Course code	Course Name	L-T-P Credits	Year of Introduction
CS201	DISCRETE COMPUTATIONAL STRUCTURES	3-1-0-4	2016

Pre-requisite: NIL

Course Objectives

1. To introduce mathematical notations and concepts in discrete mathematics that is essential for computing.
2. To train on mathematical reasoning and proof strategies.
3. To cultivate analytical thinking and creative problem solving skills.

Syllabus

Review of Set theory, Countable and uncountable Sets, Review of Permutations and combinations, Pigeon Hole Principle, Recurrence Relations and Solutions, Algebraic systems (semigroups, monoids, groups, rings, fields), Posets and Lattices, Prepositional and Predicate Calculus, Proof Techniques.

Expected Outcome:

Students will be able to

1. identify and apply operations on discrete structures such as sets, relations and functions in different areas of computing.
2. verify the validity of an argument using propositional and predicate logic.
3. construct proofs using direct proof, proof by contraposition, proof by contradiction and proof by cases, and by mathematical induction.
4. solve problems using algebraic structures.
5. solve problems using counting techniques and combinatorics.
6. apply recurrence relations to solve problems in different domains.

Text Books

1. Trembly J.P and Manohar R, "Discrete Mathematical Structures with Applications to Computer Science", Tata McGraw–Hill Pub.Co.Ltd, New Delhi, 2003.
2. Ralph. P. Grimaldi, "Discrete and Combinatorial Mathematics: An Applied Introduction", 4/e, Pearson Education Asia, Delhi, 2002.

References:

1. Liu C. L., "Elements of Discrete Mathematics", 2/e, McGraw–Hill Int. editions, 1988.
2. Bernard Kolman, Robert C. Busby, Sharan Cutler Ross, "Discrete Mathematical Structures", Pearson Education Pvt Ltd., New Delhi, 2003
3. Kenneth H.Rosen, "Discrete Mathematics and its Applications", 5/e, Tata McGraw – Hill Pub. Co. Ltd., New Delhi, 2003.
4. Richard Johnsonbaugh, "Discrete Mathematics", 5/e, Pearson Education Asia, New Delhi, 2002.
5. Joe L Mott, Abraham Kandel, Theodore P Baker, "Discrete Mathematics for Computer Scientists and Mathematicians", 2/e, Prentice-Hall India, 2009.

Course Plan			
Module	**Contents**	**Hours (54)**	**End Sem Exam Marks**
I	**Review of elementary set theory** : Algebra of sets – Ordered pairs and Cartesian products – Countable and Uncountable sets **Relations** :- Relations on sets –Types of relations and their properties – Relational matrix and the graph of a relation – Partitions – Equivalence relations - Partial ordering- Posets – Hasse diagrams - Meet and Join – Infimum and Supremum ***Functions** :-* *Injective, Surjective and Bijective functions - Inverse of a function- Composition*	3 6 1	15 %
II	Review of Permutations and combinations, Principle of inclusion exclusion, Pigeon Hole Principle, **Recurrence Relations**: Introduction- Linear recurrence relations with constant coefficients– Homogeneous solutions – Particular solutions – Total solutions **Algebraic systems**:- Semigroups and monoids - Homomorphism, Subsemigroups and submonoids	3 4 2	15 %
FIRST INTERNAL EXAM			
III	**Algebraic systems (contd…)**:- Groups, definition and elementary properties, subgroups, Homomorphism and Isomorphism, Generators - Cyclic Groups, Cosets and Lagrange's Theorem Algebraic systems with two binary operations- rings, fields-sub rings, ring homomorphism	6 2	15 %
IV	**Lattices and Boolean algebra** :- Lattices –Sublattices – Complete lattices – Bounded Lattices - Complemented Lattices – Distributive Lattices – Lattice Homomorphisms. Boolean algebra – sub algebra, direct product and homomorphisms	7 3	15 %
SECOND INTERNAL EXAM			
V	**Propositional Logic**:- Propositions – Logical connectives – Truth tables Tautologies and contradictions – Contra positive – Logical	2 3	20 %

	equivalences and implications Rules of inference: Validity of arguments.	 3	
VI	**Predicate Logic**:- Predicates – Variables – Free and bound variables – Universal and Existential Quantifiers – Universe of discourse. Logical equivalences and implications for quantified statements – Theory of inference : Validity of arguments. **Proof techniques:** Mathematical induction and its variants – Proof by Contradiction – Proof by Counter Example – Proof by Contra positive.	3 3 3	20 %
END SEMESTER EXAM			

Question Paper Pattern:

1. There will be *five* parts in the question paper – A, B, C, D, E
2. Part A
    a. Total marks : 12
    b. *Four* questions each having 3 marks, uniformly covering module I and II; All *four* questions have to be answered.
3. Part B
    a. Total marks : 18
    b. *Three* questions each having 9 marks, uniformly covering module I and II; T*wo* questions have to be answered. Each question can have a maximum of three subparts
4. Part C
    a. Total marks : 12
    b. *Four* questions each having 3 marks, uniformly covering module III and IV; All *four* questions have to be answered.
5. Part D
    a. Total marks : 18
    b. *Three* questions each having 9 marks, uniformly covering module III and IV; T*wo* questions have to be answered. Each question can have a maximum of three subparts
6. Part E
    a. Total Marks: 40
    b. *Six* questions each carrying 10 marks, uniformly covering modules V and VI; *four* questions have to be answered.
    c. A question can have a maximum of three sub-parts.

7. There should be at least 60% analytical/numerical questions.

Course code	Course Name	L-T-P -Credits	Year of Introduction
CS202	Computer Organization and Architecture	3-1-0-4	2016

Pre-requisite: CS203 Switching theory and logic design

Course Objectives

1. To impart an understanding of the internal organization and operations of a computer.
2. To introduce the concepts of processor logic design and control logic design.

Syllabus

Fundamental building blocks and functional units of a computer. Execution phases of an instruction. Arithmetic Algorithms. Design of the processing unit – how arithmetic and logic operations are performed. Design of the control unit – hardwired and microprogrammed control. I/O organisation – interrupts, DMA, different interface standards. Memory Subsystem – different types.

Expected outcome

Students will be able to:

1. identify the basic structure and functional units of a digital computer.
2. analyze the effect of addressing modes on the execution time of a program.
3. design processing unit using the concepts of ALU and control logic design.
4. identify the pros and cons of different types of control logic design in processors.
5. select appropriate interfacing standards for I/O devices.
6. identify the roles of various functional units of a computer in instruction execution.

Text Books:

1. Hamacher C., Z. Vranesic and S. Zaky, *Computer Organization* ,5/e, McGraw Hill, 2011.
2. Mano M. M., Digital Logic & Computer Design, 4/e, Pearson Education, 2013.

References:

1. Mano M. M., Digital Logic & Computer Design, 4/e, Pearson Education, 2013.
2. Patterson D.A. and J. L. Hennessey, Computer Organization and Design, 5/e, Morgan Kauffmann Publishers, 2013.
3. William Stallings, Computer Organization and Architecture: Designing for Performance, Pearson, 9/e, 2013.
4. Chaudhuri P., Computer Organization and Design, 2/e, Prentice Hall, 2008.
5. Rajaraman V. and T. Radhakrishnan, Computer Organization and Architecture, Prentice Hall, 2011.
6. Messmer H. P., The Indispensable PC Hardware Book, 4/e, Addison-Wesley, 2001

Course Plan

Module	Contents	Hours (51)	Sem.ExamMarks
I	**Basic Structure of computers**–functional units – basic operational concepts –bus structures – software. Memory locations and addresses – memory operations – instructions and instruction sequencing – addressing modes – ARM Example (programs not required). Basic I/O operations – stacks subroutine calls.	6	15%

II	**Basic processing unit** – fundamental concepts – instruction cycle - execution of a complete instruction –multiple- bus organization – sequencing of control signals. **Arithmetic algorithms: A**lgorithms for multiplication and division of binary and BCD numbers — array multiplier —Booth's multiplication algorithm — restoring and non-restoring division — algorithms for floating point, multiplication and division.	10	15%
FIRST INTERNAL EXAMINATION			
III	**I/O organization:** accessing of I/O devices – interrupts –direct memory access –buses –interface circuits –standard I/O interfaces (PCI, SCSI, USB)	8	15%
IV	**Memory system :** basic concepts –semiconductor RAMs –memory system considerations – semiconductor ROMs –flash memory –cache memory and mapping functions.	9	15%
SECOND INTERNAL EXAMINATION			
V	**Processor Logic Design:** Register transfer logic – inter register transfer – arithmetic, logic and shift micro operations –conditional control statements. **Processor organization:**–design of arithmetic unit, logic unit, arithmetic logic unit and shifter –status register –processor unit –design of accumulator.	9	20%
VI	**Control Logic Design:** Control organization – design of hardwired control –control of processor unit –PLA control. **Micro-programmed control:** Microinstructions –horizontal and vertical micro instructions – micro-program sequencer –micro programmed CPU organization.	9	20%
END SEMESTER EXAM			

Question Paper Pattern:

1. There will be *five* parts in the question paper – A, B, C, D, E
2. Part A
    a. Total marks : 12
    b. *Four* questions each having 3 marks, uniformly covering module I and II; All *four* questions have to be answered.
3. Part B
    a. Total marks : 18
    b. *Three* questions each having 9 marks, uniformly covering module I and II; T*wo* questions have to be answered. Each question can have a maximum of three subparts
4. Part C
    a. Total marks : 12
    b. *Four* questions each having 3 marks, uniformly covering module III and IV; All *four* questions have to be answered.
5. Part D
    a. Total marks : 18
    b. *Three* questions each having 9 marks, uniformly covering module III and IV; T*wo* questions have to be answered. Each question can have a maximum of three subparts
6. Part E
    a. Total Marks: 40
    b. *Six* questions each carrying 10 marks, uniformly covering modules V and VI; *four* questions have to be answered.
    c. A question can have a maximum of three sub-parts.
7. There should be at least 60% analytical/numerical/design questions..

Course No.	Course Name	L-T-P-Credits	Year of Introduction
CS203	Switching Theory and Logic Design	3-1-0-4	2016

Pre-requisite: Nil

Course Objectives

1. To impart an understanding of the basic concepts of Boolean algebra and digital systems.
2. To impart familiarity with the design and implementation of different types of practically used sequential circuits.
3. To provide an introduction to use Hardware Description Language

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, Arithmetic algorithms

Expected Outcome:

Students 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. [Chapters: 1, 2, 3, 4, 5, 6, 7].
2. Floyd T. L., *Digital Fundamentals*, 10/e, Pearson Education, 2009. [Chapters: 5, 6].
3. M. Morris Mano, *Computer System Architecture*, 3/e, Pearson Education, 2007. [Chapter 10.1, 10.2, 10.5, 10.6, 10.7].
4. Harris D. M. and, S. L. Harris, Digital *Design and Computer Architecture*, 2/e, Morgan Kaufmann Publishers, 2013 [Chapter 4.1, 4.2]

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.*

COURSE PLAN

Module	Contents	Contact Hours (52)	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 QuinMcClusky 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, de-multiplexer, parity generator.	**10**	**15%**
IV	Sequential logic circuits: latches and flip-flops – edge-triggering and level-triggering — RS, JK, D and T flip-flops — race condition — master-slave flip-flop. Clocked sequential circuits: state diagram — state reduction and assignment — design with state equations	**08**	**15%**
V	Registers: registers with parallel load - shift registers universal shift registers – application: serial adder. Counters: asynchronous counters — binary and BCD ripple counters — timing sequences — synchronous counters — up-down counter, BCD counter, Johnson counter — timing sequences and state diagrams.	**08**	**20%**

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.* Arithmetic algorithms: Algorithms for addition and subtraction of binary and BCD numbers, algorithms for floating point addition and subtraction.	**08**	**20%**

Question Paper Pattern:

1. There will be *five* parts in the question paper – A, B, C, D, E
2. Part A
   a. Total marks : 12
   b. *Four* questions each having *3* marks, uniformly covering module I and II; All *four* questions have to be answered.
3. Part B
   a. Total marks : 18
   b. *Three* questions each having *9* marks, uniformly covering module I and II; T*wo* questions have to be answered. Each question can have a maximum of three subparts
4. Part C
   a. Total marks : 12
   b. *Four* questions each having *3* marks, uniformly covering module III and IV; All *four* questions have to be answered.
5. Part D
   a. Total marks : 18
   b. *Three* questions each having *9* marks, uniformly covering module III and IV; T*wo* questions have to be answered. Each question can have a maximum of three subparts
6. Part E
   a. Total Marks: 40
   b. *Six* questions each carrying 10 marks, uniformly covering modules V and VI; *four* questions have to be answered.
   c. A question can have a maximum of three sub-parts.
7. There should be at least 60% analytical/design/numerical questions.

Course code	Course Name	L-T-P -Credits	Year of Introduction
CS204	Operating Systems	3-1-0-4	2016

Pre-requisite: CS205 Data structures

Course Objectives

1. To impart fundamental understanding of the purpose, structure, functions of operating system.
2. To impart the key design issues of an operating system

Syllabus

Basic concepts of Operating System, its structure, Process management, inter-process communication, process synchronization, CPU Scheduling, deadlocks, Memory Management, swapping, segmentation, paging, Storage Management - disk scheduling, RAID, File System Interface-implementation. Protection.

Expected outcome

Students will be able to:

1. identify the significance of operating system in computing devices.
2. exemplify the communication between application programs and hardware devices through system calls.
3. compare and illustrate various process scheduling algorithms.
4. apply appropriate memory and file management schemes.
5. illustrate various disk scheduling algorithms.
6. appreciate the need of access control and protection in an operating system.

Text Book:

1. Abraham Silberschatz, Peter B Galvin, Greg Gagne, Operating System Concepts, 9/e, Wiley India, 2015.

References:

1. Garry Nutt, Operating Systems: 3/e, Pearson Education, 2004
2. Bhatt P. C. P., An Introduction to Operating Systems: Concepts and Practice, 3/e, Prentice Hall of India, 2010.
3. William Stallings, Operating Systems: Internals and Design Principles, Pearson, Global Edition, 2015.
4. Andrew S Tanenbaum, Herbert Bos, Modern Operating Systems, Pearson, 4/e, 2015.
5. Madnick S. and J. Donovan, Operating Systems, McGraw Hill, 2001.
6. Hanson P. B., Operating System Principle, Prentice Hall of India, 2001.
7. Deitel H. M., An Introduction to Operating System Principles, Addison-Wesley, 1990.

Course Plan

Module	Contents	Hours (52)	Sem. Exam marks

I	**Introduction**: Functions of an operating system. Single processor, multiprocessor and clustered systems – overview. Kernel Data Structures – Operating Systems used in different computing environments. **Operating System Interfaces and implementation -** User Interfaces, System Calls – examples. Operating System implementation - approaches. Operating System Structure – Monolithic, Layered, Micro-kernel, Modular. System Boot process.	7	15%
II	**Process Management**: Process Concept – Processes-States – Process Control Block – Threads. Scheduling – Queues – Schedulers – Context Switching. Process Creation and Termination. **Inter Process Communication**: Shared Memory, Message Passing, Pipes.	9	15%
FIRST INTERNAL EXAMINATION			
III	**Process Synchronization**: Critical Section-Peterson's solution. Synchronization – Locks, Semaphores, Monitors, Classical Problems – Producer Consumer, Dining Philosophers and Readers-Writers Problems	9	15%
IV	**CPU Scheduling** – Scheduling Criteria – Scheduling Algorithms. **Deadlocks** – Conditions, Modeling using graphs. Handling – Prevention – Avoidance – Detection-Recovery.	8	15%
SECOND INTERNAL EXAMINATION			
V	**Memory Management**: Main Memory – Swapping – Contiguous Memory allocation – Segmentation – Paging – Demand paging	9	20%
VI	**Storage Management:** *Overview of mass storage structure- disks and tapes. Disk structure – accessing disks.* Disk scheduling and management. Swap Space. **File System Interface**: File Concepts – Attributes – operations – types – structure – access methods. File system mounting. Protection. File system implementation. Directory implementation – allocation methods. Free space Management. **Protection**– Goals, Principles, Domain. Access Matrix.	10	20%
END SEMESTER EXAM			

Question Paper Pattern:

1. There will be *five* parts in the question paper – A, B, C, D, E
2. Part A
    a. Total marks : 12
    b. *Four* questions each having *3* marks, uniformly covering module I and II; All *four* questions have to be answered.
3. Part B
    a. Total marks : 18
    b. *Three* questions each having *9* marks, uniformly covering module I and II; T*wo* questions have to be answered. Each question can have a maximum of three subparts
4. Part C
    a. Total marks : 12
    b. *Four* questions each having *3* marks, uniformly covering module III and IV; All *four* questions have to be answered.
5. Part D
    a. Total marks : 18
    b. *Three* questions each having *9* marks, uniformly covering module III and IV; T*wo* questions have to be answered. Each question can have a maximum of three subparts
6. Part E
    a. Total Marks: 40
    b. *Six* questions each carrying 10 marks, uniformly covering modules V and VI; *four* questions have to be answered.
    c. A question can have a maximum of three sub-parts.
7. There should be at least 60% analytical/numerical/design questions.

Course code	Course Name	L-T-P-Credits	Year of Introduction
CS205	Data Structures	3-1-0-4	2016

Pre-requisite: B101-05 Introduction to Computing and Problem Solving

Course Objectives

1. To impart a thorough understanding of linear data structures such as stacks, queues and their applications.
2. To impart a thorough understanding of non-linear data structures such as trees, graphs and their applications.
3. To impart familiarity with various sorting, searching and hashing techniques and their performance comparison.
4. To impart a basic understanding of memory management.

Syllabus

Introduction to various programming methodologies, terminologies and basics of algorithms analysis, Basic Abstract and Concrete Linear Data Structures, Non-linear Data Structures, Memory Management, Sorting Algorithms, Searching Algorithms, Hashing.

