Course Structure and Syllabus

For

B. Tech Programme

(With effect from the Academic Year 2017-2018)

Department of Computer Engineering

DR. BABASAHEB AMBEDKAR TECHNOLOGICAL UNIVERSITY, MAHARASHTRA (INDIA).

Department of Computer Engineering
Dr. Babasaheb Ambedkar Technological University, Lonere 402 103

Programme Educational Objectives

Name of Programme: ***Bachelor of Technology (Computer Engineering)***

A graduate in the discipline of Computer Engineering is generally expected to have three kinds of knowledge. First, the graduate should have *conceptual knowledge* of the core topics of Computer Science. Second, she/he should have *knowledge of mathematical formalism* underlying various programming concepts. Third, graduates in the discipline of Computer Engineering should have the *knowledge of the state of the technologies and tools* so that he/she can apply the principles of Computer Science to solve real-life problems from diverse application domains. The programme of B. Tech. in Computer Engineering at Dr. Babasaheb Ambedkar Technological University (DBTAU) essentially aims to meet these broad expectations. At the same time, the program intends to comply with the courses and syllabus available at **National Program on Technology Enhanced Learning** (**NPTEL**). The following specific educational objectives aims to achieve these global and regional expectations.

Objective Identifier	***Objectives***
PEO1	To provide knowledge of sound mathematical principles underlying various programming concepts.
PEO2	To develop an ability to understand complex issues in the analysis, design, implementation and operation of information systems.
PEO3	To provide knowledge of mechanisms for building large-scale computer-based systems.
PEO4	To develop an ability to provide computer-based solutions to the problems from other disciplines of science and engineering.
PEO5	To impart skills necessary for adapting rapid changes taking place in the field of information and communication technologies.
PEO6	To provide knowledge of ethical issues arising due to deployment of information and communication technologies in the society on large scale.

Programme Outcomes

After undergoing the learning process of four years, students of B. Tech. (Computer Engineering) at Dr. Babasaheb Ambedkar Technological University will have an ability to build information systems and provide computer based solutions to real life problems. The graduates of this programme will demonstrate following abilities and skill sets.

Outcome Identifier	Outcomes
PO1	The graduates will possess the knowledge of various discrete mathematical structures, Logic and numerical techniques.
PO2	The graduates will have an ability to apply mathematical formalism of Finite Automata and Probability in modeling and analysis of systems.
PO3	The graduates will have knowledge of core programming paradigms such as database orientation, object orientation, and agent orientation and concepts essential to implement software based system.
PO4	The graduates will have an ability to analyze problem, specify algorithmic solutions to them and to evaluate alternative solutions.
PO5	The graduate will have broad understanding of the impact of a computer based solutions in economic, environmental and social context and will demonstrate use of analytical tools in gathering requirements and distilling relevant information to provide computer based solutions.
PO6	The graduates will demonstrate the ability to build human centric interfaces to computers.
PO7	The graduates will posses the knowledge of advanced and emerging topics in the fields of operating systems, databases and computer networks.
PO8	The graduates will posses skills necessary to communicate design engineering ideas. The skills set include verbal, written and listening skills.
PO9	The graduates will understand ethical issues in providing computer based solutions also they will have an ability and attitude to address the ethical issues.
PO10	The graduates will understand the role of system software such as operating systems, database management systems, compilers, middle-ware and internet protocols in realizing distributed information environment

ABET's Criteria for Accreditating Engineering Programmes

(a) An ability to apply knowledge of mathematics, science and engineering.

(b) An ability to design and conduct experiments as well as to analyze and interpret data.

(c) An ability to design a system, a component, or process, to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability.

(d) An ability to function on multidisciplinary teams.

(e) An ability to identify, formulate and solve engineering problems.

(f) An understanding of professional and ethical responsibility.

(g) An ability to communicate effectively.

(h) The broad education necessary to understand the impact of engineering solutions in a global, economical, environmental and social context.

(i) A recognition of the need for and an ability to engage in life-long learning.

