBeans Components in JSP Pages, Sharing Data Between JSP pages -Passing Control and Data between Pages – Sharing Session and Application Data – Application Models - MVC Design, Enterprise -Managed Persistence (CMP) and bean managed - lifecycle of EJB - Java Message Service (JMS) and Message Driven Beans (MDB). Distributed programming services CORBA and RMI – Transaction management, Security, deployment building session beans -creating session beans - Entity beans.

Expected Outcome

The students will be able to,

1. Acquire the fundamental concepts of web systems and applications.
2. Identify the methodologies and techniques for developing web applications.
3. Get skills to develop websites.

References

1. Hans Bergsten , Java Server Pages, O'Reilly, 2003
2. Jason Hunter, William Crawford , Java Servlet Programming, Second Edition, , O'Reilly Media
3. Joseph J. Bambara, Paul R. Allen, Mark Ashnault, Ziyad Dean, Thomas Garben, Sherry Smith J2EE UNLEASHED — SAMS Techmedia
4. Roman, Scott Ambler, Tyler Jewell (ed.), Mastering EJB(2nd Edition) – Ed– John Wiley Publications, 2003.
5. Stepahnie Bodoff, Dale Green, Kim Hasse, Eric Jendrock, Monica Pawlan, Beth Stearns , The J2EE Tutorial, Pearson Education , Asia.

COURSE PLAN

Module	Contents	Hours	Sem. Exam Marks
I	Introduction - Web architecture - web application lifecycle - XML and J2EE.	7	15%
	Servlets: Introduction to Servlets, Benefits of Servlets, use as controller in MVC, basic HTTP, servlet container, Servlets API, javax.servelet Package, Reading Servlet parameters, service method detail. HTML clients, servlet lifecycle		

II	Session management, dispatching requests, Servlets with JDBC, JDBC: Architecture - JDBC API	7	15%
FIRST INTERNAL EXAM			
III	Java Server Pages: Generating Dynamic Content, Using Scripting Elements, Implicit JSP Objects. Conditional Processing – Displaying Values, Setting attributes, Error Handling and Debugging, Using JavaBeans Components in JSP Pages.	6	15%
IV	Passing Control and Data between Pages – Sharing Session and Application Data – Application Models - MVC Design	6	15%
SECOND INTERNAL EXAM			
V	Enterprise JavaBeans : Overview, distributed programming, EJB framework, Session and entity beans, Stateless and stateful session bean, Bean attributes, Parts of a Bean. Container-Managed Persistence (CMP) and bean managed persistence.	8	20%
VI	lifecycle of EJB - Java Message Service (JMS) and Message Driven Beans (MDB). Distributed programming services CORBA and RMI – Transaction management, Security, deployment, building session beans -creating session beans - Entity beans.	**8**	20%
END SEMESTER EXAM			

QUESTION PAPER PATTERN

Maximum Marks: 100 Exam Duration: 3 hours

The question paper shall consist of Part A, Part B and Part C.

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Part C shall consist of three questions of 20 marks each uniformly covering Modules V and VI. The student has to answer any two questions (20×2=40 marks).

Note : Each question can have a maximum of 4 subparts, if needed

Course code	Course Name	L-T-P-Credits	Year of Introduction
IT431	Web Application Development Lab	0-0-3-1	2016

Prerequisite: IT409 Web application development

Course Objectives

- To develop the skill in Creating dynamic web pages with servlets
- To provide knowledge in connecting java programs with database using JDBC.
- To develop the skill in server side programming using JSP.
- To provide knowledge about MVC Design.
- Testing the application on an Application Server.
- Debugging Web applications locally and remotely.
- Developing applications in a team environment.

List of Exercises / Experiments (Minimum 8 are mandatory)

1. Authentication using Java Servlet
2. Authentication using JSP
3. Authentication using MVC Architecture
4. Design and development of Online Book Shop
5. Design and development of Online Examination
6. Design and development of online ticket reservation system
7. Design and development of online library
8. Design and development of online banking
9. Design and development of online job portal
10. Design and development of Online Auction

Class Project (Individual) (Mandatory)

Students are encouraged to propose innovative ideas in the field of E-commerce as projects.