Expected Outcome:

Students will be able to

1. compare different programming methodologies and define asymptotic notations to analyze performance of algorithms.
2. use appropriate data structures like arrays, linked list, stacks and queues to solve real world problems efficiently.
3. represent and manipulate data using nonlinear data structures like trees and graphs to design algorithms for various applications.
4. illustrate and compare various techniques for searching and sorting.
5. appreciate different memory management techniques and their significance.
6. illustrate various hashing techniques.

Text Books:

1. Samanta D., Classic Data Structures, Prentice Hall India, 2/e, 2009.
2. Richard F. Gilberg, Behrouz A. Forouzan, Data Structures: A Pseudocode Approach with C, 2/e, Cengage Learning, 2005.

References

1. Horwitz E., S. Sahni and S. Anderson, Fundamentals of Data Structures in C, University Press (India), 2008.
2. Aho A. V., J. E. Hopcroft and J. D. Ullman, Data Structures and Algorithms, Pearson Publication,1983.
3. Tremblay J. P. and P. G. Sorenson, Introduction to Data Structures with Applications, Tata McGraw Hill, 1995.
4. Peter Brass, Advanced Data Structures, Cambridge University Press, 2008
5. Lipschuts S., Theory and Problems of Data Structures, Schaum's Series, 1986.
6. Wirth N., Algorithms + Data Structures = Programs, Prentice Hall, 2004.
7. Hugges J. K. and J. I. Michtm, A Structured Approach to Programming, PHI, 1987.
8. Martin Barrett, Clifford Wagner, And Unix: Tools For Software Design, John Wiley, 2008 reprint.

COURSE PLAN			
Module	**Contents**	**Hours (56)**	**Sem. Exam Marks**
I	Introduction to programming methodologies – structured approach, stepwise refinement techniques, programming style, documentation – analysis of algorithms: frequency count, definition of Big O notation, asymptotic analysis of simple algorithms. Recursive and iterative algorithms.	**9**	**15%**
II	Abstract and Concrete Data Structures- Basic data structures – vectors and arrays. Applications, Linked lists:- singly linked list, doubly linked list, Circular linked list, operations on linked list, linked list with header nodes, applications of linked list: polynomials,.	**9**	**15%**
III	Applications of linked list (continued): Memory management, memory allocation and de-allocation. First-fit, best-fit and worst-fit allocation schemes Implementation of Stacks and Queues using arrays and linked list, DEQUEUE (double ended queue). Multiple Stacks and Queues, Applications.	**9**	**15%**
IV	String: - representation of strings, concatenation, substring searching and deletion. Trees: - m-ary Tree, Binary Trees – level and height of the tree, complete-binary tree representation using array, tree traversals (Recursive and non-recursive), applications. Binary search tree – creation, insertion and deletion and search operations, applications.	**10**	**15%**
V	Graphs – representation of graphs, BFS and DFS (analysis not required) applications. Sorting techniques – *Bubble sort, Selection Sort,* Insertion sort, Merge sort, Quick sort, Heaps and Heap sort. Searching algorithms (Performance comparison expected. Detailed analysis not required)	**09**	**20%**
VI	Linear and Binary search. (Performance comparison expected. Detailed analysis not required) Hash Tables – Hashing functions – Mid square, division, folding, digit analysis, collusion resolution and Overflow handling techniques.	**10**	**20%**

Question Paper Pattern:

1. There will be *five* parts in the question paper – A, B, C, D, E
2. Part A
    a. Total marks : 12
    b. *Four* questions each having *3* marks, uniformly covering module I and II; All *four* questions have to be answered.
3. Part B
    a. Total marks : 18
    b. *Three* questions each having *9* marks, uniformly covering module I and II; T*wo* questions have to be answered. Each question can have a maximum of three subparts
4. Part C
    a. Total marks : 12
    b. *Four* questions each having *3* marks, uniformly covering module III and IV; All *four* questions have to be answered.
5. Part D
    a. Total marks : 18
    b. *Three* questions each having *9* marks, uniformly covering module III and IV; T*wo* questions have to be answered. Each question can have a maximum of three subparts
6. Part E
    a. Total Marks: 40
    b. *Six* questions each carrying 10 marks, uniformly covering modules V and VI; *four* questions have to be answered.
    c. A question can have a maximum of three sub-parts.
7. There should be at least 60% analytical/numerical/design questions.

Course code	Course Name	L-T-P - Credits	Year of Introduction
CS206	Object Oriented Design and Programming	2-1-0-3	2016

Pre-requisite: CS205 Data structures

Course Objectives

1. To introduce basic concepts of object oriented design techniques.
2. To give a thorough understanding of Java language.
3. To provide basic exposure to the basics of multithreading, database connectivity etc.
4. To impart the techniques of creating GUI based applications.

Syllabus

Object oriented concepts, Object oriented systems development life cycle, Unified Modeling Language, Java Overview, Classes and objects, Parameter passing, Overloading, Inheritance, Overriding, Packages, Exception Handling, Input/Output, Threads and multithreading, Applets, Event Handling mechanism, Working with frames and graphics, AWT Controls, Swings, Java database connectivity.

Expected outcome.

Students will be able to:

1. apply object oriented principles in software design process.
2. develop Java programs for real applications using java constructs and libraries.
3. understand and apply various object oriented features like inheritance, data abstraction, encapsulation and polymorphism to solve various computing problems using
   Java language.
4. implement Exception Handling in java.
5. use graphical user interface and Event Handling in java.
6. develop and deploy Applet in java.

Text Books:

1. Herbert Schildt, Java: The Complete Reference, 8/e, Tata McGraw Hill, 2011.
2. Bahrami A., Object Oriented Systems Development using the Unified Modeling Language, McGraw Hill, 1999.

References:

1. Y. Daniel Liang, Introduction to Java Programming, 7/e, Pearson, 2013.
2. Nageswararao R., Core Java: An Integrated Approach, Dreamtech Press, 2008.
3. Flanagan D., Java in A Nutshell, 5/e, O'Reilly, 2005.
4. Barclay K., J. Savage, Object Oriented Design with UML and Java, Elsevier, 2004.
5. Sierra K., Head First Java, 2/e, O'Reilly, 2005.
6. Balagurusamy E., Programming JAVA a Primer, 5/e, McGraw Hill, 2014.
7.

Course Plan

Module	Contents	Hours (42)	Sem. ExamMarks
I	Object oriented concepts, Object oriented systems development life cycle. Unified Modeling Language, UML class diagram, Use-case diagram. Java Overview: Java virtual machine, *data types, operators, control statements,* Introduction to Java programming.	08	15%

II	Classes fundamentals, objects, methods, constructors, parameter passing, overloading, access control keywords.	07	15%
FIRST INTERNAL EXAMINATION			
III	Inheritance basics, method overriding, abstract classes, interface. Defining and importing packages. Exception handling fundamentals, multiple catch and nested try statements.	06	15%
IV	Input/Output: files, stream classes, reading console input. Threads: thread model, use of Thread class and Runnable interface, thread synchronization, multithreading.	06	15%
SECOND INTERNAL EXAMINATION			
V	String class - basics. Applet basics and methods. Event Handling: delegation event model, event classes, sources, listeners.	07	20%
VI	Introduction to AWT: working with frames, graphics, color, font. AWT Control fundamentals. Swing overview. Java database connectivity: JDBC overview, creating and executing queries, dynamic queries.	08	20%
END SEMESTER EXAM			

Question Paper Pattern:

1. There will be *five* parts in the question paper – A, B, C, D, E
2. Part A
    a. Total marks : 12
    b. *Four* questions each having 3 marks, uniformly covering module I and II; All *four* questions have to be answered.
3. Part B
    a. Total marks : 18
    b. *Three* questions each having 9 marks, uniformly covering module I and II; T*wo* questions have to be answered. Each question can have a maximum of three subparts
4. Part C
    a. Total marks : 12
    b. *Four* questions each having 3 marks, uniformly covering module III and IV; All *four* questions have to be answered.
5. Part D
    a. Total marks : 18
    b. *Three* questions each having 9 marks, uniformly covering module III and IV; T*wo* questions have to be answered. Each question can have a maximum of three subparts

6. Part E
    a. Total Marks: 40
    b. *Six* questions each carrying 10 marks, uniformly covering modules V and VI; *four* questions have to be answered.
    c. A question can have a maximum of three sub-parts.

7. There should be at least 60% analytical/design questions.

Course code	Course Name	L-T-P -Credits	Year of Introduction
CS207	ELECTRONIC DEVICES & CIRCUITS	3-0-0-3	2016

Pre-requisite: BE101-04 Introduction to Electronics Engg**.**

Course Objectives:

1. To introduce to the students the fundamental concepts of electronic devices and circuits for engineering applications
2. To develop the skill of analysis and design of various analog circuits using electronic devices
3. To provide comprehensive idea about working principle, operation and applications of electronic circuits
4. To equip the students with a sound understanding of fundamental concepts of operational amplifiers
5. To expose to the diversity of operations that operational amplifiers can perform in a wide range of applications
6. To expose to a variety of electronic circuits/systems using various analog ICs

Syllabus

RC Circuits, Diode Circuits, Regulated power supplies, **Field effect transistor,** DC analysis of BJT, RC Coupled amplifier, MOSFET amplifiers, Feedback amplifiers, Power amplifiers, Oscillators, Multivibrators, Operational Amplifier and its applications, Timer IC.

Expected Outcome:

Students will be able to

1. explain, illustrate, and design the different electronic circuits using electronic components
2. design circuits using operational amplifiers for various applications

Text Books:

1. David A Bell, Electronic Devices and Circuits, Oxford University Press, 2008
2. Salivahanan S. and V. S. K. Bhaaskaran, Linear Integrated Circuits, Tata McGraw Hill, 2008

References :

1. Neamen D., Electronic Circuits, Analysis and Design, 3/e, TMH, 2007
2. Robert Boylestad and L Nashelsky, Electronic Devices and Circuit Theory, Pearson.
3. Bogart T. F., Electronic Devices Circuits, 6/e, Pearson, 2012.
4. Maini A. K. and V. Agrawal, Electronic Devices and Circuits, Wiley India, 2011.
5. K.Gopakumar, Design and Analysis of Electronic Circuits, Phasor Books, Kollam, 2013
6. Millman J. and C. Halkias, Integrated Electronics, 2/e, McGraw-Hill, 2010.

Course Plan

Module	Contents	Hours (40)	Sem Exam Marks
1	**Wave shaping circuits:** Sinusoidal and non-sinusoidal wave shapes, Principle and working of RC differentiating and integrating circuits, Conversion of one non-sinusoidal wave shape into another. Clipping circuits - Positive, negative and biased clipper.	5	15%

	Clamping circuits - Positive, negative and biased clamper. Voltage multipliers- Voltage doubler and tripler. Simple sweep circuit using transistor as a switch.		
2	**Regulated power supplies:** Review of simple zener voltage regulator, Shunt and series voltage regulator using transistors, Current limiting and fold back protection, 3 pin regulators-78XX and 79XX, IC 723 and its use as low and high voltage regulators, DC to DC conversion, Circuit/block diagram and working of SMPS.	4	15 %
	Field effect transistors: JFET – Structure, principle of operation and characteristics, Comparison with BJT. MOSFET- Structure, Enhancement and Depletion types, principle of operation and characteristics.	3	
	FIRST INTERNAL EXAM		
3	**Amplifiers:** Introduction to transistor biasing, operating point, concept of load line, thermal stability, fixed bias, self bias, voltage divider bias. Classification of amplifiers, RC coupled amplifier - voltage gain and frequency response. Multistage amplifiers - effect of cascading on gain and bandwidth. Feedback in amplifiers - Effect of negative feedback on amplifiers. MOSFET Amplifier- Circuit diagram and working of common source MOSFET amplifier.	7	15 %
4	**Oscillators:** Classification, criterion for oscillation, analysis of Wien bridge oscillator, Hartley and Crystal oscillator. Non-sinusoidal oscillators: Astable, monostable and bi-stable multivibrators using transistors (Only design equations and working of circuit are required, Analysis not required).	5	15 %
	SECOND INTERNAL EXAM		
5	**Operational amplifiers:** Differential amplifier, characteristics of op-amps(gain, bandwidth, slew rate, CMRR, offset voltage, offset current), comparison of ideal and practical op-amp(IC741), applications of op-amps- scale changer, sign changer, adder/summing amplifier, subtractor, integrator, differentiator, Schmitt trigger, Wien bridge oscillator.	8	20 %

6	**Integrated circuits:** Active filters – Low pass and high pass (first and second order) active filters using op-amp with gain (No analysis required). D/A and A/D convertors – important specifications, Sample and hold circuit. Binary weighted resistor and R-2R ladder type D/A convertors. (concepts only). Flash, dual slope and successive approximation type A/D convertors. Circuit diagram and working of Timer IC555, astable and monostablemultivibrators using 555.	8	20 %
END SEMESTER EXAM			

Question Paper Pattern:

1. There will be *five* parts in the question paper – A, B, C, D, E
2. Part A
   a. Total marks : 12
   b. *Four* questions each having 3 marks, uniformly covering module I and II; All *four* questions have to be answered.
3. Part B
   a. Total marks : 18
   b. *Three* questions each having 9 marks, uniformly covering module I and II; T*wo* questions have to be answered. Each question can have a maximum of three subparts
4. Part C
   a. Total marks : 12
   b. *Four* questions each having 3 marks, uniformly covering module III and IV; All *four* questions have to be answered.
5. Part D
   a. Total marks : 18
   b. *Three* questions each having 9 marks, uniformly covering module III and IV; T*wo* questions have to be answered. Each question can have a maximum of three subparts
6. Part E
   a. Total Marks: 40
   b. *Six* questions each carrying 10 marks, uniformly covering modules V and VI; *four* questions have to be answered.
   c. A question can have a maximum of three sub-parts.
7. There should be at least 60% analytical/numerical/design questions.

Course code	Course Name	L-T-P - Credits	Year of Introduction
CS208	Principles of Database Design	2-1-0-3	2016

Pre-requisite: CS205 Data structures

Course Objectives

- To impart the basic understanding of the theory and applications of database management systems.
- To give basic level understanding of internals of database systems.
- To expose to some of the recent trends in databases.

Syllabus:

Types of data, database and DBMS, Languages and users. Software Architecture, E-R and Extended E-R Modelling, Relational Model – concepts and languages, relational algebra and tuple relational calculus, SQL, views, assertions and triggers, relational db design, FDs and normal forms, Secondary storage organization, indexing and hashing, query optimization, concurrent transaction processing and recovery principles, recent topics.

Expected outcome.

Students will be able to:

1. define, explain and illustrate the fundamental concepts of databases.
2. construct an Entity-Relationship (E-R) model from specifications and to perform the transformation of the conceptual model into corresponding logical data structures.
3. model and design a relational database following the design principles.
4. develop queries for relational database in the context of practical applications
5. define, explain and illustrate fundamental principles of data organization, query optimization and concurrent transaction processing.
6. appreciate the latest trends in databases.

Text Books:

1. Elmasri R. and S. Navathe, *Database Systems: Models, Languages, Design andApplication Programming*, Pearson Education, 2013.
2. Sliberschatz A., H. F. Korth and S. Sudarshan, *Database System Concepts*, 6/e, McGraw Hill, 2011.

References:

1. Powers S., *Practical RDF*, O'Reilly Media, 2003.
2. Plunkett T., B. Macdonald, *et al.*, *Oracle Big Data Hand Book*, Oracle Press, 2013.

Course Plan

Module	Contents	Hours (42)	Sem. Exam Marks
I	**Introduction:** Data: structured, semi-structured and unstructured data**,** Concept & Overview of DBMS, Data Models, Database Languages, Database Administrator, Database Users, Three Schema architecture of DBMS. Database architectures and classification. (Reading: Elmasri Navathe, Ch. 1 and 2. Additional Reading: Silbershatz, Korth, Ch. 1) **Entity-Relationship Model:** Basic concepts, Design Issues, Mapping Constraints, Keys, Entity-	06	15%

	Relationship Diagram, Weak Entity Sets, Relationships of degree greater than 2 (Reading: Elmasri Navathe, Ch. 7.1-7.8)		
II	**Relational Model:** Structure of relational Databases, Integrity Constraints, synthesizing ER diagram to relational schema (Reading: Elmasri Navathe, Ch. 3 and 8.1, Additional Reading: Silbershatz, Korth, Ch. 2.1-2.4) **Database Languages:** Concept of DDL and DML relational algebra (Reading: Silbershatz, Korth, Ch 2.5-2.6 and 6.1-6.2, Elmasri Navathe, Ch. 6.1-6.5)	**06**	**15%**
FIRST INTERNAL EXAM			
III	**Structured Query Language (SQL**): Basic SQL Structure, examples, Set operations, Aggregate Functions, nested sub-queries (Reading: Elmasri Navathe, Ch. 4 and 5.1) **Views, assertions and triggers** (Reading: Elmasri Navathe, Ch. 5.2-5.3, Optional reading: Silbershatz, Korth Ch. 5.3).	**07**	**15%**
IV	**Relational Database Design:** Different anomalies in designing a database, normalization, functional dependency (FD), Armstrong's Axioms, closures, Equivalence of FDs, minimal Cover (proofs not required). Normalization using functional dependencies, INF, 2NF, 3NF and BCNF, lossless and dependency preserving decompositions (Reading: Elmasri and Navathe, Ch. 14.1-14.5, 15.1-15.2. Additional Reading: Silbershatz, Korth Ch. 8.1-8.5)	**07**	**15%**
SECOND INTERNAL EXAM			
V	**Physical Data Organization**: index structures, primary, secondary and clustering indices, Single level and Multi-level indexing, B+-Trees (basic structure only, algorithms not needed), (Reading Elmasri and Navathe, Ch. 17.1-17.4) **Query Optimization**: heuristics-based query optimization, (Reading Elmasri and Navathe, Ch. 18.1, 18.7)	**07**	**20%**
VI	**Transaction Processing Concepts:** overview of concurrency control and recovery acid properties, serial and concurrent schedules, conflict serializability. Two-phase locking, failure classification, storage structure, stable storage, log based recovery, deferred database modification, check-pointing, (Reading Elmasri and Navathe, Ch. 20.1-20.5 (except 20.5.4-20.5.5) , Silbershatz, Korth Ch. 15.1 (except 15.1.4-15.1.5), Ch. 16.1 – 16.5) R**ecent topics (preliminary ideas only):** Semantic Web and RDF(Reading: Powers Ch.1, 2), GIS, biological databases (Reading: Elmasri and Navathe Ch. 23.3-23.4) Big Data (Reading: Plunkett and Macdonald, Ch. 1, 2)	**09**	**20%**
END SEMESTER EXAM			

Question Paper Pattern:

1. There will be *five* parts in the question paper – A, B, C, D, E
2. Part A
    a. Total marks : 12
    b. *Four* questions each having 3 marks, uniformly covering module I and II; All *four* questions have to be answered.
3. Part B
    a. Total marks : 18
    b. *Three* questions each having 9 marks, uniformly covering module I and II; T*wo* questions have to be answered. Each question can have a maximum of three subparts
4. Part C
    a. Total marks : 12
    b. *Four* questions each having 3 marks, uniformly covering module III and IV; All *four* questions have to be answered.
5. Part D
    a. Total marks : 18
    b. *Three* questions each having 9 marks, uniformly covering module III and IV; T*wo* questions have to be answered. Each question can have a maximum of three subparts
6. Part E
    a. Total Marks: 40
    b. *Six* questions each carrying 10 marks, uniformly covering modules V and VI; *four* questions have to be answered.
    c. A question can have a maximum of three sub-parts.
7. There should be at least 60% analytical/numerical/design questions.