(j) A knowledge of contemporary issues, and

(k) An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

Mapping of Programme Outcomes with ABET's Criteria

	a	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**
PO1	x										
PO2	x								x		
PO3		x	x								
PO4			x		x						
PO5			x					x			
PO6					x						
PO7										x	
PO8							x				
PO9						x					
PO10											x

Second Year B. Tech. (Computer Engineering)

No.	Course Type	Code	Course Name	L	T	P	CR
Semester Third							
1	Core	CE301	Digital Circuits	3	1		4
2	Core	CE302	Discrete Mathematics	3	1		4
3	Core	CE303	Computer Architecture and Organization	3			3
4	Core	CE304	Basic Human Rights	3			3
5	DSE	CE305	**Elective 301** 1. Object-Oriented Programming in C++ 2. Object-Oriented Programming in Java	3			3
6	Core	CE306	Numerical Methods	3			3
7	Lab Course	CE307	Digital Circuits Laboratory			2	1
8	Lab Course	CE308	Object-Oriented Programming Laboratory			2	1
9	SEC	CE309	Web Page Design (HTML)	1		2	3
Total Credits 25							
Semester Fourth							
1	Core	CE401	Data Communications	3	1		4
2	Core	CE402	Data Structures	3	1		4
3	Core	CE403	Operating Systems	3	1		4
4	GE	CE404	**Elective 401** 1. Micro-Processors 2. Any Course offered by other Department	3			3
5	GE (Math)	CE405	**Elective 402** 1. Probability, Statistics, and Queueing Theory 2. Engineering Mathematics – III	3			3
6	Lab Course	CE406	Data Structure Laboratory		4		2
7	Lab Course	CE407	Operating System Laboratory		2		1
8	SEC	CE408	Web Application Development (JSP, PHP, J2EE)	1		2	2
9	SEC	CE409	Python Programming	1		2	2
Total Credits 25							

Third Year B. Tech. (Computer Engineering)

No.	Course Type	Code	Course Name	L	T	P	CR
Semester Fifth							
1	Core	CE501	Database Management System	3	1		4
2	Core	CE502	Design and Analysis of Algorithms	3	1		4
3	Core	CE503	Theory of Computations	3	1		4
4	DSE	CE504	**Elective 501** 1. Object Oriented Analysis and Design 2. Introduction to Data Analytics 3. Digital Image Processing	3			3
5	DSE	CE505	**Elective 502** 1. Management Sciences 2. Development Engineering 3. National Service Scheme – I (NSS – I)	3			3
6	Lab Course	CE506	Database Management System Laboratory			2	1
7	Lab Course	CE507	Design & Analysis of Algorithm Laboratory			4	2
8	SEC	CE508	Smart Phones Application Development	1		2	2
9	AECC	CE509	Seminar			4	2
Total Credits 25							
Semester Sixth							
1	Core	CE601	Compiler Construction	3	1		4
2	Core	CE602	Computer Networks	3	1		4
3	DSE	CE603	**Elective 601** 1. Computer Graphics 2. Database Implementation Techniques	3			3
4	DSE	CE604	**Elective 602** 1. Human Computer Interaction 2. Real Time System	3			3
5	DSE	CE605	**Elective 603** 1. Bio-Metrics 2. Operating System Design	3			3
6	Lab Course	CE606	Computer Networks Laboratory			2	1
7	Lab Course	CE607	Compiler Construction Laboratory			2	1
8	SEC	CE608	System Administration	1		2	2
9	SEC	CE609	MOOC (Self Study Course)			4	2
10	AECC	CE610	Industrial Training			4	2
Total Credits 25							

Fourth Year of B. Tech. (Computer Engineering)

No.	Course Type	Code	Course Name	L	T	P	CR
Semester Seventh							
1	Core	CE701	Software Engineering	3			3
2	Core	CE702	Artificial Intelligence	3			3
3	Core	CE703	Inter-Networking Protocols	3			3
4	DSE	CE704	**Elective 701** 1. Distributed System 2. Cloud Computing	3			3
5	DSE	CE705	**Elective 702** 1. Computer Vision 2. Natural Language Processing	3			3
	Lab Course	CE706	Inter Networking Protocol Laboratory			4	2
6	Lab Course	CE707	Software Engineering Laboratory			2	1
7	Lab Course	CE708	Artificial Intelligence Laboratory			2	1
8	Lab Course	CE709	Project Phase I			4	4
9	SEC	CE7	Hadoop Platform Development	1		2	2
Total Credits 25							
Eight Semester							
1	DSE	CE801	**Elective-801** 1. Software Quality Assurance 2. Software Architecture	3			3
2	DSE	CE802	**Elective 802** 1. Data Science with R 2. Cryptography and Network Security	3			3
3	DSE	CE803	**Elective-803** 1. Bio-Informatics 2. Internet of Things (IoT) 3. Cyber Law	3			3
4	GE	CE804	**Elective 804** 1. Principles of Management 2. Business Intelligence 3. National Service Scheme – II (NSS-II)	3			3
5	AECC	CE806	Project Phase II		2	6	8
6	SEC	CE807	Contiguous Integration	1		2	2
Total Credits 22							