Expected Outcome

By the end of the course, the student will be able to:

i. Write programs in java to access database.
ii. Write programmes in servlet to create dynamic web pages which access databases and track user sessions
iii. Develop server side programmes in JSP.
iv. Design and develop web applications using MVC architecture.
v. Test and debug a web application.
vi. Develop web application in a team environment.

References

1. Jason Hunter, William Crawford , Java Servlet Programming, Second Edition, ,O'Reilly Media

2. Hans Bergsten, Java Server Pages, O'Reilly

3. http://www.oracle.com/technetwork/java/index-jsp-135475.html

4. http://www.oracle.com/technetwork/java/javaee/jsp/index.html

Course code	Course Name	L-T-P-Credits	Year of Introduction
IT461	Software Testing and Quality Assurance	3-0-0-3	2016

Prerequisite: IT364 Software project management

Course Objectives

- To study fundamental concepts in software testing, including software testing objectives, process, criteria, strategies, and methods.
- To learn planning of a test project, designing test cases and data, conducting test operations, managing software problems and defects, and generating a test report.
- To develop an understanding of the meaning and importance of quality in relation to software systems and the software development process.
- To discuss issues and techniques for implementing and managing software quality assurance processes and procedures.

Syllabus

Introduction to software engineering- Phases in Software development. Process models- prescriptive process models- Specialised process models- The unified process- Agile development- Agile development models. Project management concepts. Process and project metrics- Estimation for software projects- Software project estimation, decomposition techniques. Empirical estimation models- Task set- Scheduling. Risk management- The RMMM Plan. Software Configuration Management - The SCM Repository - The SCM Process. Software quality assurance- Formal Approaches to SQA. Statistical Software Quality Assurance- Six Sigma for Software Engineering. Software Reliability. The ISO 9000 Quality Standards. The SQA Plan. Software process improvement- The CMMI, SPI Return on Investment. SPI trends.

Expected Outcome

The students will be able to

i. Apply software testing knowledge and engineering methods.
ii. Understand and identify various software testing problems, and solve these problems by designing and selecting software test models, criteria, strategies, and methods.
iii. Apply the techniques learned to improve the quality of their own software development.
iv. Prepare a software quality plan for a software project.

References

1. Daniel Galin , Software Quality Assurance From theory to implementation, Pearson
2. Louise Tamres , Introducing Software Testing , Pearson
3. M G Limaye , Software Testing, Principles , Techniques and Tools , TMH

Module	Course Plan	Hours	Sem. Exam Marks
I	Fundamentals of Software Testing – Approaches to testing, Requirement traceability matrix, Essentials of testing, workbench, misconceptions about testing, Principles of Software Testing, test policy, challenges, cost aspect,– Structured approach to Testing – categories of defect, Developing Testing methodologies, skills required for testing.	3	15%
	Levels of Testing – proposal testing, requirement testing, design testing, code testing, unit testing, module testing, integration testing, big-bang testing, sandwich testing, critical path first, subsystem testing, system testing, testing stages.	3	

II	Acceptance Testing- importance, alpha testing, beta testing, gamma testing, Customer's responsibility, Acceptance criteria, criticality of requirements, developing acceptance test plan, user responsibilities, executing acceptance plan.	**3**	**15%**
	Special Tests I.	**5**	
FIRST INTERNAL EXAM			
III	Special Tests II.	4	**15%**
	Testing tools- features, guidelines for selecting a tool, tools and skills of testing, static and dynamic testing tools, advantages and disadvantages, automated test tools, process of procurement of COTS, procurement of tools from contractor, contracting a software.	4	
IV	Test planning - Test strategy – test plan-Test plan templates (System testing) – Quality plan- quality plan templates. Guidelines for developing test plan - Test Estimation – Test standards – Building Test data and Test cases - Test Scenario – Test Scripts - Tools used to build test data. Testing object oriented software – Testing web applications.	**4**	**15%**
	Test metrics and Test reports – categories of the product/project test metrics – Resources consumed in Testing – Effectiveness of testing – defect density – defect leakage ratio – residual defect density – test team efficiency – test case efficiency - test reports Integration test reports – System Test report – acceptance test report - guidelines for writing and using test report - final test reporting – test status report - benchmarking.	**4**	
SECOND INTERNAL EXAM			
V	Software quality – definition, Software quality assurance – definition and objectives, Software quality assurance and software engineering. Software quality factors- The need for comprehensive software quality requirements, Classifications of software requirements into software quality factors, Product operation software quality factors, Product revision software quality factors, Product transition software quality factors, Alternative models of software quality factors , Software compliance with quality factors	**3**	**20%**
	The components of the software quality assurance system – The SQA system – an SQA architecture, Pre-project components, Software project life cycle components, Infrastructure components for error prevention and improvement, Management SQA components, SQA standards, system certification, and assessment components , Organizing for SQA – the human components ,Considerations guiding construction of an organization's SQA system	**3**	
VI	Pre-project software quality components- Contract review- The contract review process and its stages, Contract review objectives, Implementation of a contract review, Contract review subjects. SQA components in the project life cycle- Integrating quality activities in the project life cycle- Classic	**3**	**20%**