Course No.	Course Name	L-T-P - Credits	Year of Introduction
CS231	DATA STRUCTURES LAB	0-0-3-1	2016

Pre-requisite: CS205 Data structures

Course Objectives

1. To implement basic linear and non-linear data structures and their major operations.
2. To implement applications using these data structures.
3. To implement algorithms for various sorting techniques.

List of Exercises/Experiments : (Minimum 12 are to be done)

1. Implementation of Stack and Multiple stacks using one dimensional array. **
2. Application problems using stacks: Infix to post fix conversion, postfix and pre-fix evaluation, MAZE problem etc. **
3. Implementation of Queue, DEQUEUE and Circular queue using arrays.
4. Implementation of various linked list operations. **
5. Implementation of stack, queue and their applications using linked list.
6. Implementation of trees using linked list
7. Representation of polynomials using linked list, addition and multiplication of polynomials. **
8. Implementation of binary trees using linked lists and arrays- creations, insertion, deletion and traversal. **
9. Implementation of binary search trees – creation, insertion, deletion, search
10. Application using trees
11. Implementation of sorting algorithms – bubble, insertion, selection, quick (recursive and non-recursive), merge sort (recursive and non-recursive), and heap sort.**
12. Implementation of searching algorithms – linear search, binary search.**
13. Representation of graphs and computing various parameters (in degree, out degree etc.) - adjacency list, adjacency matrix.
14. Implementation of BFS, DFS for each representation.
15. Implementation of hash table using various mapping functions, various collision and overflow resolving schemes.**
16. Implementation of various string operations.

17. Simulation of first-fit, best-fit and worst-fit allocations.

18. Simulation of a basic memory allocator and garbage collector using doubly linked list.

** *mandatory.*

Expected Outcome:

Students will be able to:

1. appreciate the importance of structure and abstract data type, and their basic usability in different applications
2. analyze and differentiate different algorithms based on their time complexity.
3. implement linear and non-linear data structures using linked lists.
4. understand and apply various data structure such as stacks, queues, trees, graphs, etc. to solve various computing problems.
5. implement various kinds of searching and sorting techniques, and decide when to choose which technique.
6. identify and use a suitable data structure and algorithm to solve a real world problem.

Course code	Course Name	L-T-P-Credits	Year of Introduction
CS232	Free and Open Source Software Lab	0-0-3-1	2016

Pre-requisite: CS204 Operating systems

Course Objectives: To expose students to FOSS environment and introduce them to use open source packages in open source platform.

List of Exercises/Experiments:

1. Getting started with Linux basic commands for directory operations, displaying directory structure in tree format etc.
2. Linux commands for operations such as redirection, pipes, filters, job control, changing ownership/permissions of files/links/directory.
3. Advanced linux commands curl, wget, ftp, ssh and grep
4. Shell Programming : Write shell script to show various system configuration like
   - Currently logged user and his login name
   - Your current shell
   - Your home directory
   - Your operating system type
   - Your current path setting
   - Your current working directory
   - Number of users currently logged in
5. Write shell script to show various system configurations like
   - your OS and version, release number, kernel version
   - all available shells
   - computer CPU information like processor type, speed etc
   - memory information
   - hard disk information like size of hard-disk, cache memory, model etc
   - File system (Mounted)
6. Write a shell script to implement a menu driven calculator with following functions
   1. Addition
   2. Subtraction
   3. Multiplication
   4. Division
   5. Modulus
7. Write a script called addnames that is to be called as follows
   ./addnames ulist username

   Here *ulist* is the name of the file that contains list of user names and *username* is a particular student's username. The script should
   - check that the correct number of arguments was received and print a message, in case the number of arguments is incorrect
   - check whether the ulist file exists and print an error message if it does not
   - check whether the username already exists in the file. If the username exists, print a message stating that the name already exists. Otherwise, add the username to the end of the list.

8. Version Control System setup and usage using GIT. Try the following features.
   - Creating a repository
   - Checking out a repository
   - Adding content to the repository
   - Committing the data to a repository
   - Updating the local copy
   - Comparing different revisions
   - Revert
   - Conflicts and a conflict Resolution

9. Shell script which starts on system boot up and kills every process which uses more than a specified amount of memory or CPU.

10. Introduction to packet management system : Given a set of RPM or DEB, build and maintain, and serve packages over http or ftp. Configure client systems to access the package repository.

11. Perform simple text processing using Perl, Awk.

12. Running PHP : simple applications like login forms after setting up a LAMP stack

13. Virtualisation environment (e.g., xen, kqemu, virtualbox or lguest) to test applications, new kernels and isolate applications. It could also be used to expose students to other alternate OS such as freeBSD

14. Compiling from source : learn about the various build systems used like the auto* family, cmake, ant etc. instead of just running the commands. This could involve the full process like fetching from a cvs and also include autoconf, automake etc.,

15. Kernel configuration, compilation and installation : Download / access the latest kernel source code from *kernel.org*, compile the kernel and install it in the local system. Try to view the source code of the kernel

16. GUI Programming: Create scientific calculator – using any one of Gambas, GTK, QT

17. Installing various software packages. Either the package is yet to be installed or an older version is present. The student can practice installing the latest version. (Internet access is needed).
   - Install samba and share files to windows
   - Install Common Unix Printing System(CUPS)

18. Set up the complete network interface by configuring services such as gateway, DNS, IP tables etc. using *ifconfig*

Expected outcome:

The students will be able to:

1. Identify and apply various Linux commands
2. Develop shell scripts and GUI for specific needs
3. Use tools like GIT
4. Perform basic level application deployment, kernel configuration and installation, packet management and installation etc.

Course No.	Course Name	L-T-P - Credits	Year of Introduction
CS233	ELECTRONICS CIRCUITS LAB	0-0-3-1	2016

Pre-requisite: CS207 Electronic devices & circuits

Course Objectives:

1. To introduce the working of analog electronic circuits.
2. To design, implement and demonstrate analog circuits using electronic components.
3. To provide hands-on experience to the students so that they are able to put theoretical concepts to practice.
4. To use computer simulation tools such as PSPICE, or Multisim to the simulation of electronic circuits.
5. To create an ability to develop descriptions, explanations, predictions and models using evidence .
6. To create an ability to communicate effectively the scientific procedures and explanations about the experiments in oral/report forms.

List of Exercises/Experiments :

(Minimum 13 experiments are to be done in the semester, at least 6 each should be selected from the first(Exp. 1-10) and second(Exp. 11-20) half. Experiment no. 18 is compulsory).

1. Forward and reverse characteristics of PN diode and Zener diode
2. Input and output characteristics of BJT in CE configuration and evaluation of parameters
3. RC integrating and differentiating circuits-Transient response with different time constant
4. RC low pass and high pass circuits- Frequency response with sinusoidal input
5. Clipping circuits (Positive, negative and biased) - Transient and transfer characteristics
6. Clamping circuits (Positive, negative and biased)- Transient characteristics
7. Bridge Rectifier - with and without filter- ripple factor and regulation
8. Simple Zener regulator- Line and load characteristics
9. RC coupled CE amplifier – Mid band gain and frequency response
10. RC phase shift or Wien bridge oscillator using transistor
11. Astable and Monostable multivibrators using transistors
12. Series voltage regulator (Two transistors)- Line and load characteristics
13. Voltage regulator using LM 723)- Line and load characteristics
14. Astable and mono stable multivibrators using 555 Timer
15. Inverting and non-inverting amplifier using op-amp IC741
16. Instrumentation amplifier using op-amp IC741
17. RC phase shift or Wien bridge oscillator using op-amp IC741
18. Simulation of simple circuits (at least 6 from above) using any SPICE software(Transient, AC and DC analysis)

Expected Outcome:

Students will be able to:

1. identify basic electronic components, design and develop electronic circuits.
2. Design and demonstrate functioning of various discrete analog circuits
3. Be familiar with computer simulation of electronic circuits and how to use it proficiently for design and development of electronic circuits.
4. Understand the concepts and their applications in engineering.
5. Communicate effectively the scientific procedures and explanations in formal technical presentations/reports.

Course code	Course Name	L-T-P - Credits	Year of Introduction
CS234	DIGITAL SYSTEMS LAB	0-0-3-1	2016

Pre-requisite: CS203 Switching theory and logic design

Course Objectives:

1. To familiarize students with digital ICs, the building blocks of digital circuits
2. To provide students the opportunity to set up different types of digital circuits and study their behaviour

List of Exercises/Experiments : (minimum 12 exercises/experiments are mandatory)

1. Familiarizations and verification of the truth tables of basic gates and universal gates.
2. Verification of Demorgan's laws for two variables.
3. Implementation of half adder and full adder circuits using logic gates.
4. Implementation of half subtractor and full subtractor circuits using logic gates.
5. Implementation of parallel adder circuit.
6. Realization of 4 bit adder/subtractor and BCD adder circuits using IC 7483.
7. Implementation of a 2 bit magnitude comparator circuit using logic gates.
8. Design and implementation of code convertor circuits
9. a) BCD to excess 3 code b) binary to gray code
10. Implementation of multiplexer and demultiplexer circuits using logic gates. Familiarization with various multiplexer and demultiplexer ICs.
11. Realization of combinational circuits using multiplexer/demultiplexer ICs.
12. Implementation of SR, D, JK, JK master slave and T flip flops using logic gates. Familiarization with IC 7474 and IC 7476.
13. Implementation of shift registers using flip flop Integrated Circuits.
14. Implementation of ring counter and Johnson counter using flip flop Integrated Circuits.
15. Realization of asynchronous counters using flip flop ICs.
16. Realization of synchronous counters using flip flop ICs. Familiarization with various counter Integrated Circuits.
17. Implementation of a BCD to 7 segment decoder and display.
18. Simulation of Half adder, Full adder using VHDL.

(Note: The experiments may be done using hardware components and/or VHDL)

Course outcome:

Students will be able to:

1. identify and explain the digital ICs and their use in implementing digital circuits.
2. design and implement different kinds of digital circuits.

Course code	Course Name	L-T-P Credits	Year of Introduction
CS301	THEORY OF COMPUTATION	3-1-0-4	2016

Prerequisite: Nil

Course Objectives

- To introduce the concept of formal languages.
- To discuss the Chomsky classification of formal languages with discussion on grammar and automata for regular, context-free, context sensitive and unrestricted languages.
- To discuss the notions of decidability and halting problem.

Syllabus

Introduction to Automata Theory, Structure of an automaton, classification of automata, grammar and automata for generating each class of formal languages in the Chomsky Hierarchy, decidability and Halting problem.

Expected Outcome

The Students will be able to

i. Classify formal languages into regular, context-free, context sensitive and unrestricted languages.
ii. Design finite state automata, regular grammar, regular expression and Myhill- Nerode relation representations for regular languages.
iii. Design push-down automata and context-free grammar representations for context-free languages.
iv. Design Turing Machines for accepting recursively enumerable languages.
v. Understand the notions of decidability and undecidability of problems, Halting problem.

Text Books

1. John E Hopcroft, Rajeev Motwani and Jeffrey D Ullman, Introduction to Automata Theory, Languages, and Computation, 3/e, Pearson Education, 2007
2. John C Martin, Introduction to Languages and the Theory of Computation, TMH, 2007
3. Michael Sipser, Introduction To Theory of Computation, Cengage Publishers, 2013

References

1. Dexter C. Kozen, Automata and Computability, Springer1999.

Course Plan

Module	Contents	Hours	End Sem. Exam Marks
I	Introduction to Automata Theory and its significance. **Type 3 Formalism:** Finite state automata – Properties of transition functions, Designing finite automata, NFA, Finite Automata with Epsilon Transitions, Equivalence of NFA and DFA, Conversion of NFA to DFA, Equivalence and Conversion of NFA with and without Epsilon Transitions.	**10**	**15 %**
II	Myhill-Nerode Theorem, Minimal State FA Computation. Finite State Machines with Output- Mealy and Moore machine (Design Only), Two- Way Finite Automata. Regular Grammar, Regular Expressions, Equivalence of regular expressions and NFA with epsilon transitions. Converting Regular Expressions to NFA with epsilon transitions Equivalence of DFA and regular expressions, converting DFA to Regular Expressions.	**10**	**15 %**

FIRST INTERNAL EXAM			
III	Pumping Lemma for Regular Languages, Applications of Pumping Lemma. Closure Properties of Regular sets (Proofs not required), Decision Problems related with Type 3 Formalism **Type 2 Formalism:-** Context-Free Languages (CFL), Context-Free Grammar (CFG), Derivation trees, Ambiguity, Simplification of CFG, Chomsky Normal Form, Greibach normal forms	**09**	**15 %**
IV	Non-Deterministic Pushdown Automata (NPDA), design. Equivalence of acceptance by final state and empty stack in PDA. Equivalence between NPDA and CFG, Deterministic Push Down Automata, Closure properties of CFLs (Proof not required), Decision Problems related with Type 3 Formalism.	**08**	**15 %**
SECOND INTERNAL EXAM			
V	Pumping Lemma for CFLs, Applications of Pumping Lemma. **Type 1 Formalism:** Context-sensitive Grammar. Linear Bounded Automata (Design not required) **Type 0 Formalism:** Turing Machine (TM) – Basics and formal definition, TMs as language acceptors, TMs as Transducers, Designing Turing Machines.	**09**	**20 %**
VI	Variants of TMs -Universal Turing Machine, Multi- tape TMs, Non Deterministic TMs, Enumeration Machine (Equivalence not required), Recursively Enumerable Languages, Recursive languages, Properties of Recursively Enumerable Languages and Recursive Languages, Decidability and Halting Problem. Chomsky Hierarchy	**08**	**20 %**
END SEMESTER EXAM			

Question Paper Pattern

1. There will be *five* parts in the question paper – A, B, C, D, E
2. Part A
   a. Total marks : 12 b. *Four* questions each having *3* marks, uniformly covering modules I and II; All*four* questions have to be answered.
3. Part B
   a. Total marks : 18 b. *Three* questions each having *9* marks, uniformly covering modules I and II; T*wo* questions have to be answered. Each question can have a maximum of three subparts.
4. Part C
   a. Total marks : 12 b. *Four* questions each having *3* marks, uniformly covering modules III and IV; All*four* questions have to be answered.
5. Part D
   a. Total marks : 18 b. *Three* questions each having *9* marks, uniformly covering modules III and IV; *Two* questions have to be answered. Each question can have a maximum of three subparts
6. Part E
   a. Total Marks: 40 b. *Six* questions each carrying 10 marks, uniformly covering modules V and VI; *four* questions have to be answered. A question can have a maximum of three sub-parts.

There should be at least 60% analytical/numerical questions.

Course code	Course Name	L-T-P - Credits	Year of Introduction
CS302	Design and Analysis of Algorithms	3-1-0-4	2016

Prerequisite: Nil

Course Objectives

- To introduce the concepts of Algorithm Analysis, Time Complexity, Space Complexity.
- To discuss various Algorithm Design Strategies with proper illustrative examples.
- To introduce Complexity Theory.

Syllabus

Introduction to Algorithm Analysis, Notions of Time and Space Complexity, Asymptotic Notations, Recurrence Equations and their solutions, Master's Theorem, Divide and Conquer and illustrative examples, AVL trees, Red-Black Trees, Union-find algorithms, Graph algorithms, Divide and Conquer, Dynamic Programming, Greedy Strategy, Back Tracking and Branch and Bound, Complexity classes

Expected outcome

The students will be able to

i. Analyze a given algorithm and express its time and space complexities in asymptotic notations.
ii. Solve recurrence equations using Iteration Method, Recurrence Tree Method and Master's Theorem.
iii. Design algorithms using Divide and Conquer Strategy.
iv. Compare Dynamic Programming and Divide and Conquer Strategies.
v. Solve Optimization problems using Greedy strategy.
vi. Design efficient algorithms using Back Tracking and Branch Bound Techniques for solving problems.
vii. Classify computational problems into P, NP, NP-Hard and NP-Complete.

