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
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
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

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
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
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
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
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
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			

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

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.

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

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			

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

Course code	Course Name	L-T-P - Credits	Year of Introduction
**341	DESIGN PROJECT	0-1-2-2	2016

Prerequisite : Nil

Course Objectives

- To understand the engineering aspects of design with reference to simple products
- To foster innovation in design of products, processes or systems
- To develop design that add value to products and solve technical problems

Course Plan

Study : Take minimum three simple products, processes or techniques in the area of specialisation, study, analyse and present them. The analysis shall be focused on functionality, strength, material, manufacture/construction, quality, reliability, aesthetics, ergonomics, safety, maintenance, handling, sustainability, cost etc. whichever are applicable. Each student in the group has to present individually; choosing different products, processes or techniques.

Design: The project team shall identify an innovative product, process or technology and proceed with detailed design. At the end, the team has to document it properly and present and defend it. The design is expected to concentrate on functionality, design for strength is not expected.

Note : The one hour/week allotted for tutorial shall be used for discussions and presentations. The project team (not exceeding four) can be students from different branches, if the design problem is multidisciplinary.

Expected outcome.

The students will be able to

i. Think innovatively on the development of components, products, processes or technologies in the engineering field
ii. Analyse the problem requirements and arrive workable design solutions

Reference:

Michael Luchs, Scott Swan, Abbie Griffin, 2015. Design Thinking. 405 pages, John Wiley & Sons, Inc

Evaluation

First evaluation (Immediately after first internal examination) 20 marks
Second evaluation (Immediately after second internal examination) 20 marks
Final evaluation (Last week of the semester) 60 marks

Note: All the three evaluations are mandatory for course completion and for awarding the final grade.

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
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.