	and other software development methodologies ,Factors affecting intensity of quality assurance activities in the development process , Verification, validation and qualification, A model for SQA defect removal effectiveness and cost.		
	Reviews- Review objectives, Formal design reviews (DRs), Peer reviews, comparison of the team review methods, Expert opinions. Assuring the quality of software maintenance components- Introduction- The foundations of high quality, Pre-maintenance software quality components, Maintenance software quality assurance tools	**3**	
END SEMESTER EXAM			

QUESTION PAPER PATTERN

Maximum Marks: 100 Exam Duration: 3 hours

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Part C shall consist of three questions of 20 marks each uniformly covering Modules V and VI. The student has to answer any two questions (20×2=40 marks).

Note : Each question can have a maximum of 4 subparts, if needed

Course code	Course Name	L-T-P - Credits	Year of Introduction
IT462	Internet of things	3-0-0-3	2016

Prerequisite: Nil

Course Objectives

- To explore the world of current technologies.
- To understand with the concepts of internet of things.
- To get a knowledge basics in the history and developments of internet.
- To be familiar with the big data and cloud in the IoT basis.

Syllabus

Internet: An Overview, Internet Technology, Internet Communication Technologies, Current trends in Internet: Internet of everything , Cloud Technology, Scalable Computing, Models of distributed and cloud computing , Performance and Security, Internet of Things, Smart Technology, IoT Components, Prototyping in IoT, Big Data, Big Data versus IoT, Combined applications.

Expected outcome .

- The student will understand the basics of internet, the concepts of internet of things, cloud and big data.

Text Books:

1. Anthony Townsend., Smart cities: big data, civic hackers, and the quest for a new utopia, WW Norton & Company, 2013
2. Arshdeep Bahga, Vijay Madisetti, , Internet of things: a hands-on approach, CreateSpace Independent Publishing Platform, 2013.
3. Dieter Uckelmann, Mark Harrison, Michahelles Florian (Ed.), Architecting the internet of things, Springer, 2011
4. Dr. Ovidiu Vermesan, Dr Peter Friess, Internet of Things: Converging Technologies for Smart Environments and Integrated Ecosystems, River Publishers, 2013
5. Olivier Hersent, David Boswarthick, Omar Elloumi The internet of things: key applications and protocols, Wiley, 2012.

References:

1. Adrian McEwen, Hakim Cassimally, Designing internet of things, John Wiley & Sons, 2013 .
2. Charalampos, Doukas, Building Internet of things with the Arduino, Creat space .
3. Rob Faludi, Building wireless sensor networks, O'Reilly.
4. Cuno Pfister, Getting started with the internet of things, Maker Media, Inc., 2011 .

Course Plan

Module	Contents	Hours	Sem. Exam Marks
I	Internet: An Overview: Introduction, History of Internet, Internet Technology, Basics of Internet, Classification of Internet, Topologies, Applications, Internet of Things and Related Future Internet Technologies, Internet of Things Vision, Towards the IoT Universe(s), The Internet of Things Today.	5	15%
II	Internet Communication Technologies, Networks and Communication , Processes , Data Management , IoT Related Standardization , Protocol, Communication protocols, Types of communication protocols, Addressing Schemes, M2M Service Layer Standardisation, OGC Sensor Web for IoT, IEEE and IETF,	8	15%