Text Books

1. Ellis Horowitz, SartajSahni, SanguthevarRajasekaran, Computer Algorithms, Universities Press, 2007 [Modules 3,4,5]
2. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein, Introduction to Algorithms, MIT Press, 2009 [Modules 1,2,6]

References

1. Alfred V. Aho, John E. Hopcroft and Jeffrey D. Ullman, The Design and Analysis of Computer Algorithms, Pearson Education, 1999.
2. Anany Levitin, Introduction to the Design and Analysis of Algorithms, Pearson, 3rd Edition, 2011.
3. Gilles Brassard, Paul Bratley, Fundamentals of Algorithmics, Pearson Education, 1995.
4. Richard E. Neapolitan, Kumarss Naimipour, Foundations of Algorithms using C++ Psuedocode, Second Edition, 1997.

Course Plan

Module	Contents	Hours	End Sem. Exam Marks

I	***Introduction to Algorithm Analysis***Time and Space Complexity- Elementary operations and Computation of Time Complexity- Best, worst and Average Case Complexities- Complexity Calculation of simple algorithms ***Recurrence Equations:***Solution of Recurrence Equations – Iteration Method and Recursion Tree Methods	**04** **04**	**15 %**
II	***Master's Theorem***(Proof not required) – examples, Asymptotic Notations and their properties- Application of Asymptotic Notations in Algorithm Analysis- Common Complexity Functions ***AVL Trees*** – rotations, Red-Black Trees insertion and deletion (Techniques only; algorithms not expected). B-Trees – insertion and deletion operations. Sets- Union and find operations on disjoint sets.	**05** **05**	**15%**
FIRST INTERNAL EXAM			
III	***Graphs*** – DFS and BFS traversals, complexity, Spanning trees – Minimum Cost Spanning Trees, single source shortest path algorithms, Topological sorting, strongly connected components.	**07**	**15%**
IV	***Divide and Conquer:***The Control Abstraction, 2 way Merge sort, Strassen's Matrix Multiplication, Analysis ***Dynamic Programming :*** The control Abstraction- The Optimality Principle- Optimal matrix multiplication, Bellman-Ford Algorithm	**04** **05**	**15%**
SECOND INTERNAL EXAM			
V	Analysis, Comparison of Divide and Conquer and Dynamic Programming strategies ***Greedy Strategy:*** - The Control Abstraction- the Fractional Knapsack Problem, Minimal Cost Spanning Tree Computation- Prim's Algorithm – Kruskal's Algorithm.	**02** **04** **03**	**20%**
VI	***Back Tracking:*** -The Control Abstraction – The N Queen's Problem, 0/1 Knapsack Problem ***Branch and Bound:***Travelling Salesman Problem. ***Introduction to Complexity Theory :-***Tractable and Intractable Problems- The P and NP Classes- Polynomial Time Reductions - The NP- Hard and NP-Complete Classes	**03** **03** **03**	**20%**
END SEMESTER EXAM			

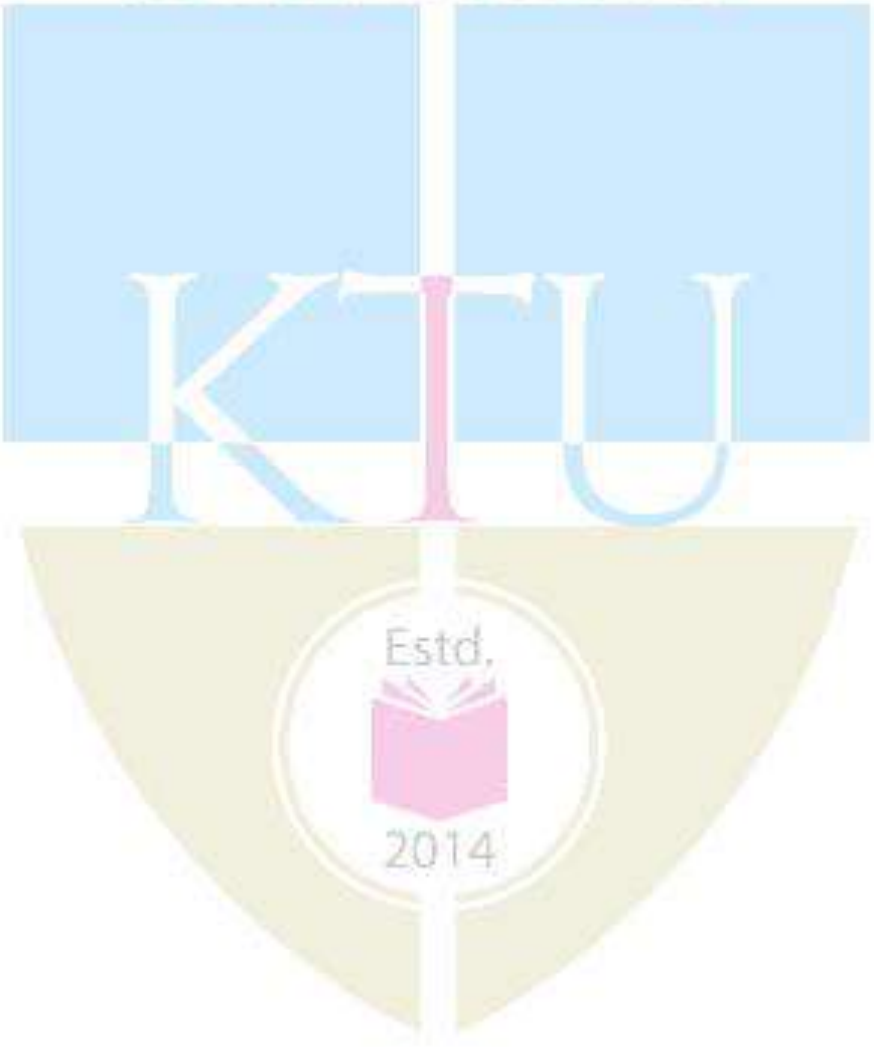
Question Paper Pattern

1. There will be *five* parts in the question paper – A, B, C, D, E
2. Part A
   a. Total marks : 12
   b. *Four* questions each having *3* marks, uniformly covering modules I and II; All*four* questions have to be answered.
3. Part B
   a. Total marks : 18
   b. *Three* questions each having *9* marks, uniformly covering modules I and II; *Two* questions have to be answered. Each question can have a maximum of three subparts.
4. Part C

a. Total marks : 12
b. *Four* questions each having *3* marks, uniformly covering modules III and IV; All*four* questions have to be answered.

5. Part D
   a. Total marks : 18
   b. *Three* questions each having *9* marks, uniformly covering modules III and IV; *Two* questions have to be answered. Each question can have a maximum of three subparts
6. Part E
   a. Total Marks: 40
   b. *Six* questions each carrying 10 marks, uniformly covering modules V and VI; *four* questions have to be answered.
   c. A question can have a maximum of three sub-parts.

7. There should be at least 60% analytical/numerical questions.



Course code	Course Name	L-T-P Credits	Year of Introduction
CS303	SYSTEM SOFTWARE	2-1-0-3	2016

Prerequisite: Nil

Course Objectives

- To make students understand the design concepts of various system software like Assembler, Linker, Loader and Macro pre-processor, Utility Programs such as Text Editor and Debugger.

Syllabus

Different types of System Software, SIC & SIC/XE Architecture and Programming, Basic Functions of Assembler, Assembler Design, Single pass and 2 Pass Assemblers and their Design, Linkers and Loaders, Absolute Loader and Relocating loader, Design of Linking Loader, Macro Processor and its design, Fundamentals of Text Editor Design, Operational Features of Debuggers

Expected Outcome

The Students will be able to

i. distinguish different software into different categories..
ii. design, analyze and implement one pass, two pass or multi pass assembler.
iii. design, analyze and implement loader and linker.
iv. design, analyze and implement macro processors.
v. critique the features of modern editing /debugging tools.

Text book

1. Leland L. Beck, System Software: An Introduction to Systems Programming, 3/E, Pearson Education Asia, 1997.

References

1 D.M. Dhamdhere, Systems Programming and Operating Systems, Second Revised Edition, Tata McGraw Hill.
2. http://gcc.gnu.org/onlinedocs/gcc-2.95.3/cpp_1.html - The C Preprocessor
3. J Nithyashri, System Software, Second Edition, Tata McGraw Hill.
4. John J. Donovan, Systems Programming, Tata McGraw Hill Edition 1991.
5. Jonathan Corbet, Alessandro Rubini, Greg Kroah-Hartman, Linux Device Drivers, Third Edition, O.Reilly Books
6. M. Beck, H. Bohme, M. Dziadzka, et al., Linux Kernel Internals, Second Edition, Addison Wesley Publications,
7. Peter Abel, IBM PC Assembly Language and Programming, Third Edition, Prentice Hall of India.
8. Writing UNIX device drivers - George Pajari – Addison Wesley Publications (Ebook : http://tocs.ulb.tu-darmstadt.de/197262074.pdf).

Course Plan

Module	Contents	Hours	End Sem Exam. Marks

I	***Introduction :*** System Software Vs. Application Software, Different System Software– Assembler, Linker, Loader, Macro Processor, Text Editor, Debugger, Device Driver, Compiler, Interpreter, Operating System(Basic Concepts only) SIC & SIC/XE Architecture, Addressing modes, SIC & SIC/XE Instruction set, Assembler Directives and Programming.	**2** **6**	**15%**
II	***Assemblers*** Basic Functions of Assembler. Assembler output format – Header, Text and End Records- Assembler data structures, Two pass assembler algorithm, Hand assembly of SIC/XE program, Machine dependent assembler features.	**6**	**15 %**
FIRST INTERNAL EXAM			
III	***Assembler design options:*** Machine Independent assembler features – program blocks, Control sections, Assembler design options- Algorithm for Single Pass assembler, Multi pass assembler, Implementation example of MASM Assembler	**7**	**15 %**
IV	***Linker and Loader*** Basic Loader functions - Design of absolute loader, Simple bootstrap Loader, Machine dependent loader features- Relocation, Program Linking, Algorithm and data structures of two pass Linking Loader, Machine dependent loader features, Loader Design Options.	**7**	**15 %**
SECOND INTERNAL EXAM			
V	***Macro Preprocessor:-*** Macro Instruction Definition and Expansion. One pass Macro processor Algorithm and data structures, Machine Independent Macro Processor Features, Macro processor design options	**7**	**20 %**
VI	***Device drivers:*** Anatomy of a device driver, Character and block device drivers, General design of device drivers ***Text Editors:*** Overview of Editing, User Interface, Editor Structure. ***Debuggers :-*** Debugging Functions and Capabilities, Relationship with other parts of the system, Debugging Methods- By Induction, Deduction and Backtracking.	**2** **2** **4**	**20 %**
END SEMESTER EXAM			

Question Paper Pattern

1. There will be *five* parts in the question paper – A, B, C, D, E
2. Part A
    a. Total marks : 12
    b. *Four* questions each having *3* marks, uniformly covering modules I and II; All*four* questions have to be answered.
3. Part B
    a. Total marks : 18
    b. *Three* questionseach having *9* marks, uniformly covering modules I and II; T*wo* questions have to be answered. Each question can have a maximum of three subparts.
4. Part C
    a. Total marks : 12
    b. *Four* questions each having *3* marks, uniformly covering modules III and IV; All*four* questions have to be answered.
5. Part D
    a. Total marks : 18
    b. *Three* questions each having *9* marks, uniformly covering modules III and IV; *Two* questions have to be answered. Each question can have a maximum of three subparts
6. Part E
    a. Total Marks: 40
    b. *Six* questions each carrying 10 marks, uniformly covering modules V and VI; *four* questions have to be answered.
    c. A question can have a maximum of three sub-parts.

7. There should be at least 60% analytical/numerical questions.

Course code	Course Name	L-T-P Credits	Year of Introduction
CS304	COMPILER DESIGN	3-0-0-3	2016

Prerequisite: Nil

Course Objectives

- To provide a thorough understanding of the internals of Compiler Design.

Syllabus

Phases of compilation, Lexical analysis, Token Recognition, Syntax analysis, Bottom Up and Top Down Parsers, Syntax directed translation schemes, Intermediate Code Generation, Triples and Quadruples, Code Optimization, Code Generation.

Expected Outcome

The students will be able to

i. Explain the concepts and different phases of compilation with compile time error handling.
ii. Represent language tokens using regular expressions, context free grammar and finite automata and design lexical analyzer for a language.
iii. Compare top down with bottom up parsers, and develop appropriate parser to produce parse tree representation of the input.
iv. Generate intermediate code for statements in high level language.
v. Design syntax directed translation schemes for a given context free grammar.
vi. Apply optimization techniques to intermediate code and generate machine code for high level language program.

Text Books

1. Aho A. Ravi Sethi and D Ullman. Compilers – Principles Techniques and Tools, Addison Wesley, 2006.
2. D. M.Dhamdhare, System Programming and Operating Systems,Tata McGraw Hill & Company, 1996.

References

1. Kenneth C. Louden, Compiler Construction – Principles and Practice, Cengage Learning Indian Edition, 2006.
2. Tremblay and Sorenson, The Theory and Practice of Compiler Writing, Tata McGraw Hill & Company,1984.

Course Plan

Module	Contents	Hours	End Sem. Exam Marks
I	Introduction to compilers – Analysis of the source program, Phases of a compiler, Grouping of phases, compiler writing tools – bootstrapping **Lexical Analysis**: The role of Lexical Analyzer, Input Buffering, Specification of Tokens using Regular Expressions, Review of Finite Automata, Recognition of Tokens.	**07**	**15%**
II	**Syntax Analysis:** Review of Context-Free Grammars – Derivation trees and Parse Trees, Ambiguity. **Top-Down Parsing**: Recursive Descent parsing, Predictive parsing, LL(1) Grammars.	**06**	**15%**

FIRST INTERNAL EXAM			
III	**Bottom-Up Parsing**: Shift Reduce parsing – Operator precedence parsing (Concepts only) LR parsing – Constructing SLR parsing tables, Constructing, Canonical LR parsing tables and Constructing LALR parsing tables.	**07**	**15%**
IV	**Syntax directed translation**: Syntax directed definitions, Bottom- up evaluation of S-attributed definitions, L- attributed definitions, Top-down translation, Bottom-up evaluation of inherited attributes. **Type Checking :** Type systems, Specification of a simple type checker.	**08**	**15%**
SECOND INTERNAL EXAM			
V	**Run-Time Environments:** Source Language issues, Storage organization, Storage-allocation strategies. **Intermediate Code Generation (ICG)**: Intermediate languages – Graphical representations, Three-Address code, Quadruples, Triples. Assignment statements, Boolean expressions.	**07**	**20%**
VI	**Code Optimization:**Principal sources of optimization, Optimization of Basic blocks **Code generation**: Issues in the design of a code generator. The target machine, A simple code generator.	**07**	**20%**
END SEMESTER EXAM			

Question Paper Pattern

1. There will be *five* parts in the question paper – A, B, C, D, E
2. Part A

a. Total marks : 12 b.. *Four* questions each having *3* marks, uniformly covering modules I and II; All*four* questions have to be answered.

3. Part B

a. Total marks : 18 b. *Three* questionseach having *9* marks, uniformly covering modules I and II; *Two* questions have to be answered. Each question can have a maximum of three subparts.

4. Part C

a. Total marks : 12 b. *Four* questions each having *3* marks, uniformly covering modules III and IV; All *four* questions have to be answered.

5. Part D

a. Total marks : 18 b. *Three* questions each having *9* marks, uniformly covering modules III and IV; *Two* questions have to be answered. Each question can have a maximum of three subparts

6. Part E

b. Total Marks: 40 b. *Six* questions each carrying 10 marks, uniformly covering modules V and VI; *four* questions have to be answered.

c. A question can have a maximum of three sub-parts.

7. There should be at least 60% analytical/numerical questions.

Course code	Course Name	L-T-P - Credits	Year of Introduction
CS305	Microprocessors and Microcontrollers	2-1-0-3	2016

Prerequisite: CS202 Computer Organisation and Architecture

Course Objectives

- To impart basic understanding of the internal organisation of 8086 Microprocessor and 8051 microcontroller.
- To introduce the concepts of interfacing microprocessors with external devices.
- To develop Assembly language programming skills.

Syllabus

Introduction to 8086 Microprocessor; Architecture and signals, Instruction set of 8086, Timing Diagram, Assembly Language Programming, Memory and I/O interfacing, Interfacing with 8255, 8279, 8257, Interrupts and Interrupt handling, Microcontrollers - 8051 Architecture and its salient features, Instruction Set and Simple Programming Concepts.

Expected Outcome

The Students will be able to

i. Describe different modes of operations of a typical microprocessor and microcontroller.
ii. Design and develop 8086 assembly language programs using software interrupts and various assembler directives.
iii. Interface microprocessors with various external devices.
iv. Analyze and compare the features of microprocessors and microcontrollers.
v. Design and develop assembly language programs using 8051 microcontroller.

Text Books

1. Bhurchandi and Ray, *Advanced Microprocessors and Peripherals*, Third Edition McGraw Hill, 2012
2. Raj Kamal, *Microcontrollers: Architecture, Programming, Interfacing and System Design*, Pearson Education, 2011.
3. Douglas V. Hall, SSSP Rao, *Microprocessors and Interfacing*, Third Edition, McGrawHill Education, 2012.

References

1. Barry B. Brey, *The Intel Microprocessors – Architecture, Programming and Interfacing*, Eigth Edition, Pearson Education, 2015
2. A. NagoorKani, *Microprocessors and Microcontrollers*, Second Edition, Tata McGraw Hill, 2012.