Mapping with NPTEL Courses

Course at DBATU	NPTEL Course and Link	Course Instructor
Semester III		
Digital Circuits	Digital Circuit (Web)	Prof. Roy Paily Palanthinkal Prof. Anil Mahanta, IIT Guwahati
Computer Architecture and Organization	Computer Organization and Architecture (Web) Computer Organization(Video)	Prof. B. Raman, IIT Bombay Prof. S. Raman, IIT Madras
Discrete Mathematics	Discrete Mathematics (Video) Discrete Mathematics (Video)	Prof. K. Krithivasan, IIT Madras Dr. S. Gangopadhyay, IIT Roorkee
Object-oriented Programming	Programming in C++ (Video)	Prof. Partha P. Das, IIT Kharagpur
Numeric Methods	Numerical Methods and Computation(Video)	Prof. S. R. K. Iyengar, IIT Delhi
Basic Human Rights	Not Available	Not Available
Semester IV		
Data Communication	Data Communication (Video)	Prof. Ajit Pal, IIT Kharagpur
Data Structure	Data Structures And Algorithms (Video)	Prof. Naveen Garg, IIT Delhi
Operating System	Operating System (Web) Introduction to Operating Systems (Video)	Prof. P. C. P. Bhatt, IISc Bangalore Prof. Chester Rebeiro, IIT Madras
Micro-Processor	Microprocessors and Microcontrollers (Web)	Prof. Krishna Kumar, IISc Bangalore
Probability, Statistics and Queueing Theory	Probability and Distributions (Web) Probability and Statistics (Video)	Prof. Neeraj Misra, IIT Kanpur Prof. S. Kumar, IIT Kharagpur
Engineering Mathematics-III	Mathematics III (Video)	Prof. P.N. Agrawal, Dr. Tanuja Srivastava IIT Roorkee
Python Programming	Programming, Data Structures and Algorithms in Python (Video)	Prof. Madhavan Mukund, Chennai Mathematical Institute

Mapping with NPTEL Courses

Course at DBATU	NPTEL Course and Link	Course Instructor
Semester V		
Database Management System	Database Design (Video) Introduction to Database Systems and Design (Web)	Prof. D. Janaki Ram, IIT Madras Prof. P. Sreenivasa Kumar, IIT Madras
Design and Analysis of Algorithm	Design and Analysis of Algorithms (Video) Design and Analysis of Algorithms (Video)	Prof. Abhiram G. Ranade, Prof. Ajit A. Diwan, IIT Bombay Prof. Madhavan Mukund, Chennai Mathematical Institute
Theory of Computation	Theory of Computation(Video) Theory of Automata, Formal Languages and Computation	Prof. Somenath Biswas, IIT Kanpur Prof. Kamala Krithivasan, IIT Madras
Object Oriented Analysis and Design	Object-Oriented Analysis and Design (Video)	Prof. Partha P. Das, IIT Kharagpur
Introduction to Data Analytics	Introduction to Data Analytics	IIT Madras
Digital Image Processing	Digital Image Processing (Web)	Dr. G. Harit, IIT Kharagpur
Management Science	Management Science (Video) Management Science (Web)	Prof. Anuradha Sharma, IIT Delhi Prof. M. Thenmozhi, IIT Madras
Development Engineering	Not Available	Not Available
National Service Scheme – I	Not Available	Not Available
Smart Phone Application Development	Mobile Computing (Video)	Prof. Pushpendra Singh, IIITD
Semester VI		
Compiler Construction	Principles of Compiler Design Compiler Design (Video)	Prof. Y. N. Srikanth, IISc Bangalore Prof. S. K. Aggarwal, IIT Kanpur
Computer Networks	Computer Networks (Video) Computer Networks (Web)	Prof. Sujoy Ghosh, IIT Kharagpur Prof. Ajit Pal, IIT Kharagpur
Computer Graphics	Computer Graphics (Video)	Prof. Sukhendu Das, IIT Madras
Database Implementation Technique	Database Design (Video)	Prof. D. Janaki Ram, IIT Madras
Human Computer Interface	Human-Computer Interaction (Video)	Prof. Pradeep P. Yammiyavar, Dr. S. Bhattacharya, IIT Guwahati
Real-time System	Real Time Systems (Video)	Prof. Rajib Mall, IIT Kharagpur
Bio-metric	Biometrics (Video)	Prof. Phalguni Gupta, IIT Kanpur
Operating System Design	Not Available	Not Available