	ITU-T, Current trends in Internet: Internet of everything, Internet of everything, Internet of things, Storage, Databases.		
FIRST INTERNAL EXAMINATION			
III	Cloud Technology: Introduction, Overview, Why cloud ? , How to implement cloud ?, Usage of cloud, Scalable Computing, Cloud computing, Characteristics of cloud computing, Classifications, Virtual machines, Virtualization technology, Models of distributed and cloud computing, Distributed computing, Clustering, Grid computing, Service oriented Architecture. Performance and Security, Performance analysis, Security, Implementations of Cloud computing.	8	15%
IV	Internet of Things: IoT : An overview, Introduction, Characteristics, IoT technology, IoT as a Network of Networks, IoT architecture, IoT developments, Smart Technology, Brief introduction of smart technology, Smart devices, Smart environment. IoT Components, Basic Principles, Embedded technology Vs IoT, Sensors, Wireless sensor networks, Aurdino, Rasberry Pi.	7	15%
SECOND INTERNAL EXAMINATION			
V	Prototyping in IoT, Basics of prototypes, Prototyping in IoT, Communication in IoT, Prototyping model, Data handling in IoT, fabryq, Bluetooth Low Energy, µfabryq, Operating Systems for Low-End IoT Devices, Open Source Oss, Contiki, RIOT, FreeRTOS, TinyOS, OpenWSN, nuttX, eCos, mbedOS, L4 microkernel family, uClinux, Android and Brillo, Other open source OS, Closed Source Oss, ThreadX, QNX, VxWorks, Wind River Rocket, PikeOS, emboss, Nucleus RTOS, Sciopta, µC/OS-II and µC/OS-III.	7	20%
VI	Big Data, BigData versus IoT, BigData influcement in IoT, A cyclic model of BigData, Cloud and Internet of Things, Data Storage, Analysis and Communication, Classifications, Characteristics of BigData, Types of BigData, Analysing of Data, Applications, Real time situations, BigData tools, A combined application of IoT , Cloud and BigData in IoT.	7	20%
END SEMESTER EXAM			

QUESTION PAPER PATTERN

Maximum Marks: 100 Exam Duration: 3 hours

The question paper shall consist of Part A, Part B and Part C.

Part A shall consist of three questions of 15 marks each uniformly covering Modules I and II. The student has to answer any two questions (15×2=30 marks).

Part B shall consist of three questions of 15 marks each uniformly covering Modules III and IV. The student has to answer any two questions (15×2=30 marks).

Part C shall consist of three questions of 20 marks each uniformly covering Modules V and VI. The student has to answer any two questions (20×2=40 marks).

Note : Each question can have a maximum of 4 subparts, if needed

Course code	Course Name	L-T-P-Credits	Year of Introduction
IT463	Semantic Web	3-0-0-3	2016

Prerequisite : Nil

Course Objectives

- To introduce semantic web technologies and semantic web architecture
- To study the use of XML in Semantic Web
- To Explore RDF and OWL
- To introduce Logic and Inference
- To study ontology engineering
- To analyse semantic web applications.

Syllabus

The Semantic Web Vision, Today's Web, From Today's Web to the Semantic Web: Examples, Semantic Web Technologies, A Layered Approach, Structured Web Document in XML, The XML Language, Structuring, Namespace, Addressing and Querying XML Documents, Processing,Describing Web Documents in RDF, RDF: XML-Based Syntax, RDF Schema, An Axiomatic Semantics for RDF and RDF Schema, A Direct Inference System for RDF and RDFS, Querying in RQL, Web Ontology Language(OWL), Examples, OWL in OWL, Future Extensions,Logic and Inference, Example of Monotonic Rules: Family Relationships , Monotonic Rules Syntax and Semantics, Nonmonotonic Rules: Motivation, Syntax and Example, Rule Markup in XML ,Applications, Ontology Engineering, Constructing Ontologies Manually, Reusing Existing Ontologies, Using Semiautomatic Methods, On-To-Knowledge Semantic Web Architecture.

Expected Outcome

- Conceptual understanding of the above topics and ability to apply them in practical situations.