Course Plan

Module	Contents	Hours	End Sem. Exam Marks
I	Evolution of microprocessors, 8086 Microprocessor - Architecture and signals, Memory organisation, Minimum and maximum mode of operation, Minimum mode Timing Diagram. Comparison of 8086 and 8088.	07	15%
II	8086 Addressing Modes, 8086 Instruction set and Assembler Directives - Assembly Language Programming with Subroutines, Macros, Passing Parameters, Use of stack.	08	15%

FIRST INTERNAL EXAM			
III	Interrupts - Types of Interrupts and Interrupt Service Routine. Handling Interrupts in 8086, Interrupt programming. Basic Peripherals and their Interfacing with 8086 - Programmable Interrupt Controller - 8259 - Architecture.	**07**	**15%**
IV	Interfacing Memory, I/O, 8255 - Detailed study - Architecture, Control word format and modes of operation, Architecture and modes of operation of 8279 and 8257 (Just mention the control word, no need to memorize the control word format)	**07**	**15%**
SECOND INTERNAL EXAM			
V	Microcontrollers - Types of Microcontrollers - Criteria for selecting a microcontroller - Example Applications. Characteristics and Resources of a microcontroller. Organization and design of these resources in a typical microcontroller - 8051. 8051 Architecture, Register Organization, Memory and I/O addressing, Interrupts and Stack.	**08**	**20%**
VI	8051 Addressing Modes, Different types of instructions and Instruction Set, Simple programs. Peripheral Chips for timing control - 8254/8253.	**08**	**20%**
END SEMESTER EXAM			

Question Paper Pattern

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2. Part A
   a. Total marks : 12
   b. *Four* questions each having *3* marks, uniformly covering modules I and II; All*four* questions have to be answered.
3. Part B
   a. Total marks : 18
   b. *Three*questions each having *9* marks, uniformly covering modules I and II; T*wo* questions have to be answered. Each question can have a maximum of three subparts.
4. Part C
   a. Total marks : 12
   b. *Four* questions each having *3* marks, uniformly covering modules III and IV;All*four* questions have to be answered.
5. Part D
   a. Total marks : 18
   b. *Three*questionseach having *9* marks, uniformly covering modules III and IV; *Two* questions have to be answered. Each question can have a maximum of three subparts
6. Part E
   a. Total Marks: 40
   b. *Six* questions each carrying 10 marks, uniformly covering modules V and VI; *four* questions have to be answered.
   c. A question can have a maximum of three sub-parts.
7. There should be at least 60% analytical/numerical questions.

Course code	Course Name	L-T-P - Credits	Year of Introduction
CS306	Computer Networks	3-0-0-3	2016

Prerequisite: Nil

Course Objectives

- To build an understanding of the fundamental concepts of computer networking.
- To introduce the basic taxonomy and terminology of computer networking.
- To introduce advanced networking concepts.

Syllabus

Concept of layering, LAN technologies (Ethernet), Flow and error control techniques, switching, IPv4/IPv6, routers and routing algorithms (distance vector, link state), TCP/UDP and sockets, congestion control, Application layer protocols.

Expected Outcome

The students will be able to

i. Visualise the different aspects of networks, protocols and network design models.
ii. Examine various Data Link layer design issues and Data Link protocols.
iii. Analyse and compare different LAN protocols.
iv. Compare and select appropriate routing algorithms for a network.
v. Examine the important aspects and functions of network layer, transport layer and application layer in internetworking.

Text Books

1. Andrew S. Tanenbaum, Computer Networks, 4/e, PHI.
2. Behrouz A. Forouzan, Data Communications and Networking, 4/e, Tata McGraw Hill.
3. Larry L. Peterson & Bruce S. Dave, Computer Networks-A Systems Approach, 5/e, Morgan Kaufmann, 2011.

References

1. Fred Halsall, Computer Networking and the Internet, 5/e.
2. James F. Kurose, Keith W. Ross, Computer Networking: A Top-Down Approach, 6/e.
3. Keshav, An Engineering Approach to Computer Networks, Addison Wesley, 1998.
4. Request for Comments (RFC) Pages - IETF -https://www.ietf.org/rfc.html
5. W. Richard Stevens. TCP/IP Illustrated volume 1, Addison-Wesley, 2005.
6. William Stallings, Computer Networking with Internet Protocols, Prentice-Hall, 2004.

Course Plan

Module	Contents	Hours	End Sem. Exam Marks
I	Introduction – Uses – Network Hardware – LAN –MAN – WAN, Internetworks – Network Software – Protocol hierarchies – Design issues for the layers – Interface & Service – Service Primitives. Reference models – OSI – TCP/IP.	07	15%
II	Data Link layer Design Issues – Flow Control and ARQ techniques. Data link Protocols – HDLC. DLL in Internet. MAC Sub layer – IEEE 802 FOR LANs & MANs, IEEE 802.3, 802.4, 802.5. Bridges - Switches – High Speed LANs - Gigabit Ethernet. Wireless LANs - 802.11 a/b/g/n, 802.15.PPP	08	15%
FIRST INTERNAL EXAMINATION			

III	Network layer – Routing – Shortest path routing, Flooding, Distance Vector Routing, Link State Routing, RIP, OSPF, Routing for mobile hosts.	**07**	**15%**
IV	Congestion control algorithms – QoS. Internetworking – Network layer in internet. IPv4 - IP Addressing – Classless and Classfull Addressing. Sub-netting.	**07**	**15%**
SECOND INTERNAL EXAMINATION			
V	Internet Control Protocols – ICMP, ARP, RARP, BOOTP. Internet Multicasting – IGMP, Exterior Routing Protocols – BGP. IPv6 – Addressing – Issues, ICMPv6.	**07**	**20%**
VI	Transport Layer – TCP & UDP. Application layer –FTP, DNS, Electronic mail, MIME, SNMP. Introduction to World Wide Web.	**07**	**20%**
END SEMESTER EXAM			

Question Paper Pattern

1. There will be *five* parts in the question paper – A, B, C, D, E
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   b. *Four* questions each having *3* marks, uniformly covering modules I and II;All*four* questions have to be answered.
3. Part B
   a. Total marks : 18
   b. *Three* questions each having *9* marks, uniformly covering modules I and II; *Two* questions have to be answered. Each question can have a maximum of three subparts.
4. Part C
   a. Total marks : 12
   b. *Four* questions each having *3* marks, uniformly covering modules III and IV; All*four* questions have to be answered.
5. Part D
   a. Total marks : 18
   b. *Three* questions each having *9* marks, uniformly covering modules III and IV; *Two* questions have to be answered. Each question can have a maximum of three subparts
6. Part E
   a. Total Marks: 40
   b. *Six* questions each carrying 10 marks, uniformly covering modules V and VI; *four* questions have to be answered.
   c. A question can have a maximum of three sub-parts.

7. There should be at least 60% analytical/numerical questions.

Course code.	Course Name	L-T-P-Credits	Year of Introduction
CS307	DATA COMMUNICATION	3-0-0-3	2016

Prerequisite: Nil

Course Objectives

- To introduce fundamental communication models.
- To discuss various time domain and frequency domain concepts of data communication.
- To introduce the concepts of encoding, multiplexing and spread spectrum.

Syllabus

Data Transmission, Transmission Impairments, Channel Capacity, Transmission media, Wireless propagation, Signal encoding Techniques, Multiplexing, Digital data transmission techniques, Sampling theorem, Error detection and correction, Spread spectrum, Basic principles of switching.

Expected Outcome

The Students will be able to

i. Identify and list the various issues present in the design of a data communication system.
ii. Apply the time domain and frequency domain concepts of signals in data communication.
iii. Compare and select transmission media based on transmission impairments and channel capacity.
iv. Select and use appropriate signal encoding techniques and multiplexing techniques for a given scenario.
v. Design suitable error detection and error correction algorithms to achieve error free data communication and explain different switching techniques.

Text Books

1. Curt M. White, Fundamentals of Networking and Communication 7/e, Cengage learning. [Chapter 3,4,9,10]
2. Forouzan B. A., Data Communications and Networking, 5/e, Tata McGraw Hill, 2013. [Chapters:3,4, 5, 6,7,8]
3. Schiller J., Mobile Communications, 2/e, Pearson Education, 2009. [Chapters:2,3]
4. William Stallings, Data and Computer Communication 9/e, Pearson Education, Inc. [Chapters: 4, 5, 6, 7, 8, 9].

References

1. Forouzan B. A., Data Communications and Networking, 4/e, Tata McGraw Hill, 2007.
2. Tanenbaum A. S. and D. Wetherall, Computer Networks, Pearson Education, 2013.

COURSE PLAN

Module	Contents	Hours	End Sem. Exam Marks

I	Data Transmission: Communication model Simplex, half duplex and full duplex transmission - Periodic Analog signals: Sine wave, phase, wavelength, time and frequency domain, bandwidth - Digital Signals; Digital data Transmission:- Analog & Digital data, Analog & Digital signals, Analog &Digital transmission – Transmission Impairments: Attenuation, Delay distortion, Noise - Channel capacity: Nyquist Bandwidth, Shannon's Capacity formula.	**08**	**15%**
II	Transmission media - Guided Transmission Media: Twisted pair, Coaxial cable, optical fiber, Wireless Transmission, Terrestrial microwave, Satellite microwave. Wireless Propagation: Ground wave propagation, Sky Wave propagation, LoS Propagation.	**07**	**15%**
FIRST INTERNAL EXAM			
III	Signal Encoding techniques - Digital Data Digital Signals: NRZ, Multilevel binary, Biphase - Digital Data Analog Signals : ASK, FSK, PSK - Analog Data Digital Signals: Sampling theorem, PCM, Delta Modulation - Analog Data Analog Signals: AM, FM, PM.	**07**	**15%**
IV	Multiplexing- Space Division Multiplexing-Frequency Division Multiplexing: Wave length Division Multiplexing - Time Division multiplexing: Characteristics, Digital Carrier system, SONET/SDH- Statistical time division multiplexing: Cable Modem - Code Division Multiplexing. Multiple Access– CDMA.	**07**	**15%**
SECOND INTERNAL EXAM			
V	Digital Data Communication Techniques - Asynchronous transmission, Synchronous transmission-Detecting and Correcting Errors-Types of Errors-Error Detection: Parity check, Cyclic Redundancy Check (CRC) - Error Control Error Correction: Forward Error Correction and Hamming Distance.	**06**	**20%**
VI	Spread Spectrum Techniques-Direct Sequence Spread Spectrum (DSSS), Frequency Hopping Spread Spectrum (FHSS). Basic principles of switching - Circuit Switched Networks, Structure of Circuit Switch - Packet Switching: Datagram Networks, Virtual Circuit Networks, Structure of packet switches.	**07**	**20%**
END SEMESTER EXAM			

Question Paper Pattern

1. There will be *five* parts in the question paper – A, B, C, D, E
2. Part A
    a. Total marks : 12
    b. *Four* questions each having 3 marks, uniformly covering modules I and II;All*four* questions have to be answered.
3. Part B

a. Total marks : 18
b. *Three*questions each having *9* marks, uniformly covering modules I and II; T*wo* questions have to be answered. Each question can have a maximum of three subparts.

4. Part C
   a. Total marks : 12
   b. *Four* questions each having *3* marks, uniformly covering modules III and IV;All*four* questions have to be answered.
5. Part D
   a. Total marks : 18
   b. *Three*questionseach having *9* marks, uniformly covering modules III and IV;*Two* questions have to be answered. Each question can have a maximum of three subparts
6. Part E
   a. Total Marks: 40
   b. *Six* questions each carrying 10 marks, uniformly covering modules V and VI; *four* questions have to be answered.
   c. A question can have a maximum of three sub-parts.
7. There should be at least 60% analytical/numerical questions.

Course code	Course Name	L-T-P-Credits	Year of Introduction
CS308	Software Engineering and Project Management	3-0-0-3	2016

Pre-requisite: Nil

Course Objectives

- To introduce the fundamental concepts of software engineering.
- To build an understanding on various phases of software development.
- To introduce various software process models.

Syllabus

Introduction to software engineering, Software process models, Software development phases, Requirement analysis, Planning, Design, Coding, Testing, Maintenance.

Expected Outcome

The students will be able to

i. Identify suitable life cycle models to be used.
ii. Analyze a problem and identify and define the computing requirements to the problem.
iii. Translate a requirement specification to a design using an appropriate software engineering methodology.
iv. Formulate appropriate testing strategy for the given software system.
v. Develop software projects based on current technology, by managing resources economically and keeping ethical values.

References

1. Ian Sommerville, Software Engineering, University of Lancaster, Pearson Education, Seventh edition, 2004.
2. K. K.Aggarwal and Yogesh Singh, Software Engineering, New age International Publishers, Second edition, 2005.
3. Roger S. Pressman, Software Engineering : A practitioner's approach, McGraw Hill publication, Eighth edition, 2014
4. S.A. Kelkar, Software Project Management: A concise study, PHI, Third edition, 2012.
5. Walker Royce, Software Project Management : A unified frame work, Pearson Education, 1998

COURSE PLAN

Module	Contents	Hours	End Sem. Exam Marks
I	Introduction to software engineering- scope of software	07	15%

	engineering – historical aspects, economic aspects, maintenance aspects, specification and design aspects, team programming aspects. Software engineering a layered technology – processes, methods and tools. Software process models – prototyping models, incremental models, spiral model, waterfall model.		
II	Process Framework Models: Capability maturity model (CMM), ISO 9000. Phases in Software development – requirement analysis- requirements elicitation for software, analysis principles, software prototyping, specification.	**06**	**15%**
FIRST INTERNAL EXAM			
III	Planning phase – project planning objective, software scope, empirical estimation models- COCOMO, single variable model, staffing and personal planning. Design phase – design process, principles, concepts, effective modular design, top down, bottom up strategies, stepwise refinement.	**07**	**15%**
IV	Coding – programming practice, verification, size measures, complexity analysis, coding standards. Testing – fundamentals, white box testing, control structure testing, black box testing, basis path testing, code walk-throughs and inspection, testing strategies-Issues, Unit testing, integration testing, Validation testing, System testing.	**07**	**15%**
SECOND INTERNAL EXAM			
V	Maintenance-Overview of maintenance process, types of maintenance. Risk management: software risks - risk identification-risk monitoring and management. Project Management concept: People – Product-Process-Project.	**07**	**20%**
VI	Project scheduling and tracking: Basic concepts-relation between people and effort-defining task set for the software project-selecting software engineering task Software configuration management: Basics and standards User interface design - rules. Computer aided software engineering tools - CASE building blocks, taxonomy of CASE tools, integrated CASE environment.	**08**	**20%**
END SEMESTER EXAM			

Question Paper Pattern

1. There will be *five* parts in the question paper – A, B, C, D, E
2. Part A
   a. Total marks : 12
   b. *Four* questions each having 3 marks, uniformly covering modules I and II;

All*four* questions have to be answered.

3. Part B
   a. Total marks : 18
   b. *Three* questions each having *9* marks, uniformly covering modules I and II; *Two* questions have to be answered. Each question can have a maximum of three subparts.
4. Part C
   a. Total marks : 12
   b. *Four* questions each having 3 marks, uniformly covering modules III and IV; All*four* questions have to be answered.
5. Part D
   a. Total marks : 18
   b. *Three* questions each having *9* marks, uniformly covering modules III and IV; *Two* questions have to be answered. Each question can have a maximum of three subparts
6. Part E
   a. Total Marks: 40
   b. *Six* questions each carrying 10 marks, uniformly covering modules V and VI; *four* questions have to be answered.
   c. A question can have a maximum of three sub-parts.

7. There should be at least 60% analytical/numerical questions.

Course code	Course Name	L-T-P Credits	Year of Introduction
CS309	GRAPH THEORY AND COMBINATORICS	2-0-2-3	2016

Prerequisite: Nil

Course Objectives

- To introduce the fundamental concepts in graph theory, including properties and characterization of graphs/ trees and Graphs theoretic algorithms

Syllabus

Introductory concepts of graphs, Euler and Hamiltonian graphs, Planar Graphs, Trees, Vertex connectivity and edge connectivity, Cut set and Cut vertices, Matrix representation of graphs, Graphs theoretic algorithms.

Expected Outcome

The Students will be able to

i. Demonstrate the knowledge of fundamental concepts in graph theory, including properties and characterization of graphs and trees.
ii. Use graphs for solving real life problems.
iii. Distinguish between planar and non-planar graphs and solve problems.
iv. Develop efficient algorithms for graph related problems in different domains of engineering and science.

Text Books

1. Douglas B. West, Introduction to Graph Theory, Prentice Hall India Ltd., 2001
2. Narasingh Deo, Graph theory, PHI, 1979.
3. Robin J. Wilson, Introduction to Graph Theory, Longman Group Ltd., 2010

References

1. R. Diestel, *Graph Theory*, free online edition, 2016: diestel-graph-theory.com/basic.html.

Course Plan

Module	Contents	Hours	End Sem. Exam Marks
I	**Introductory concepts** - What is graph – Application of graphs – finite and infinite graphs – Incidence and Degree – Isolated vertex, pendent vertex and Null graph. Paths and circuits – Isomorphism, sub graphs, walks, paths and circuits, Connected graphs, disconnect graphs.	09	15 %
II	Euler graphs, Hamiltonian paths and circuits, Dirac's theorem for Hamiltonicity, Travelling salesman problem. Directed graphs – types of digraphs, Digraphs and binary relation	10	15 %
	FIRST INTERNAL EXAM		
III	Trees – properties, pendent vertex, Distance and centres - Rooted and binary tree, counting trees, spanning trees.	07	15 %
IV	Vertex Connectivity, Edge Connectivity, Cut set and Cut Vertices, Fundamental circuits, Planar graphs, Different representation of planar graphs, Euler's theorem, Geometric dual, Combinatorial dual.	09	15 %
	SECOND INTERNAL EXAM		

V	Matrix representation of graphs- Adjacency matrix, Incidence Matrix, Circuit matrix, Fundamental Circuit matrix and Rank, Cut set matrix, Path matrix	**08**	**20 %**
VI	Graphs theoretic algorithms - Algorithm for computer representation of a graph, algorithm for connectedness and components, spanning tree, shortest path.	**07**	**20 %**
END SEMESTER EXAM			

Question Paper Pattern

1. There will be *five* parts in the question paper – A, B, C, D, E
2. Part A
   a. Total marks : 12
   b. *Four* questions each having *3* marks, uniformly covering modules I and II; All*four* questions have to be answered.
3. Part B
   a. Total marks : 18
   b. *Three*questions each having *9* marks, uniformly covering modules I and II; T*wo* questions have to be answered. Each question can have a maximum of three subparts.
4. Part C
   a. Total marks : 12
   b. *Four* questions each having *3* marks, uniformly covering modules III and IV; All*four* questions have to be answered.
5. Part D
   a. Total marks : 18
   b. *Three*questions each having *9* marks, uniformly covering modules III and IV; *Two* questions have to be answered. Each question can have a maximum of three subparts.
6. Part E
   a. Total Marks: 40
   b. *Six* questions each carrying 10 marks, uniformly covering modules V and VI; *four* questions have to be answered.
   c. A question can have a maximum of three sub-parts.
7. There should be at least 60% analytical/numerical questions.