Mapping with NPTEL Courses

Course at DBATU	NPTEL Course and Link	Course Instructor
Semester VII		
Software Engineering	Software Enginneing (Video) Software Engineering (Web)	Prof. R. K. Joshi, IIT Bombay Prof. Rajib Mall, IIT Kharagpur
Artificial Intelligence	Artificial Intelligence (Video) Artificial Intelligence (Web)	Prof. Deepak Khemani, IIT Madras Prof. S. Sarkar, Prof. P. Mitra, IIT Kharagpur
Inter Networking Protocols	Not Available	Not Available
Distributed System	Distributed Computing Systems (Web)	Prof. Ananthanarayana V. S, NITK
Cloud Computing	Not Available	Not Available
Computer Vision	Not Available	Not Available
Natural Language Processing	Natural Language Processing (Video)	Prof. Pushpak Bhattacharyya, IIT Bombay
Hadoop Platform Development	Not Available	Not Available
Semester VIII		
Software Quality Assurance	Software Testing	Prof. Rajib Mall, IIT Kharagpur
Software Architecture	Software Architecture Design (Video) Software Enginneing (Video)	Dr. Bedir Tekinerdoğan Prof. R. K. Joshi, IIT Bombay
Data Science with R	Introductory Data Science using R (Video)	David Langer
Cryptography and Network Security	Cryptography and Network Security (Video)	Dr. Debdeep Mukhopadhyay, IIT Kharagpur
Bio-Informatics	Not Available	Not Available
Internet of Things	Not Available	Not Available
IBM Watson/Bluemix	Not Available	Not Available
Principles of Management	Not Available	Not Available
National Service Scheme – II	Not Available	Not Available
Business Intelligence	Not Available	Not Available

CE301 Digital Circuits

Course Objectives and Outcomes:

- [DCCO1] Perform the conversion among different number systems.
- [DCCO2] Design digital components including – decoders, multiplexers, arithmetic circuits.
- [DCCO3] Design of synchronous sequential circuits.
- [DCCO4] Describe design methodology for different combinational logic circuit.
- [DCCO5] Analyze digital systems and improve the performance by reducing complexities.
- [DCCO6] Test digital systems and analyze faults.

CO to PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
DCCO1	x									
DCCO2				x						
DCCO3				x						
DCCO4		x		x						
DCCO5		x		x						
DCCO6	x	x								

Unit I

Number Systems and Codes: Binary number system, Signed binary numbers, Binary arithmetic, Decimal number system, Hexadecimal number system, Octal number system, Arithmetic operations using 1's complement, 2's complement, 9's complement, 10's complement. Codes: Numeric codes, Weighted and non-weighted codes, Sequential codes, Self complimenting codes, Cyclic codes, Reflective codes, BCD code, Excess-3 code, Gray code, Error detecting and correcting codes.

Unit II

Boolean Algebra and Logic Functions: Introduction to analog and digital signal, Logic gates and switching functions: AND, OR, NOT, EX-OR, EX-NOR, NAND, NOR. Implementation of universal gates using logic gates, De Morgan's theorem, Boolean algebra, Representation of logic functions using POS and SOP form, Minimization of completely and incompletely specified switching functions Karnaugh map (2,3,4,5,6 variable).