References

1. Grigoris Antoniou, Frank Van Harmelon, "A Semantic Web Primer", The MIT Press.
2. J. Davies, D. Fensel, and F. van Harmelen. Towards the Semantic Web: Ontology-Driven Knowledge Management, New York, Wiley, 2003.
3. Natalya. F. Noy and Deborah L. McGuinness, Ontology Development 101: A Guide to Creating Your First Ontology, *http://protege.stanford.edu/publications/ontology_development/ontology101.pdf*

COURSE PLAN

Module	Contents	Hours	Sem. Exam Marks
I	The Semantic Web Vision, Today's Web, From Today's Web to the Semantic Web: Examples, Semantic Web Technologies, A Layered Approach, Structured	4	15%

COURSE PLAN			
Module	**Contents**	**Hours**	**Sem. Exam Marks**
	Structured Web Document in XML, The XML Language, Structuring, Namespace, Addressing and Querying XML Documents, Processing	5	
II	Describing Web Documents in RDF, RDF: XML-Based Syntax, RDF Schema, An Axiomatic Semantics for RDF and RDF Schema, A Direct Inference System for RDF and RDFS, Querying in RQL	6	15%
FIRST INTERNAL EXAM			
III	Web Ontology Language(OWL), Examples, OWL in OWL, Future Extensions	6	15%
IV	Logic and Inference:Rules , Example of Monotonic Rules: Family Relationships , Monotonic Rules Syntax and Semantics, Nonmonotonic Rules: Motivation, Syntax and Example, Rule Markup in XML	6	15%
SECOND INTERNAL EXAM			
V	Applications: Horizontal Information Products at Elsevier, Data Integration at Audi, Skill Finding at Swiss Life, Think Tank Portal at EnerSearch, e-Learning, Web Services	9	20%
VI	Ontology Engineering, Constructing Ontologies Manually, Reusing Existing Ontologies, Using Semiautomatic Methods, On-To-Knowledge Semantic Web Architecture, Key Research challenges in Semantic Web	6	20%
END SEMESTER EXAM			

QUESTION PAPER PATTERN

Maximum Marks: 100 Exam Duration: 3 hours

The question paper shall consist of Part A, Part B and Part C.

Part A shall consist of three questions of 15 marks each uniformly covering Modules I and II. The student has to answer any two questions (15×2=30 marks).

Part B shall consist of three questions of 15 marks each uniformly covering Modules III and IV. The student has to answer any two questions (15×2=30 marks).

Part C shall consist of three questions of 20 marks each uniformly covering Modules V and VI. The student has to answer any two questions (20×2=40 marks).

Note : Each question can have a maximum of 4 subparts, if needed

Course code	Course Name	L-T-P - Credits	Year of Introduction
IT464	Information Storage Management	3-0-0-3	2016

Pre-requisites: NIL

Course Objectives

- To understand data creation, the amount of data being created, the value of data to a business, challenges in data storage and data management,
- To understand solutions available for data storage, Core elements of a data center infrastructure, role of each element in supporting business activities

Syllabus

Storage system architecture, Networked storage, Information availability and monitoring a data centre, remote data replication technologies, securing storage and storage virtualization,

Expected outcome .

The student will understand the concept of data storage in distributed environment in data centre, challenges in data storage and management technologies.

Text Books:

1. Robert Spalding, "Storage Networks: The Complete Reference", Tata McGraw Hill, New Delhi, 2006.
2. Somasundaram G, Alok Shrivastava, "ISM – Storing, Managing and Protecting Digital Information", EMC Education Services, Wiley India, New Delhi, 2012.

References:

1. Gerald J Kowalski, Mark T Maybury, "Information Storage and Retrieval Systems: Theory and Implementation", BS Publications, New Delhi, 2009.
2. Marc Farley Osborne, "Building Storage Networks", Tata McGraw Hill, New Delhi, 2001.
3. Meeta Gupta, "Storage Area Network Fundamentals", Pearson Education, New Delhi, 2002.

Course Plan

Module	Contents	Hours	Sem. Exam Marks
I	Data, Information, Evolution of storage architecture, Data center infrastructure, Information lifecycle. Overview: Virtualization - Cloud, Data center environment: Application - Desktop - Memory virtualization - Connectivity - Disk drive interface -	7	15%
II	Storage media - Flash drives, RAID: Implementation - Methods - Levels, Intelligent storage system	5	15%
	FIRST INTERNAL EXAMINATION		
III	Introduction to DAS and SCSI, SAN: Evolution - Components - Connectivity options - Ports - FC architecture - Zoning - FC topologies, SAN based virtualization: Block level - VSAN, IP SAN: iSCSI - FCIP components - FCIP topology and frame structure, FCOE: Components – Benefits	7	15%
IV	NAS: Benefits – Components - Implementations - File sharing protocols - I/O operations - Factors affecting NAS performance - File level virtualization, Object based storage: Operation Benefits - Fixed content and archives - Archive types, CAS: Architecture -	7	15%