Course code	Course Name	L-T-P Credits	Year of Introduction
CS331	SYSTEM SOFTWARE LAB	0-0-3-1	2016

Prerequisite: Nil

Course Objectives

- To build an understanding on design and implementation of different types of system software.

List of Exercises/Experiments: (Exercises/experiments marked with * are mandatory from each part. Total 12 Exercises/experiments are mandatory)

Part A

1. Simulate the following non-preemptive CPU scheduling algorithms to find turnaround time and waiting time.
   a) FCFS b) SJF c) Round Robin (pre-emptive) d) Priority
2. Simulate the following file allocation strategies.
   a) Sequential b) Indexed c) Linked
3. Implement the different paging techniques of memory management.
4. Simulate the following file organization techniques *
   a) Single level directory b) Two level directory c) Hierarchical
5. Implement the banker's algorithm for deadlock avoidance.*
6. Simulate the following disk scheduling algorithms. *
   a) FCFS b)SCAN c) C-SCAN
7. Simulate the following page replacement algorithms
   a) FIFO b)LRU c) LFU
8. Implement the producer-consumer problem using semaphores. *
9. Write a program to simulate the working of the dining philosopher's problem.*

Part B

10. Implement the symbol table functions: create, insert, modify, search, and display.
11. Implement pass one of a two pass assembler. *
12. Implement pass two of a two pass assembler. *
13. Implement a single pass assembler. *
14. Implement a two pass macro processor *
15. Implement a single pass macro processor.
16. Implement an absolute loader.
17. Implement a relocating loader.
18. Implement pass one of a direct-linking loader.
19. Implement pass two of a direct-linking loader.
20. Implement a simple text editor with features like insertion / deletion of a character, word, and sentence.
21. Implement a symbol table with suitable hashing.*

Expected Outcome

The students will be able to

i. Compare and analyze CPU Scheduling Algorithms like FCFS, Round Robin, SJF, and Priority.
ii. Implement basic memory management schemes like paging.
iii. Implement synchronization techniques using semaphores etc.
iv. Implement banker's algorithm for deadlock avoidance.
v. Implement memory management schemes and page replacement schemes and file allocation and organization techniques.
vi. Implement system software such as loaders, assemblers and macro processor.

Course code	Course Name	L-T-P-Credits	Year of Introduction
CS332	MICROPROCESSOR LAB	0-0-3-1	2016

Pre-requisite: CS305 Microprocessors and Microcontrollers

Course Objectives

- To practice assembly language programming on 8086.
- To practice fundamentals of interfacing/programming various peripheral devices with microprocessor/microcontroller.

List of Exercises/ Experiments: (Minimum 12 Exercises/ Experiments are mandatory. Exercises/ Experiments marked with * are mandatory)

I. Assembly Language Programming Exercises/Experiments using 8086 Trainer kit

1. Implementation of simple decimal arithmetic and bit manipulation operations.*
2. Implementation of code conversion between BCD, Binary, Hexadecimal and ASCII.
3. Implementation of searching and sorting of 16-bit numbers.
4. Programming exercises using stack and subroutines.*

II. Exercises/Experiments using MASM (PC Required)

5. Study of Assembler and Debugging commands.
6. Implementation of decimal arithmetic(16 and 32 bit) operations.*
7. Implementation of String manipulations.*
8. Implementation of searching and sorting of 16-bit numbers.
9. Implementation of Matrix operations like addition, transpose, multiplication etc.

III. Interfacing Exercises/Experiments with 8086 trainer kit through Assembly Language Programming

10. Interfacing with stepper motor - Rotate through any given sequence.*
11. Interfacing with 8255 (mode0 and mode1 only).*
12. Interfacing with 8279 (Rolling message, 2 key lock out and N-key roll over implementation).*
13. Interfacing with 8253/54 Timer/Counter.
14. Interfacing with Digital-to-Analog Converter.*
15. Interfacing with Analog-to- Digital Converter.
16. Interfacing with 8259 Interrupt Controller.

IV. Exercises/Experiments using 8051 trainer kit

17. Familiarization of 8051 trainer kit by executing simple Assembly Language programs such as decimal arithmetic and bit manipulation.*
18. Implementation of Timer programming (in mode1).
19. Implementation of stepper motor interfacing, ADC/DAC interfacing and sensor interfacing with 8251 through Assembly Language programming.

Expected Outcome

The students will be able to

i. Develop assembly language programs for problem solving using software interrupts and various assembler directives.

ii. Implement interfacing of various I/O devices to the microprocessor/microcontroller through assembly language programming.

Course code	Course Name	L-T-P - Credits	Year of Introduction
CS333	APPLICATION SOFTWARE DEVELOPMENT LAB	0-0-3-1	2016

Pre-requisite : CS208 Principles of Database Design

Course Objectives

- To introduce basic commands and operations on database.
- To introduce stored programming concepts (PL-SQL) using Cursors and Triggers .
- To familiarize front end tools of database.

List of Exercises/Experiments: (Exercises/experiments marked with * are mandatory. Total 12 Exercises/experiments are mandatory)

1. Creation of a database using DDL commands and writes DQL queries to retrieve information from the database.
2. Performing DML commands like Insertion, Deletion, Modifying, Altering, and Updating records based on conditions.
3. Creating relationship between the databases. *
4. Creating a database to set various constraints. *
5. Practice of SQL TCL commands like Rollback, Commit, Savepoint.
6. Practice of SQL DCL commands for granting and revoking user privileges.
7. Creation of Views and Assertions *
8. Implementation of Build in functions in RDBMS *
9. Implementation of various aggregate functions in SQL *
10. Implementation of Order By, Group By& Having clause. *
11. Implementation of set operators, nested queries and Join queries *
12. Implementation of various control structures using PL/SQL *
13. Creation of Procedures and Functions *
14. Creation of Packages *
15. Creation of database Triggers and Cursors *
16. Practice various front-end tools and report generation.
17. Creating Forms and Menus
18. Mini project (Application Development using Oracle/ MySQL using Database connectivity)*
    a. Inventory Control System.
    b. Material Requirement Processing.
    c. Hospital Management System.
    d. Railway Reservation System.
    e. Personal Information System.
    f. Web Based User Identification System.
    g. Timetable Management System.
    h. Hotel Management System.

Expected Outcome

The students will be able to

i. Design and implement a database for a given proble\\\\m using database design principles.
ii. Apply stored programming concepts (PL-SQL) using Cursors and Triggers.
iii. Use graphical user interface, Event Handling and Database connectivity to develop and deploy applications and applets.
iv. Develop medium-sized project in a team.

Course code	Course Name	L-T-P-Credits	Year of Introduction
CS334	Network Programming Lab	0-0-3-1	2016

Pre-requisite: CS307 Data Communication

Course Objectives

- To introduce Network related commands and configuration files in Linux Operating System.
- To introduce tools for Network Traffic Analysis and Network Monitoring.
- To practice Network Programming using Linux System Calls.
- To design and deploy Computer Networks.

List of Exercises/ Experiments (12 Exercises/ Experiments are to be completed . Exercises/ Experiments marked with * are mandatory)

1. Getting started with Basics of Network configurations files and Networking Commands in Linux.
2. To familiarize and understand the use and functioning of System Calls used for Operating system and network programming in Linux.
3. Familiarization and implementation of programs related to Process and thread.
4. Implement the First Readers-Writers Problem.
5. Implement the Second Readers-Writers problem.
6. Implement programs for Inter Process Communication using PIPE, Message Queue and Shared Memory.
7. Implement Client-Server communication using Socket Programming and TCP as transport layer protocol.*
8. Implement Client-Server communication using Socket Programming and UDP as transport layer protocol.*
9. Implement a multi user chat server using TCP as transport layer protocol.*
10. Implement Concurrent Time Server application using UDP to execute the program at remoteserver. Client sends a time request to the server, server sends its system time back to the client. Client displays the result.*
11. Implement and simulate algorithm for Distance vector routing protocol.
12. Implement and simulate algorithm for Link state routing protocol.
13. Implement Simple Mail Transfer Protocol.*
14. Develop concurrent file server which will provide the file requested by client if it exists. If not server sends appropriate message to the client. Server should also send its process ID (PID) to clients for display along with file or the message.*
15. Using Wireshark observe data transferred in client server communication using UDP and identify the UDP datagram.
16. Using Wireshark observe Three Way Handshaking Connection Establishment, Data Transfer and Three Way Handshaking Connection Termination in client server communication using TCP.
17. Develop a packet capturing and filtering application using raw sockets.
18. Design and configure a network with multiple subnets with wired and wireless LANs using required network devices. Configure the following services in the network- TELNET, SSH, FTP server, Web server, File server, DHCP server and DNS server.*
19. Install network simulator NS-2 in any of the Linux operating system and simulate wired and wireless scenarios.

Expected Outcome

The students will be able to

1. Use network related commands and configuration files in Linux Operating System.
2. Develop operating system and network application programs.
3. Analyze network traffic using network monitoring tools.

Course code	Course Name	L-T-P Credits	Year of Introduction
CS361	SOFT COMPUTING	3-0-0-3	2016

Prerequisite: Nil

Course Objectives

- To introduce the concepts in Soft Computing such as Artificial Neural Networks, Fuzzy logic-based systems, genetic algorithm-based systems and their hybrids.

Syllabus

Introduction to Soft Computing, Artificial Neural Networks, Fuzzy Logic and Fuzzy systems, Genetic Algorithms, hybrid systems.

Expected Outcome

The Students will be able to

1. Learn soft computing techniques and their applications.
2. Analyze various neural network architectures.
3. Define the fuzzy systems.
4. Understand the genetic algorithm concepts and their applications.
5. Identify and select a suitable Soft Computing technology to solve the problem; construct a solution and implement a Soft Computing solution.

Text Books

1. S. N. Sivanandam and S. N.Deepa, Principles of soft computing – John Wiley & Sons, 2007.
2. Timothy J. Ross, Fuzzy Logic with engineering applications , John Wiley & Sons, 2016.

References

1. N. K. Sinha and M. M. Gupta, Soft Computing & Intelligent Systems: Theory & Applications-Academic Press /Elsevier. 2009.
2. Simon Haykin, Neural Network- A Comprehensive Foundation- Prentice Hall International, Inc.1998
3. R. Eberhart and Y. Shi, Computational Intelligence: Concepts to Implementation, Morgan Kaufman/Elsevier, 2007.
4. Driankov D., Hellendoorn H. and Reinfrank M., An Introduction to Fuzzy Control-Narosa Pub., 2001.
5. Bart Kosko, Neural Network and Fuzzy Systems- Prentice Hall, Inc., Englewood Cliffs, 1992
6. Goldberg D.E., Genetic Algorithms in Search, Optimization, and Machine Learning-Addison Wesley, 1989.

Course Plan

Module	Contents	Hours	End Sem. Exam Marks
I	Introduction to Soft Computing Artificial neural networks - biological neurons, Basic models of artificial neural networks – Connections, Learning, Activation Functions, McCulloch and Pitts Neuron, Hebb network.	**07**	**15%**
II	Perceptron networks – Learning rule – Training and testing algorithm, Adaptive Linear Neuron, Back propagation Network – Architecture, Training algorithm	**07**	**15%**
FIRST INTERNAL EXAM			

III	Fuzzy logic - fuzzy sets - properties - operations on fuzzy sets, fuzzy relations - operations on fuzzy relations	**07**	**15%**
IV	Fuzzy membership functions, fuzzification, Methods of membership value assignments – intuition – inference – rank ordering, Lambda – cuts for fuzzy sets, Defuzzification methods	**07**	**15%**
SECOND INTERNAL EXAM			
V	Truth values and Tables in Fuzzy Logic, Fuzzy propositions, Formation of fuzzy rules - Decomposition of rules – Aggregation of rules, Fuzzy Inference Systems - Mamdani and Sugeno types, Neuro-fuzzy hybrid systems – characteristics - classification	**07**	**20%**
VI	Introduction to genetic algorithm, operators in genetic algorithm - coding - selection - cross over – mutation, Stopping condition for genetic algorithm flow, Genetic-neuro hybrid systems, Genetic-Fuzzy rule based system	**07**	**20%**
END SEMESTER EXAMINATION			

Question Paper Pattern

1. There will be *five* parts in the question paper – A, B, C, D, E
2. Part A
   a. Total marks : 12
   b. *Four*questions each having *3* marks, uniformly covering modules I and II; All*four* questions have to be answered.
3. Part B
   a. Total marks : 18
   b. *Three*questions each having *9* marks, uniformly covering modules I and II; T*wo* questions have to be answered. Each question can have a maximum of three sub-parts
4. Part C
   a. Total marks : 12
   b. *Four* questions each having *3* marks, uniformly covering modules III and IV;All*four* questions have to be answered.
5. Part D
   a. Total marks : 18
   b. *Three*questions each having *9* marks, uniformly covering modules III and IV; *Two* questions have to be answered. Each question can have a maximum of three subparts
6. Part E
   a. Total Marks: 40
   b. *Six* questions each carrying 10 marks, uniformly covering modules V and VI; *four* questions have to be answered.
   c. A question can have a maximum of three sub-parts.
7. There should be at least 60% analytical/numerical/design questions.

Course code	Course Name	L-T-P-Credits	Year of Introduction
CS362	Computer Vision	3-0-0-3	2016

Pre-requisite: NIL

Course Objectives

- To build an understanding on detailed models of image formation.
- To expose the students to image feature detection and matching.
- To introduce fundamental algorithms for pattern recognition.
- To introduce various classification techniques.
- To expose the students to various structural pattern recognition and feature extraction techniques.

Syllabus

Image formation and Image model with Components of a vision system, Multiple images and the Geometry of multiple views, High level vision, Basics of pattern recognition, Linear discriminant based classifiers and tree classifiers, Unsupervised Methods, Recent Advances in Pattern Recognition.

Expected Outcome

The students will be able to

i. Appreciate the detailed models of image formation.
ii. Analyse the techniques for image feature detection and matching.
iii. Apply various algorithms for pattern recognition.
iv. Examine various clustering algorithms.
v. Analyze structural pattern recognition and feature extraction techniques.

Text Books:

1. Bernd Jahne and Horst HauBecker, Computer vision and Applications, Academic press, 2000.
2. David A. Forsyth & Jean Ponce, Computer vision – A Modern Approach, Prentice Hall, 2002.

References

1. C. M. Bishop, Pattern Recognition and Machine Learning, Springer, 2006.
2. R. O. Duda, P. E. Hart and D. G. Stork, Pattern Classification, John Wiley, 2001.
3. Richard Hartley and Andrew Zisserman, Multiple View Geometry in Computer Vision, Second Edition, Cambridge University Press, 2004.
4. S. Theodoridis and K. Koutroumbas, Pattern Recognition, 4th Ed., Academic Press, 2009.

COURSE PLAN

Module	Contents	Hours	End Sem. Exam Marks

I	Image formation and Image model- Components of a vision system- Cameras- camera model and camera calibration- Radiometry- Light in space- Light in surface - Sources, shadows and shading.	**06**	**15%**
II	Multiple images-The Geometry of multiple views- Stereopsis- Affine structure from motion- Elements of Affine Geometry Affine structure and motion from two images- Affine structure and motion from multiple images- From Affine to Euclidean images.	**07**	**15%**
FIRST INTERNAL EXAM			
III	High level vision- Geometric methods- Model based vision- Obtaining hypothesis by pose consistency, pose clustering and using Invariants, Verification.	**07**	**15%**
IV	Introduction to pattern and classification, supervised and unsupervised learning, Clustering Vs classification, Bayesian Decision Theory- Minimum error rate classification Classifiers, discriminant functions, decision surfaces- The normal density and discriminant-functions for the Normal density.	**07**	**15%**
SECOND INTERNAL EXAM			
V	**Linear discriminant based classifiers and tree classifiers** Linear discriminant function based classifiers- Perceptron- Minimum Mean Squared Error (MME) method, Support Vector machine, Decision Trees: CART, ID3.	**07**	**20%**
VI	**Unsupervised Methods** Basics of Clustering; similarity / dissimilarity measures; clustering criteria. Different distance functions and similarity measures, K-means algorithm. **Recent Advances in Pattern Recognition** Neural network structures for pattern recognition, Pattern classification using Genetic Algorithms.	**08**	**20%**
END SEMESTER EXAM			

Question Paper Pattern

1. There will be *five* parts in the question paper – A, B, C, D, E
2. Part A
   a. Total marks : 12
   b. *Four* questions each having *3* marks, uniformly covering modules I and II; All*four* questions have to be answered.
3. Part B
   a. Total marks : 18
   b. *Three*questions each having *9* marks, uniformly covering modules I and II;

T*wo* questions have to be answered. Each question can have a maximum of three subparts.

4. Part C
    a. Total marks : 12
    b. *Four* questions each having *3* marks, uniformly covering modules III and IV; All*four* questions have to be answered.
5. Part D
    a. Total marks : 18
    b. *Three*questions each having *9* marks, uniformly covering modules III and IV; *Two* questions have to be answered. Each question can have a maximum of three subparts
6. Part E
    a. Total Marks: 40
    b. *Six* questions each carrying 10 marks, uniformly covering modules V and VI; *four* questions have to be answered.
    c. A question can have a maximum of three sub-parts.

7. There should be at least 60% analytical/numerical questions.

Course code	Course Name	L-T-P Credits	Year of Introduction
CS363	Signals and Systems	3-0-0-3	2016

Pre-requisite: NIL

Course Objectives

- To introduce fundamental concepts of continuous time and discrete time signals.
- To introduce fundamental concepts of continuous time and discrete time systems.
- To introduce frequency domain representation and analysis of signals.