Unit III

Combinational Circuits Design: Quine – McCluskey method, TTL and CMOS logic families, Half and full adder, Half and full subtractor, Binary parallel adder, Binary parallel subtractor, Look ahead carry header, BCD to 7-segment decoder, Binary to Gray code converter, Gray to Binary code converter.

Unit IV

Combinational Logic Design using MSI Circuits: Multiplexer, Demultiplexer, BCD arithmetic: BCD adder, BCD subtractor, Arithmetic logic unit, Digital comparators, Parity generators. Design of PAL, Design of PLA, Design of PROM.

Unit V

Designing with Sequential MSIs: Comparison between sequential and combinational circuit, Synchronous sequential circuits and asynchronous sequential circuits, Registers, Shift registers, Counters: asynchronous counters and synchronous counters, Sequential circuit's implementation. Flip flops: Edge triggered flip-flops, S-R flip flop, J-K flip flop, T flip flop, D flip flop.
conversion.

Unit VI

Finite State Machines and ASM Charts: Regular expressions using FSM, Optimization using FSM, Reduction of states, Mealy and Moore machine. Representation of sequential circuits using ASM charts, Synthesis of output and next state functions, Data path and control path, Partition-based design.

Text Books:

1. R. P. Jain, *Modern Digital Electronics*, 3rd Edition, McGraw-Hill Publication, 2003.
2. Zvi Kohavi, *Switching and Finite Automata Theory*, 2nd Edition, McGraw-Hill Publication, 2001.
3. M. Morris Mano, *Digital Design*, 3rd Edition, Prentice Hall Publication, 2001.

Reference Books:

1. F. J. Gill Peterson, *Switching Theory and Logic Design*, John Wiley Publication.
2. Samuel C. Lee, *Digital Circuits and Logic Design*, PHI Publication.
3. V. Rajaraman, T. Radhakrishnan, *An Introduction to Digital Computer Design*, McGraw-Hill Publication.
4. Hatchell and Gray, *Logic Synthesis and Verification Algorithms*, Kluwer Academic Publication.
5. A. Anandkumar, *Switching Theory and Logic Design*, PHI Learning, 2008.

CE302 Discrete Mathematics

Course Objectives and Outcomes:

- [DMCO1] Understand sets, relations, functions and discrete structures. Apply Propositional logic and First order logic to solve problems.
- [DMCO2] Express and solve number theoretic problems using algebraic properties of groups, rings and fields.
- [DMCO3] To design and develop real time application using graph theory.
- [DMCO4] Students would be able to model and analyze computational processes using analytic and combinatorial methods.
- [DMCO5] Students will be able to use the methods learnt as part of this subject in subsequent courses in the design and analysis of algorithms, theory of computation, and compilers.
- [DMCO6] Develop a discrete model for a given computational problem and solve.

CO to PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
DMCO1	x	x		x						
DMCO2	x									
DMCO3			x							
DMCO4		x			x					
DMCO5			x							
DMCO6				x	x					

Unit I

Fundamental Structures and Basic Logic: Sets, Venn diagram, Cartesian product, Power sets, Cardinality and countability, Propositional logic, Logical connectives, Truth tables, Normal forms, Validity, Predicate logic, Limitations of predicate logic, Universal and existential quantification, First order logic.

Unit II

Functions and Relations: Subjective, Injective, Bijective and inverse functions, Composition of function, Reflexivity, Symmetry, Transitivity and equivalence relations.

Unit III

Combinatorics: Counting, Recurrence relations, generating functions.

Unit V

Graph Theory: Basic terminology, Multi graphs and weighted graphs, Paths and circuits, Shortest path problems, Euler and Hamiltonian paths, Representation of graph, Isomorphic graphs, Planar graphs, Connectivity, Matching Coloring.

Unit IV

Trees: Rooted trees, Path length in rooted tree, Binary search trees, Spanning trees and cut set, Minimal spanning trees, Kruskal's and Prim's algorithms for minimal spanning tree.

Unit VI

Algebraic Systems: Algebraic systems, Groups, Semi group, Monoid, Subgroup, Isomorphism and homomorphism, Rings and fields, Lattices, Boolean lattices and Boolean algebra.