	Operations - Use cases, Unified storage		
SECOND INTERNAL EXAMINATION			
V	Introduction: Information availability - BC terminology - Planning lifecycle - Business impact analysis - Technology solutions, Backup and restore: Purposes - Methods - Architecture - Operations - SCB - Topologies - Targets - Deduplication, Local Replication: Terminology - Data consistency - Technologies - Restore and restart considerations, Remote replication: Modes - Technologies - Advanced replication technologies.	8	20%
VI	Securing the storage infrastructure: Security terminology - Security framework – Risk triad - Security domains -Implementations - Managing the storage infrastructure: Monitoring - Activities - Challenges - Solutions Data Warehousing with Oracle BI	8	20%
END SEMESTER EXAM			

QUESTION PAPER PATTERN

Maximum Marks: 100 Exam Duration: 3 hours

The question paper shall consist of Part A, Part B and Part C.

Part A shall consist of three questions of 15 marks each uniformly covering Modules I and II. The student has to answer any two questions (15×2=30 marks).

Part B shall consist of three questions of 15 marks each uniformly covering Modules III and IV. The student has to answer any two questions (15×2=30 marks).

Part C shall consist of three questions of 20 marks each uniformly covering Modules V and VI. The student has to answer any two questions (20×2=40 marks).

Note : Each question can have a maximum of 4 subparts, if needed

Course code	Course Name	L-T-P - Credits	Year of Introduction
IT465	Cyber Forensics	3-0-0-3	2016

Pre-requisites: Nil

Course Objectives

- To understand cyber related crimes and various investigative strategies
- To understand Computer Forensics, Computing Investigations.
- To study forensically sound principles and practices related to digital evidence collection, management, and handling.
- To study the concepts in ethical hacking

Syllabus

Introduction to Cyber Forensics, Methods in forensic investigation, Investigation of various data breaches, Types of computer forensic technology, Law enforcement in cyber forensics, Types of Computer Forensics Systems, Ethical Hacking, Types of evidence and methods of evidence collection, Investigation of cyber crimes, Cyber forensics tools, Network Forensics, Investigating network traffic.

Expected outcome .

- The students will get awareness about the cyber related crimes happening in modern world and will help them to identify them.

Text Book:

1. John R. Vacca, Computer Forensics: Computer Crime Scene Investigation, 2nd Edition, Charles River Media, 2005
2. Christof Paar, Jan Pelzl, Understanding Cryptography: A Textbook for Students and Practitioners, 2 nd Edition, Springer, 2010

References:

1. Ali Jahangiri, Live Hacking: The Ultimate Guide to Hacking Techniques & Countermeasures for Ethical Hackers & IT Security Experts, Ali Jahangiri, 2009
2. Computer Forensics: Investigating Network Intrusions and Cyber Crime (Ec-Council Press Series: Computer Forensics), 2010

Course Plan

Module	Contents	Hours	Sem. Exam Marks
I	Introduction to Cyber forensics: Information Security Investigations, Corporate Cyber Forensics, Scientific method in forensic analysis, investigating large scale Data breach cases. Analyzing Malicious software.	6	15%
II	Types of Computer Forensics Technology, Types of Military Computer Forensic Technology, Types of Law Enforcement, Computer Forensic Technology, Types of Business Computer Forensic Technology, Specialized Forensics Techniques, Hidden Data and How to Find It, Spyware and Adware, Encryption Methods and Vulnerabilities, Protecting Data from Being Compromised Internet Tracing Methods, Security and Wireless Technologies, Avoiding Pitfalls with Firewalls Biometric Security Systems	7	15%
FIRST INTERNAL EXAMINATION			