Syllabus

Signals and systems –basic operations on signals – continuous time and discrete time signals – Continuous time and discrete time systems –properties of systems - Z-transform – region of convergence – properties of Z-transform – inverse Z-transform. Fourier transform (FT) of discrete time signals – properties of FT – relation between Z-transform and FT. Discrete Fourier transform (DFT) - Properties of DFT – inverse DFT - Fast Fourier transform (FFT) - Radix-2 FFT algorithms – butterfly structure. Digital filter structures –structures for IIR - Structures for FIR.

Expected Outcome

The Students will be able to

i. Identify different types of continuous time and discrete time signals.
ii. Identify different types of continuous time and discrete time systems.
iii. Analyse signals using Z Transform and FT.
iv. Analyse signals using DFT and FFT.
v. Appreciate IIR digital filter structures.
vi. Appreciate FIR digital filter structures.

Text Books

1. M.N. Bandyopadhyaya , Introduction to Signals and Systems and Digital Signal Processing, PHI, 2005.
2. S.D. Apte, Digital Signal Processing , Wiley India, 2012.

References

1. A. Ambardar, Digital Signal Processing: A Modern Introduction, Thomson India Edition, 2007.
2. A.V. Oppenheim and R. W. Schafer, Discrete Time Signal Processing (Prentice Hall Signal Processing Series), 3e, Pearson, 2009.
3. D. Ganesh Rao and V. P. Gejji, Digital Signal Processing Theory and Lab Practice, Pearson Education Ltd.
4. J.K. Proakis and D.G. Manolakis, Introduction to Digital Signal Processing, MacMillan, 1989
5. Li Tan , Digital Signal Processing, Fundamentals and Applications, Elsevier, 2013.
6. M. H. Hayes, Digital Signal Processing, McGraw Hill (SCHAUM'S Outlines), 2011.
7. P. Ramesh Babu, Digital Signal Processing, Scitech Publications, 2012.
8. S.K. Mitra, Digital Signal Processing, McGraw Hill Education, 2013.
9. S.W. Smith, Digital Signal Processing : A Practical Guide for Engineers and Scientists, Elsevier India.

Course Plan

Module	Contents	Hours	End Sem. Exam Marks

I	Signals and systems – introduction – basic operations on signals – continuous time and discrete time signals –step, impulse, ramp, exponential and sinusoidal functions.	**07**	**15 %**
II	Continuous time and discrete time systems –properties of systems – linearity, causality, time invariance, memory, stability, invertibility. Linear time invariant systems – convolution.	**07**	**15 %**
FIRST INTERNAL EXAM			
III	Z-transform – region of convergence – properties of Z-transform – inverse Z-transform. Fourier transform (FT) of discrete time signals – properties of FT – relation between Z-transform and FT.	**07**	**15 %**
IV	Discrete Fourier transform (DFT) - Properties of DFT – inverse DFT - Fast Fourier transform (FFT) - Radix-2 FFT algorithms – butterfly structure.	**07**	**15 %**
SECOND INTERNAL EXAM			
V	Digital filter structures – block diagram and signal flow graph representation – structures for IIR – direct form structure – Cascade form structure – parallel form structure – lattice structure.	**07**	**20 %**
VI	Structures for FIR – direct form structures – direct form structure of linear phase system – cascade form structure – frequency sampling structure – lattice structure.	**07**	**20 %**
END SEMESTER EXAM			

Question Paper Pattern

1. There will be *five* parts in the question paper – A, B, C, D, E
2. Part A
   a. Total marks : 12
   b. *Four* questions each having *3* marks, uniformly covering modules I and II;All*four* questions have to be answered.
3. Part B
   a. Total marks : 18
   b. *Three*questions each having *9* marks, uniformly covering modules I and II; T*wo* questions have to be answered. Each question can have a maximum of three subparts
4. Part C
   a. Total marks : 12
   b. *Four*questions each having *3* marks, uniformly covering modules III and IV; All*four* questions have to be answered.
5. Part D
   a. Total marks : 18
   b. *Three*questions each having *9* marks, uniformly covering modules III and IV;T*wo*questions have to be answered. Each question can have a maximum of three subparts
6. Part E
   a. Total Marks: 40
   b. *Six* questions each carrying 10 marks, uniformly covering modules V and VI; *four* questions have to be answered.
   c. A question can have a maximum of three sub-parts

There should be at least 60% analytical/numerical questions

Course code	Course Name	L-T-P - Credits	Year of Introduction
CS364	Mobile Computing	3-0-0-3	2016

Pre-requisite: CS307 Data Communication

Course Objectives

- To impart basic understanding of the wireless communication systems.
- To expose students to various aspects of mobile and ad-hoc networks.

Syllabus

Mobile Computing Application and Services, Mobile Computing Architecture, Emerging Technologies, Intelligent Networks and Internet, Wireless LAN, MAC layer routing, Mobile transport layer Security Issues in mobile computing.

Expected Outcome

Student is able to

1. Explain various Mobile Computing application, services and architecture.
2. Understand various technology trends for next generation cellular wireless networks.
3. Describe protocol architecture of WLAN technology.
4. Understand Security Issues in mobile computing.

Text Books

1. Asoke K. Talukder, Hasan Ahmad, Mobile Computing Technology- Application and Service Creation, 2nd Edition, McGraw Hill Education.
2. Jochen Schiller, Mobile Communications, Pearson Education Asia, 2008.
3. Jonathan Rodriguez , Fundamentals of 5G Mobile Networks, ,Wiley Publishers, 2015
4. Theodore S. Rappaport, Wireless Communications Principles and Practice, 2/e, PHI, New Delhi, 2004.

References

1. Andrew S. Tanenbaum, Computer Networks, PHI, Third edition, 2003.

Course Plan

Module	Contents	Hours	End Sem. Exam Marks
I	Introduction to mobile computing, Middleware and Gateways, Application and services, Internet-Ubiquitous networks, Architecture and three-tier architecture for Mobile Computing, Design consideration for Mobile Computing.	06	15%
II	Spread spectrum – Direct sequence, Frequency hoping. Medium Access Control - SDMA, FDMA, TDMA, CDMA, Cellular concepts- channel assignment strategy- hand off strategy interface and system capacity- improving coverage and capacity in cellular system, Satellite Systems-GEO, LEO, MEO. Wireless Communication Systems- Telecommunication Systems- GSM-GSM services & features, architecture -DECT features & characteristics, architecture.	06	15%
FIRST INTERNAL EXAM			
III	Wireless LANS: Wireless LAN Standards – IEEE 802 Protocol Architecture, IEEE 802.11 System Architecture, Protocol Architecture & Services, Cellular Networks: Channel allocation, multiple access, location management, Handoffs. MAC Layer & Management, Routing - Classification of Routing	07	15%

	Algorithms, Algorithms such as DSR, AODV, DSDV, Mobile Agents, Service Discovery.		
IV	Mobile internet-mobile network layer-mobile IP-dynamic host configuration protocol-, mobile transport layer-implications of TCP on mobility-indirect TCP-snooping TCP- mobile TCP transmission-selective retransmission, Transaction oriented TCP- Support for mobility-file systems-WAP.	**07**	**15%**
SECOND INTERNAL EXAM			
V	Mobile Transport Layer - Conventional TCP/IP Protocols, Indirect TCP, Snooping TCP, Mobile TCP, Other Transport Layer Protocols for Mobile Networks. Protocols and Platforms for Mobile Computing - WAP, Bluetooth, XML, J2ME, JavaCard, PalmOS, Linux for Mobile Devices, Android.	**08**	**20%**
VI	Security issues in mobile computing, Information Security, Components of Information Security, Next Generation Networks-LTE – Architecture & Interface – LTE radio planning and tools, 5G architecture, MIMO, Super core concept, Features and Application Case Study – Setting up anadhoc network system, LiFi.	**08**	**20%**
END SEMESTER EXAM			

Question Paper Pattern

1. There will be *five* parts in the question paper – A, B, C, D, E
2. Part A
   a. Total marks : 12
   b. *Four* questions each having *3* marks, uniformly covering modules I and II; All*four* questions have to be answered.
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5. Part D
   a. Total marks : 18
   b. *Three* questions each having *9* marks, uniformly covering modules III and IV; *Two* questions have to be answered. Each question can have a maximum of three subparts
6. Part E
   a. Total Marks: 40
   b. *Six* questions each carrying 10 marks, uniformly covering modules V and VI; *four* questions have to be answered.
   c. A question can have a maximum of three sub-parts.

Course code	Course Name	L-T-P-Credits	Year of Introduction
CS365	OPTIMIZATION TECHNIQUES	3-0-0-3	2016

Prerequisite: Nil

Course Objectives

- To build an understanding on the basics of optimization techniques.
- To introduce basics of linear programming and meta- heuristic search techniques.

Syllabus

Basics of Operations Research - Formulation of optimization problems - Linear Programming - Transportation Problem - Assignment Problem - Network flow Problem - Tabu Search - Genetic Algorithm - Simulated Annealing – Applications.

Expected Outcome

The Students will be able to

i. Formulate mathematical models for optimization problems.
ii. Analyze the complexity of solutions to an optimization problem.
iii. Design programs using meta-heuristic search concepts to solve optimization problems.
iv. Develop hybrid models to solve an optimization problem.

Text Books

1. G. Zapfel, R. Barune and M. Bogl, Meta heuristic search concepts: A tutorial with applications to production and logistics, Springer, 2010.
2. Hamdy A. Taha, Operations Research – An introduction, Pearson Education, 2010.
3. Rao S.S., Optimization Theory and Applications, Wiley Eastern, 1984.

References

1. Gass S. I., Introduction to Linear Programming, Tata McGraw Hill.
2. Goldberg, Genetic algorithms in Search, optimization and Machine Learning, Addison Wesley, 1989.
3. K. Deb, Optimization for engineering design – algorithms and examples, Prentice Hall of India, 2004.
4. Reeves C., Modern heuristic techniques for combinatorial problems, Orient Longman, 1993.

COURSE PLAN

Module	Contents	Hours	End Sem. Exam Marks
I	Decision-making procedure under certainty and under uncertainty - Operations Research-Probability and decision- making- Queuing or Waiting line theory-Simulation and Monte- Carlo Technique- Nature and organization of optimization problems- Scope and hierarchy of optimization- Typical applications of optimization.	08	15%
II	Essential features of optimization problems - Objective function- Continuous functions - Discrete functions - Unimodal functions - Convex and concave functions, Investment costs and operating costs in objective function - Optimizing profitably constraints-Internal and external constraints-Formulation of optimization problems. Continuous functions - Discrete functions - Unimodal functions - Convex and concave functions.	07	15%

FIRST INTERNAL EXAM			
III	Necessary and sufficient conditions for optimum of unconstrained functions-Numerical methods for unconstrained functions - One-dimensional search - Gradient-free search with fixed step size. Linear Programming - Basic concepts of linear programming - Graphical interpretation-Simplex method - Apparent difficulties in the Simplex method.	**06**	**15%**
IV	Transportation Problem, Loops in transportation table, Methods of finding initial basic feasible solution, Tests for optimality. Assignment Problem, Mathematical form of assignment problem, methods of solution.	**06**	**15%**
SECOND INTERNAL EXAM			
V	Network analysis by linear programming and shortest route, maximal flow problem. Introduction to Non-traditional optimization, Computational Complexity – NP-Hard, NP-Complete. Tabu Search-Basic Tabu search, Neighborhood, Candidate list, Short term and Long term memory	**07**	**20%**
VI	Genetic Algorithms- Basic concepts, Encoding, Selection, Crossover, Mutation. Simulated Annealing - Acceptance probability, Cooling, Neighborhoods, Cost function. Application of GA and Simulated Annealing in solving sequencing and scheduling problems and Travelling salesman problem.	**08**	**20%**
END SEMESTER EXAM			

Question Paper Pattern

1. There will be *five* parts in the question paper – A, B, C, D, E
2. Part A
   a. Total marks : 12
   b. *Four* questions each having 3 marks, uniformly covering modules I and II; All*four* questions have to be answered.
3. Part B
   a. Total marks : 18
   b. *Three*questions each having 9 marks, uniformly covering modules I and II; *Two* questions have to be answered. Each question can have a maximum of three subparts.
4. Part C
   a. Total marks : 12
   b. *Four* questions each having 3 marks, uniformly covering modules III and IV; All*four* questions have to be answered.
5. Part D
   a. Total marks : 18
   b. *Three*questions each having 9 marks, uniformly covering modules III and IV; *Two* questions have to be answered. Each question can have a maximum of three subparts

6. Part E
    a. Total Marks: 40
    b. *Six* questions each carrying 10 marks, uniformly covering modules V and VI; *four* questions have to be answered.
    c. A question can have a maximum of three sub-parts.

7. There should be at least 60% analytical/numerical questions.

Course code	Course Name	L-T-P Credits	Year of Introduction
CS366	Natural language processing	3-0-0-3	2016

Prerequisite: Nil

Course Objectives

- To introduce the fundamentals of Language processing from the algorithmic viewpoint.
- To discuss various issues those make natural language processing a hard task.
- To discuss some applications of Natural Language Processing (NLP).

Syllabus

Levels of Language Analysis, Syntax, Semantics and Pragmatics of Natural Language, Language Processing, Issues and approaches to solutions, Applications of Natural Language Processing (NLP).

Expected Outcome

The student able to

1. appreciate the fundamental concepts of Natural Language Processing.
2. design algorithms for NLP tasks.
3. develop useful systems for language processing and related tasks involving text processing.

Text Books

1. D. Jurafsky and J. H. Martin, Speech and Language Processing, Prentice Hall India, 2000
2. James Allen, Natural Language Understanding, 2e, The Benjamin/Cummings Publishing Company Inc., Redwood City, CA.

References

1. Charniak, Eugene, Introduction to Artificial intelligence, Addison-Wesley, 1985..
2. Ricardo Baeza-Yates and Berthier Ribeiro-Neto, Modern Information Retrieval, Addison-Wesley,1999.
3. U. S. Tiwary and Tanveer Siddiqui, Natural Language Processing and Information Retrieval, Oxford University Press, 2008.

Course Plan

Module	Contents	Hours	End Sem. Exam Marks
I	Introduction to Natural Language Understanding- Levels of language analysis- Syntax, Semantics, Pragmatics. Linguistic Background- An Outline of English Syntax.	8	15%
II	Lexicons, POS Tagging, Word Senses. Grammars and Parsing- Features, Agreement and Augmented Grammars.	7	15%
	FIRST INTERNAL EXAM		
III	Grammars for Natural Language, Parsing methods and Efficient Parsing. Ambiguity Resolution- Statistical Methods. Probabilistic Context Free Grammar.	9	15%
IV	Semantics and Logical Form: Linking Syntax and Semantics- Ambiguity Resolution- other Strategies for Semantic Interpretation- Scoping and the Interpretation of Noun Phrases.	6	15%
	SECOND INTERNAL EXAM		
V	Knowledge Representation and Reasoning- Local Discourse	8	20%

	Context and Reference- Using World Knowledge- Discourse Structure- Defining a Conversational Agent.		
VI	Applications- Machine Translation, Information Retrieval and Extraction, Text Categorization and Summarization.	**4**	**20%**
END SEMESTER EXAM			

Question Paper Pattern

1. There will be *five* parts in the question paper – A, B, C, D, E
2. Part A
   a. Total marks : 12
   b. *Four* questions each having *3* marks, uniformly covering modules I and II; All*four* questions have to be answered.
3. Part B
   a. Total marks : 18
   b. *Three* questions each having *9* marks, uniformly covering modules I and II; *Two* questions have to be answered. Each question can have a maximum of three subparts.
4. Part C
   a. Total marks : 12
   b. *Four* questions each having *3* marks, uniformly covering modules III and IV; All*four* questions have to be answered.
5. Part D
   a. Total marks : 18
   b. *Three* questions each having *9* marks, uniformly covering modules III and IV; *Two* questions have to be answered. Each question can have a maximum of three subparts.
6. Part E
   a. Total Marks: 40
   b. *Six* questions each carrying 10 marks, uniformly covering modules V and VI; *four* questions have to be answered.
   c. A question can have a maximum of three sub-parts.

Course code	Course Name	L-T-P - Credits	Year of Introduction
CS367	Logic for Computer Science	3-0-0-3	2016

Pre-requisites : **CS205** Data Structures

Course Objectives

- To introduce the concepts of mathematical logic and its importance.
- To discuss propositional, predicate, temporal and modal logic and their applications.

Syllabus

Propositional Logic, Resolution, binary decision diagrams, Predicate logic, resolution, temporal logic, deduction, program verification, modal logic.

Expected Outcome

The students will be able to

i. Gain the concept of logic and its importance.
ii. Understand fundamental concepts in propositional, predicate and temporal logic and apply resolution techniques.
iii. Apply the concept of program verification in real-world scenarios.
iv. Know the fundamental concepts in modal logic.

Text Books

1. Arindhama Singh, Logics for Computer Science, Prentice Hall India, 2004.
2. Modechai Ben-Ari, Mathematical Logic for Computer Science, Springer, 3/e, 2012.

Reference

1. Michael Huth, Mark Ryan, Logic in Computer Science: Modeling and Reasoning about Systems, Cambridge University Press, 2005.