Text Books:

1. C. L. Liu, *Elements of Discrete Mathematics*, 3rd Edition, McGraw-Hill Publication, 2008.
2. Kenneth H. Rosen, *Discrete Mathematics and its Applications*, 6th Edition, McGraw-Hill Publication, 2010.
3. Y. N. Singh, *Discrete Mathematical Structures*, Wiley Publication.
4. Dr. Sukhendu Dey, *Graph Theory with Applications*, SPD Publication.

Reference Books:

1. Lipschutz Lipson, *Discrete Mathematics*, 3rd Edition, McGraw Hill Publication, 2009.
2. V. K. Balakrishnan, *Schaum's Outline Of Graph Theory*, 1st Edition, McGraw Hill Publication.
3. Eric Gossett, *Discrete Mathematics with Proof*, 2nd Edition, Wiley Publication.

CE303 Computer Architecture and Organization

Course Objectives and Outcomes:

- [CACO1] To understand the basic hardware and software issues of computer organization.
- [CACO2] Identify functional units, bus structure and addressing modes.
- [CACO3] Students will be able to identify where, when and how enhancements of computer performance can be accomplished.
- [CACO4] Students will also be introduced to more recent applications of computer organization in advanced digital systems.
- [CACO5] Identify memory hierarchy and performance.

CO to PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CACO1	x									
CACO2		x								
CACO3						x		x		
CACO4					x					
CACO5				x						

Unit I

Introduction: Concept of computer organization and architecture, Fundamental unit, Computer function and interconnection, CPU structure and function.

Unit II

Instruction Sets: Characteristics, Types of operands, Types of operations, Assembly language, Addressing modes, Instruction format, Types of instruction, Instruction execution, Machine state and processor status, Structure of program, Introduction to RISC and CISC architecture.

Unit III

Computer Arithmetic: The arithmetic and logic Unit, Integer representation, Integer arithmetic, Floating point representation, Floating point arithmetic, Introduction of arithmetic co-processor.

Unit IV

Memory Organization: Internal Memory: Semiconductor main memory, Error correction, Advanced DRAM organization, Virtual memory systems and cache memory systems. External Memory: Organization and characteristics of magnetic disk, Magnetic tape, Optical memory, RAID, Memory controllers.

Unit V

Control Unit: Control unit operation: Micro-operations, Control of the processor, Hardwired implementation, Micro-programmed Control Unit, Basic concepts, Micro-instruction sequencing, Micro-instruction execution, Applications of micro-programming.

Unit VI

Input/ Output Organization: External devices, I/O module, Programmed I/O, Interrupt driven I/O, Direct memory access, I/O channels and processors, External interface.

Instruction pipe-lining: Concepts. Parallel processing: Multiple processor organization, Symmetric multiprocessor, Cache coherence and the MESI protocol.

Text Books:

1. William Stalling, *Computer Organization and Architecture: Designing for Performance*, 8th Edition, Prentice Hall Publication, 2009.
2. Hayes, *Computer Architecture and Organization*, 3rd Edition, McGraw-Hill Publication.
3. Zaky, *Computer Organization*, 5th Edition, McGraw-Hill Publication.

Reference Books:

1. Hennessy and Patterson, *Computer Architecture: A Quantitative Approach*, 4th Edition, Morgan and Kaufman Publication, 2007.
2. Morris Mano, *Computer Architecture and Organization*, PHI Publication.
3. Mostafa Abd-El-Barr, Hesham El-Rewini, *Fundamentals of Computer Organization and Architecture*, Wiley Publication.
4. Miles J. Murdocca, Vincent P. Heuring, *Computer Architecture and Organization: An Integrated Approach*, Wiley Publication.
5. Sajjan G. Shiva, *Computer Organization, Design, and Architecture*, CRC Press.

CE304 Basic Human Rights

Course Objectives and Outcomes:

- [BHCO1] Be familiar with the major universal and regional systems of human rights law, their relationships to each other, and the legal value and authority of declarations, decisions, judgments and other materials generated by them.
- [BHCO2] Develop an awareness of the primary areas of concern within the field of human rights law and other relevant branches of law, and the ways in which human rights are promoted and protected.