III	Types of Computer Forensics Systems: Internet Security Systems, Intrusion Detection Systems, Firewall Security Systems, Storage Area Network Security Systems, Network Disaster Recovery Systems, Public Key Infrastructure Systems, Wireless Network Security Systems, Satellite Encryption Security Systems, Instant Messaging (IM) Security Systems, Net Privacy Systems, Identity Management Security Systems, Identity Theft, Biometric Security Systems	6	15%
IV	Ethical Hacking: Essential Terminology, Windows Hacking, Malware, Scanning, Cracking. Digital Evidence in Criminal Investigations: The Analog and Digital World, Training and Education in digital evidence, Evidence Collection and Data Seizure: Why Collect Evidence, Collection Options Obstacles	7	15%
SECOND INTERNAL EXAMINATION			
V	Types of Evidence: The Rules of Evidence, Volatile Evidence, General Procedure, Collection and Archiving, Methods of Collection, Artifacts, Collection Steps, Controlling Contamination: The Chain of Custody, Reconstructing the Attack, The digital crime scene, Investigating Cybercrime, Duties Support Functions and Competencies.	9	20%
VI	Identification of Data: Timekeeping, Forensic Identification and Analysis of Technical Surveillance Devices, Reconstructing Past Events: How to Become a Digital Detective, Useable File Formats, Unusable File Formats, Converting Files, Investigating Network Intrusions and Cyber Crime, Network Forensics and Investigating logs, Investigating network Traffic, Investigating Web attacks, Router Forensics. Cyber forensics tools and case studies.	7	20%
END SEMESTER EXAM			

QUESTION PAPER PATTERN

Maximum Marks: 100 Exam Duration: 3 hours

The question paper shall consist of Part A, Part B and Part C.

Part A shall consist of three questions of 15 marks each uniformly covering Modules I and II. The student has to answer any two questions (15×2=30 marks).

Part B shall consist of three questions of 15 marks each uniformly covering Modules III and IV. The student has to answer any two questions (15×2=30 marks).

Part C shall consist of three questions of 20 marks each uniformly covering Modules V and VI. The student has to answer any two questions (20×2=40 marks).

Note : Each question can have a maximum of 4 subparts, if needed

Course code	Course Name	L-T-P - Credits	Year of Introduction
IT466	Adhoc and Sensor Networks	3-0-0-3	2016

Prerequisite: Nil

Course Objectives

- To understand and apply the fundamental concepts of Internet of Things definitions, frameworks, applications, mechanisms and key technologies
- To evolve IoT standards
- To know wireless technologies and IPv6 technologies for the IoT

Syllabus

Overview and Motivations, IoT Definitions, IoT Frameworks, Identification of IoT Objects and Services, Structural Aspects of the IoT, Key IoT Technologies, IoT standards - Overview and Approaches, WPAN Technologies for IoTM2M, Mobile Network Technologies for IoTM2M, IPv6 Technologies for the IoT, IPv6 Address Capabilities, Header Compression Schemes, Quality of Service in Ipv6, Mobile IPv6 Technologies for the IoT, Message Types, and Destination Option, Modifications to IPv6 Neighbor Discovery, Requirements for Various IPv6 Nodes, Relationship to IPV4 Mobile IPv4 (MIP). IPv6 Over Low-power WPAN (6LoWPAN).

Expected outcome .

- Conceptual understanding of the above topics and ability to apply them in practical situations.

References:

1. Bahga, Arshdeep, and Vijay Madisetti. *Internet of Things: A Hands-on Approach*. VPT, 2014.
2. Hersent, Olivier, David Boswarthick, and Omar Elloumi. *The Internet of Things: Key Applications and Protocols*. John Wiley & Sons, 2011
3. Minoli, Daniel. *Building the internet of things with IPv6 and MIPv6: The evolving world of M2M communications*. John Wiley & Sons, 2013.
4. Pfister, Cuno. *Getting Started with the Internet of Things: Connecting Sensors and Microcontrollers to the Cloud*. " O'Reilly Media, Inc.", 2011.

Course Plan

Module	Contents	Hours	Sem. Exam Marks
I	WHAT IS THE INTERNET OF THINGS? - Overview and Motivations, Examples of Applications, IPv6 Role, Areas of Development and Standardization, IoT Definitions, IoT Frameworks, IoT application Example.	6	15%
II	FUNDAMENTAL IoT MECHANISMS AND KEY TECHNOLOGIES - Identification of IoT Objects and Services, Structural Aspects of the IoT - Environment Characteristics, Traffic Characteristics, Scalability, Interoperability, Security and Privacy, Open Architecture. Key IoT Technologies - Device Intelligence, Communication Capabilities, Mobility Support, Device Power, Sensor Technology, RFID Technology, Satellite Technology	8	15%
FIRST INTERNAL EXAMINATION			
III	EVOLVING IoT STANDARDS - Overview and Approaches, IETF IPv6 Routing Protocol for RPL Roll, Constrained Application Protocol (CoAP) - Background, Messaging Model,	7	15%