Course Plan

Module	Contents	Hours	End Sem. Exam Marks
I	Introductory Concepts: Mathematical Logic, Propositional Logic, First Order Logic, Modal and Temporal logic, Program Verification. (**Reading: Ben-Ari, Chapter 1**) Propositional Logic: Formulae and interpretations, Equivalence, Satisfiability& Validity, Semantic Tableaux, Soundness and Completeness. (**Reading: Ben-Ari, Chapter 2 except 2.4, Additional Reading : Singh, Chapter 1**)	**06**	**15%**
II	The Hilbert Deductive System, Derived Rules, Theorems and operators, Soundness and Completeness, Consistency. (**Reading: Ben-Ari, Chapter 3 except 3.7 and 3.8, Additional Reading : Singh, Chapter 1**) Resolution in Propositional Logic: Conjunctive Normal form, Clausal form, resolution rule. (**Reading: Ben-Ari, Chapter 4.1, 4,2, 4.3, Additional Reading : Singh, Chapter 1**)	**06**	**15%**
FIRST INTERNAL EXAM			
III	Binary Decision Diagrams: Definition, Reduced and ordered BDD, Operators. **(Reading: Ben-Ari, Chapter 5.1 – 5.5)** Predicate Logic: Relations, predicates, formulae and interpretation, logical equivalence, semantic tableaux, soundness.**Reading: Ben-Ari, Chapter 7.1-7.6, Additional Reading : Singh, Chapter 2**)	**07**	**15%**

IV	The Hilbert deduction system for predicate logic. Functions, PCNF and clausal form, Herbrand model. Resolution in predicate logic: ground resolution, substitution, unification, general resolution. **Reading: Ben-Ari, Chapter 8.1-8.4, 9.1, 9.3, 10.1-10.4, Additional Reading : Singh, Chapter 2, Chapter 3**)	**08**	**15%**
SECOND INTERNAL EXAM			
V	Temporal logic: Syntax and semantics, models of time, linear time temporal logic, semantic tableaux. Deduction system of temporal logic. (**Reading: Ben-Ari, Chapter 13.1-13.5, 14.1-14.2**)	**07**	**20%**
VI	Program Verification: Need for verification, Framework for verification, Verification of sequential programs, deductive system, verification, synthesis. **(Reading: Ben-Ari, Chapter 15.1-15.4, Additional Reading : Singh, Chapter 5**) **Modal Logic:** Need for modal logic, Case Study: Syntax and Semantics of K, Axiomatic System KC, **(Reading: Singh, Chapter 6.1-6.3**)	**08**	**20%**
END SEMESTER EXAM			

Assignments: Some of the assignments can be given on an interactive theorem prover like Isabelle or Coq.

Question Paper Pattern

1. There will be *five* parts in the question paper – A, B, C, D, E
2. Part A
   a. Total marks : 12
   b. *Four* questions each having *3* marks, uniformly covering modules I and II; All*four* questions have to be answered.
3. Part B
   a. Total marks : 18
   b. *Three* questions each having *9* marks, uniformly covering modules I and II; *Two* questions have to be answered. Each question can have a maximum of three subparts.
4. Part C
   a. Total marks : 12
   b. *Four* questions each having *3* marks, uniformly covering modules III and IV; All*four* questions have to be answered.
5. Part D
   a. Total marks : 18
   b. *Three* questionseach having *9* marks, uniformly covering modules III and IV; *Two* questions have to be answered. Each question can have a maximum of three subparts
6. Part E
   a. Total Marks: 40
   b. *Six* questions each carrying 10 marks, uniformly covering modules V and VI; *four* questions have to be answered.
   c. A question can have a maximum of three sub-parts.

There should be at least 60% analytical/numerical questions.

Course code	Course Name	L-T-P - Credits	Year of Introduction
CS368	Web Technologies	3-0-0-3	2016

Prerequisite: Nil

Course Objectives

- To impart the design, development and implementation of Dynamic Web Pages.
- To develop programs for Web using Scripting Languages.
- To give an introduction to Data Interchange formats in Web.

Syllabus

Basics of Internet and World Wide Web, HTML and XHTML, Cascading Style Sheets, Frameworks, Basics of JavaScript, JQuery, Introduction to XML and JSON, Overview of PHP

Expected Outcome

The student will be able to

i. Understand different components in web technology and to know about CGI and CMS.
ii. Develop interactive Web pages using HTML/XHTML.
iii. Present a professional document using Cascaded Style Sheets.
iv. Construct websites for user interactions using JavaScript and JQuery.
v. Know the different information interchange formats like XML and JSON.
vi. Develop Web applications using PHP.

Text Books

1. P. J. Deitel, H.M. Deitel, Internet &World Wide Web How To Program, 4/e, Pearson International Edition 2010.
2. Robert W Sebesta, Programming the World Wide Web, 7/e, Pearson Education Inc., 2014.

References

1. Bear Bibeault and Yehuda Katz, jQuery in Action, Second Edition, Manning Publications.[Chapter 1]
   Black Book, Kogent Learning Solutions Inc. 2009.
2. Bob Boiko, Content Management Bible, 2nd Edition, Wiley Publishers. [Chapter 1, 2]
3. Chris Bates, Web Programming Building Internet Applications, 3/e, Wiley India Edition 2009.
4. Dream Tech, Web Technologies: HTML, JS, PHP, Java, JSP, ASP.NET, XML, AJAX,
5. Jeffrey C Jackson, Web Technologies A Computer Science Perspective, Pearson Education Inc. 2009.
6. Lindsay Bassett, Introduction to JavaScript Object Notation: A To-the-Point Guide to JSON 1st Edition, O'Reilly.[Chapter 1,2,3,4]
7. Matthew MacDonald, WordPress: The Missing Manual, 2nd Edition, O'Reilly Media. [Chapter 1]

Web Resources

1. www.w3.org/CGI/
2. old.tree.ro/en/strategy-white-papers/content-management-systems.pdf
3. httpd.apache.org/download.cgi
4. https://alistapart.com/article/frameworks
5. http://getbootstrap.com/css/
6. https://www.w3.org/TR/WD-DOM/introduction.html

Course Plan

Module	Contents	Hours	End Sem. Exam Marks

I	**Introduction to the Internet:** The World Wide Web, Web Browsers, Web Servers, Uniform Resource Locators, Multipurpose Internet Mail Extensions, The Hypertext Transfer Protocol. Common Gateway Interface(CGI), Content Management System – Basics *Case Study:* Apache Server, WordPress.	**06**	**15%**
II	**Introduction to HTML/XHTML :** Origins and Evolution of HTML and XHTML, Basic Syntax of HTML, Standard HTML Document Structure, Basic Text Markup, Images, Hypertext Links, Lists, Tables, Forms, HTML5, Syntactic Differences between HTML and XHTML.	**07**	**15%**
FIRST INTERNAL EXAM			
III	**Introduction to Styles sheets and Frameworks** **Cascading Style Sheets:** Levels of Style Sheets - Style Specification Formats, Selector Forms, Property-Value Forms, Font Properties, List Properties, Alignment of Text, Color, The Box Model, Background Images, The span and div Tags. **Frameworks:** Overview and Basics of Responsive CSS Frameworks - Bootstrap.	**06**	**15%**
IV	**Introduction to JavaScript and jQuery** **The Basics of JavaScript:** Overview of JavaScript, Object Orientation and JavaScript, General Syntactic Characteristics- Primitives, Operations, and Expressions, Screen Output and Keyboard Input, Control Statements, Object Creation and Modification,Arrays, Functions. Callback Functions, Java Script HTML DOM. **Introduction to jQuery:** Overview and Basics.	**07**	**15%**
SECOND INTERNAL EXAMINATION			
V	**Introduction to Data Interchange Formats** **XML:** The Syntax of XML, XML Document Structure, Namespaces, XML Schemas, Displaying Raw XML Documents, Displaying XML Documents with CSS, XSLT Style Sheets, XML Applications. **JSON**(Basics Only): Overview, Syntax, Datatypes, Objects, Schema, Comparison with XML.	**08**	**20%**
VI	**Introduction to PHP**: Origins and Uses of PHP, Overview of PHP - General Syntactic Characteristics - Primitives, Operations, and Expressions - Control Statements, Arrays, Functions, Pattern Matching, Form Handling, Cookies, Session Tracking.	**08**	**20%**
END SEMESTER EXAM			

Assignment:

It is highly recommended to give assignment based on:

1. JavaScript Frameworks (like AngularJS or/and NodeJS)
2. Any PHP web app based on frameworks(like Laravel, CodeIgniter, CakePHP, Zend etc.)

Question Paper Pattern

1. There will be *five* parts in the question paper – A, B, C, D, E
2. Part A
   a. Total marks : 12
   b. *Four* questions each having *3* marks, uniformly covering modules I and II; All *four* questions have to be answered.
3. Part B
   a. Total marks : 18
   b. *Three* questions each having *9* marks, uniformly covering modules I and II; *Two* questions have to be answered. Each question can have a maximum of three subparts.
4. Part C
   a. Total marks : 12
   b. *Four* questions each having *3* marks, uniformly covering modules III and IV; All *four* questions have to be answered.
5. Part D
   a. Total marks : 18
   b. *Three* questions each having *9* marks, uniformly covering modules III and IV; *Two* questions have to be answered. Each question can have a maximum of three subparts
6. Part E
   a. Total Marks: 40
   b. *Six* questions each carrying 10 marks, uniformly covering modules V and VI; *four* questions have to be answered.
   c. A question can have a maximum of three sub-parts.

Course code	Course Name	L-T-P - Credits	Year of Introduction
CS369	Digital System Testing & Testable Design	3-0-0-3	2016

Pre-requisites : **CS234** Digital Systems Lab

Course Objectives

- To expose the students to the basics of digital testing techniques applied to VLSI circuits.
- To introduce the concepts of algorithm development for automatic test pattern generation for digital circuits.
- To discuss fundamentals of design for testability.

Syllabus

Basic terminology used in testing - functional and structural models of digital systems -logic simulation for design verification and testing-fault modeling - fault simulation - testing for faults - design for testability.

Expected Outcome

The students will be able to

i. Appreciate the basics of VLSI testing and functions modeling of circuits.
ii. Apply fault modeling using single stuck & multiple stuck modeling for combinational circuits.
iii. Evaluate different methods for logic and fault simulations.
iv. Generate test patterns using automatic test pattern generation methods like D, PODEM & FAN algorithms for combinational circuits.
v. Explain automatic test pattern generation using time frame expansion and simulation based method for sequential circuits.
vi. Design digital circuits using scan path and self tests.

Text Books

1. Alexander Miczo, Digital Logic Testing and Simulation, Wiley, 2e, 2003.
2. Michael L. Bushnell and Vishwani D. Agrawal, Essentials of Electronic Testing for Digital, Memory and Mixed-Signal VLSI Circuits, Springer, 2002.
3. Miron Abramovici, Melvin A. Breuer, Arthur D. Friedman, Digital Systems Testing and Testable Design, Jaico Publishers, 2006.

Reference

1. Zainalabedin Navabi, Digital System test and testable design, Springer, 2011.

Course Plan

Module	Contents	Hours	End Sem. Exam Marks
I	**Fundamentals of Testing:** Testing & Diagnosis, testing at different levels of abstraction, errors & faults, modeling & evaluation,types of testing, test generation **Modeling:** Functional modeling at logic level, functional modeling at register level & structural models.	06	15%
II	**Fault Modeling :** Logic fault models, Fault detection and redundancy, Fault equivalence & fault location, fault dominance, single stuck faults, multiple stuck fault models .	06	15%
FIRST INTERNAL EXAM			

III	**Logic & fault Simulation:** Simulationfor verification& test evaluation, types of simulation – compiled code & Event driven, serial fault simulation, statistical method for fault simulation.	**07**	**15%**
IV	**Combinational circuit test generation**: ATG for SSFs in combinational circuits – fault oriented ATG- fault independent ATG- random test generation, Sensitized path, D-algorithm, PODEM and FAN.	**07**	**15%**
SECOND INTERNAL EXAM			
V	**Sequential circuit test generation:** ATPG for single clock synchronous circuits, time frame expansion method, simulation based sequential circuit ATPG – genetic algorithm.	**07**	**20%**
VI	**Design for Testability:** introduction to testability, design for testability techniques, controllability and observability by means of scan registers, generic scan based designs – scan path, boundary scan, Introduction to BIST**.**	**09**	**20%**
END SEMESTER EXAM			

Question Paper Pattern:

1. There will be *five* parts in the question paper – A, B, C, D, E
2. Part A
    a. Total marks : 12
    b. *Four*questions each having *3* marks, uniformly covering modules I and II;All*four* questions have to be answered.
3. Part B
    a. Total marks : 18
    b. *Three* questions each having *9* marks, uniformly covering modules I and II; *Two* questions have to be answered. Each question can have a maximum of three sub-parts
4. Part C
    a. Total marks : 12
    b. *Four* questions each having *3* marks, uniformly covering modules III and IV; All*four* questions have to be answered.
5. Part D
    a. Total marks : 18
    b. *Three* questionseach having *9* marks, uniformly covering modules III and IV; *Two* questions have to be answered. Each question can have a maximum of three subparts
6. Part E
    a. Total Marks: 40
    b. *Six* questions each carrying 10 marks, uniformly covering modules V and VI; *four* questions have to be answered.
    c. A question can have a maximum of three sub-parts.
7. There should be at least 60% analytical/numerical/design questions.

Course code.	Course Name	L-T-P - Credits	Year of Introduction
CS372	HIGH PERFORMANCE COMPUTING	3-0-0-3	2016

Pre-requisites : CS202 Computer Organization and Architecture

Course Objectives

- To introduce the concepts of Modern Processors.
- To introduce Optimization techniques for serial code.
- To introduce Parallel Computing Paradigms.
- To introduce Parallel Programming using OpenMP and MPI.

Syllabus

Modern processors - pipelining-superscalarity-multicore processors- Mutithreaded processors- vector processors- basic optimization techniques for serial code - taxonomy of parallel computing paradigms- shared memory computers- distributed-memory computers- Hierarchical Systems- networks- basics of parallelization - data parallelism - function parallelism- Parallel scalability- shared memory parallel programming with OpenMp - Distributed-memory parallel programming with MPI.

Expected Outcome

The students will be able to

i. appreciate the concepts used in Modern Processors for increasing the performance.
ii. appreciate Optimization techniques for serial code.
iii. appreciate Parallel Computing Paradigms.
iv. identify the performance issues in Parallel Programming using OpenMP and MPI.

Text Book

1. Georg Hager, Gerhard Wellein, Introduction to High Performance Computing for Scientists and Engineers, Chapman & Hall / CRC Computational Science series, 2011.

References

1. Charles Severance, Kevin Dowd, High Performance Computing, O'Reilly Media, 2nd Edition, 1998.
2. Kai Hwang, Faye Alaye Briggs, Computer Architecture and Parallel Processing, McGraw Hill, 1984.

Course Plan

Module	Contents	Hours	End Sem. Exam Marks
I	Modern Processors : Stored Program Computer Architecture- General purpose cache- based microprocessor-Performance based metrics and benchmarks- Moore's Law- Pipelining- Superscalarity- SIMD- Memory Hierarchies Cache- mapping- prefetch- Multicore processors- Mutithreaded processors- Vector Processors- Design Principles- Maximum performance estimates- Programming for vector architecture.	07	15%

II	Basic optimization techniques for serial code : scalar profiling- function and line based runtime profiling- hardware performance counters- common sense optimizations- simple measures, large impact- elimination of common subexpressions- avoiding branches- using simd instruction sets- the role of compilers - general optimization options- inlining - aliasing- computational accuracy- register optimizations- using compiler logs- c++ optimizations - temporaries- dynamic memory management- loop kernels and iterators data access optimization: balance analysis and light speed estimates- storage order- case study: jacobi algorithm and dense matrix transpose.	**07**	**15%**
FIRST INTERNAL EXAM			
III	Parallel Computers : Taxonomy of parallel computing paradigms- Shared memory computers- Cache coherance- UMA - ccNUMA- Distributed-memory computers- Hierarchical systems- Networks- Basic performance characteristics- Buses- Switched and fat- tree networks- Mesh networks- Hybrids - Basics of parallelization - Why parallelize - Data Parallelism - Function Parallelism- Parallel Scalability- Factors that limit parallel execution- Scalability metrics- Simple scalability laws- parallel efficiency - serial performance Vs Strong scalability- Refined performance models- Choosing the right scaling baseline- Case Study: Can slow processors compute faster- Load balance.	**07**	**15%**
IV	Distributed memory parallel programming with MPI : message passing - introduction to MPI – example - messages and point-to-point communication - collective communication – nonblocking point-to-point communication- virtual topologies - MPI parallelization of Jacobi solver- MPI implementation - performance properties	**08**	**15%**
SECOND INTERNAL EXAM			
V	Shared memory parallel programming with OpenMp : introduction to OpenMp - parallel execution - data scoping- OpenMp work sharing for loops- synchronization - reductions - loop scheduling - tasking - case study: OpenMp- parallel jacobi algorithm- advanced OpenMpwavefront parallelization- Efficient OpenMP programming: Profiling OpenMP programs - Performance pitfalls- Case study: Parallel Sparse matrix-vector multiply.	**08**	**20%**
VI	Efficient MPI programming : MPI performance tools- communication parameters- Synchronization, serialization, contention- Reducing communication overhead- optimal domain decomposition- Aggregating messages – Nonblocking Vs Asynchronous communication- Collective communication- Understanding intra-node point-to-point communication.	**08**	**20%**
END SEMESTER EXAM			

Question Paper Pattern

1. There will be *five* parts in the question paper – A, B, C, D, E
2. Part A
   a. Total marks : 12

   b. *Four* questions each having *3* marks, uniformly covering modules I and II; All*four* questions have to be answered.
3. Part B
   a. Total marks : 18
   b. *Three* questions each having *9* marks, uniformly covering modules I and II; *Two* questions have to be answered. Each question can have a maximum of three subparts.
4. Part C
   a. Total marks : 12
   b. *Four* questions each having *3* marks, uniformly covering modules III and IV; All*four* questions have to be answered.
5. Part D
   a. Total marks : 18
   b. *Three* questions each having *9* marks, uniformly covering modules III and IV; *Two* questions have to be answered. Each question can have a maximum of three subparts
6. Part E
   a. Total Marks: 40
   b. *Six* questions each carrying 10 marks, uniformly covering modules V and VI; *four* questions have to be answered.
   c. A question can have a maximum of three sub-parts.
7. There should be at least 60% analytical/numerical questions.