	RequestResponse Model, Intermediaries and Caching. Representational State Transfer (REST), ETSI M2M, Third-Generation Partnership Project Service Requirements for Machine-Type Communications, CENELEC, IETF IPv6 Over Lowpower WPAN (6LoWPAN), ZigBee IP (ZIP), IP in Smart Objects (IPSO)		
IV	LAYER 1/2 CONNECTIVITY: WIRELESS TECHNOLOGIES FOR THE IoT - WPAN Technologies for IoTM2M - ZigbeeIEEE 802.15.4, Radio Frequency for Consumer Electronics (RF4CE), IEEE 802.15.6 WBANs. Cellular and Mobile Network Technologies for IoTM2M - Overview and Motivations, Universal Mobile Telecommunications System, LTE	7	15%
SECOND INTERNAL EXAMINATION			
V	LAYER 3 CONNECTIVITY: IPv6 TECHNOLOGIES FOR THE IoT - Overview and Motivations, Address Capabilities, IPv4 Addressing and Issues, IPv6 Address Space, IPv6 Protocol Overview, IPv6 Tunneling, IPsec in IPv6, Header Compression Schemes, Quality of Service in IPv6, Migration Strategies to IPv6.	7	20%
VI	LAYER 3 CONNECTIVITY: MOBILE IPv6 TECHNOLOGIES FOR THE IoT - Overview, Protocol Details, Generic Mechanisms, New IPv6 Protocol, Message Types, and Destination Option, Modifications to IPv6 Neighbor Discovery, Requirements for Various IPv6 Nodes, Correspondent Node Operation, HA Node Operation, Mobile Node Operation, Relationship to IPV4 Mobile IPv4 (MIP). IPv6 OVER LOW-POWER WPAN (6LoWPAN) - Background Introduction, 6LoWPANs Goals, Transmission of IPv6 Packets Over IEEE 802.15.4	7	20%
END SEMESTER EXAM			

QUESTION PAPER PATTERN

Maximum Marks: 100 Exam Duration: 3 hours

The question paper shall consist of Part A, Part B and Part C.

Part A shall consist of three questions of 15 marks each uniformly covering Modules I and II. The student has to answer any two questions (15×2=30 marks).

Part B shall consist of three questions of 15 marks each uniformly covering Modules III and IV. The student has to answer any two questions (15×2=30 marks).

Part C shall consist of three questions of 20 marks each uniformly covering Modules V and VI. The student has to answer any two questions (20×2=40 marks).

Note : Each question can have a maximum of 4 subparts, if needed

Course code	Name	L-T-P-Credits	Year of Introduction
IT332	Internet Technology Lab	0-0-3-1	2016

Prerequisite: IT302 Internet technology

Course objectives

- To create web pages using HTML, Cascading Styles sheets.XML, Javascript and PHP

LIST OF EXERCISES / EXPERIMENTS

1. Install, setup and configure Web server bundles (wamp/xamp/Apache/IIS etc.)
2. Create a web page with all possible elements of HTML5
3. Create a web page with all types of Cascading style sheets
4. Programs to demonstrate JavaScript array, object and functions
5. Client Side Scripts for Validating Web Form Controls using JavaScript
6. Programs to demonstrate DOM event bubbling.
7. Programs using XML – DTD Schema – XSLT/XSL
8. Programs using XML – Schema XSLT/XSL
9. Programs using XML – XSLT/XSL
10. Programs using AJAX
11. Server Side Scripting using PHP
12. Programs using session tracking in PHP
13. Programs using cookies tracking in PHP
14. Programs using MySQL database connectivity in PHP

Expected Outcomes

The students will be able to

i. analyze and create web pages using HTML, Cascading Styles sheets.XML, Javascript, PHP and the workings of the web and web applications

ii. develop and deploy web applications in real world application scenarios.

REFERENCES

1. Paul J. Deitel, Harvey M. Deitel, Abbey Deitel, “Internet and World Wide Web How To Program”, 5/E, Pearson Education, 2012.
2. www.w3schools.com