CO to PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
BHCO1									x	
BHCO2								x		

Unit I

The Basic Concepts

Individual, group, civil society, state, equality, justice, Human Values: - Humanity, virtues, compassion.

Unit II

Human rights and Human Duties

Origin, civil and political rights, Contribution of American bill of rights, French revolution, Declaration of independence, Rights of citizen, Rights of working and exploited people, Fundamental rights and economic program, India's charter of freedom.

Unit III

Society, religion, culture, and their inter-relationship

Impact of social structure on human behavior, Roll of socialization in human values, Science and Technology, modernization, globalization, and dehumanization.

Unit IV

Social Structure and Social Problems

Social and communal conflicts and social harmony, rural poverty, unemployment, bonded labour, Migrant workers and human rights violations, human rights of mentally and physically challenged.

Unit V

State, Individual liberty, Freedom and Democracy

The changing of state with special reference to developing countries, Concept of development under development and social action, need for collective action in developing societies and methods of social action, NGOs and human rights in India: - Land, Water, Forest issues.

Unit VI

Human Rights in Indian Constitution and Law

The constitution of India:

(i) Preamble

(ii) Fundamental rights.

(iii) Directive principles of state policy.

(iv) Fundamental duties.

(v) Some other provisions.

Universal declaration of human rights and provisions of India, Constitution and law, National human rights commission and state human rights commission.

Text Books:

1. Shastry, T. S. N., *India and Human rights: Reflections*, Concept Publishing Company India Pvt. Ltd., 2005.
2. Nirmal, C.J., *Human Rights in India: Historical, Social and Political Perspectives (Law in India)*, Oxford India.

CE305 Object-Oriented Programming using C++ (Elective 301)

Course Objectives and Outcomes:

- [OCCO1] Appreciation and understanding of object oriented concepts and their utility.
- [OCCO2] Apply Object oriented approach to design software.
- [OCCO3] Ability to formulate the problem, come up with object oriented design.
- [OCCO4] Practicing use of different features of Object Oriented Methodology like templates, exception handling, reflection etc.
- [OCCO5] Study different systems and apply different design methodologies based on the problem specification and objectives.

CO to PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
OCCO1	x		x							
OCCO2					x					
OCCO3				x						
OCCO4			x	x						
OCCO5	x		x	x						x

Unit I

Introduction to Object Oriented Programming and Objects and Classes: Need of object oriented programming, The object oriented approach, Characteristics of object oriented languages. A class, Objects as data types, Constructors, Objects as function arguments, Returning objects.

Unit II

Operator Overloading and Inheritance:. Overloading unary and binary operators, Data conversion. Derived and base class, Public and private inheritance, Levels of inheritance, Multiple inheritance Examples.

Unit III

Polymorphism: Virtual functions, Dynamic binding, Abstract classes and pure virtual functions, Friend functions, The this pointer.

Unit IV

Streams and Files: Streams, Stream output and input, Stream manipulators, Files and streams, Creating, Reading, Updating sequential and random files.

Unit V

Templates and Exception Handling: Function templates, Overloading function templates, Class templates, Exception handling overview, Need of exceptions, An exception example, Multiple exceptions, Exception specifications.

Unit VI

Standard Template Library (STL): Introduction to STL- Containers, Iterators, Algorithms, Sequence containers, Associative containers, Container adapters.

Text Books:

1. E. Balagurusamy, *Object Oriented Programming with C++*, McGraw-Hill Publication.
2. Robert Lafore, *Object Oriented Programming in C++*, Sams Publishing.
3. Dr. B. B. Meshram, *Object Oriented Paradigms with C++ Beginners Guide for C and C++*, SPD Publication.
4. Rajesh R. Shukla, *Object-Oriented Programming in C++*, Wiley India Publication.

Reference Books:

1. P. J. Deitel, H. M. Deitel, *C++ How to Program*, PHI Publication.
2. John Hubbard, *Programming with C++*, Schaum's outlines, McGraw-Hill Publication.
3. Nicolai M. Josuttis, *Object-Oriented Programming in C++*, Wiley Publication.

CE305 Object-Oriented Programming using Java (Elective 301)

Course Objectives and Outcomes:

- [OJCO1] Appreciation and understanding of object oriented concepts and their utility.
- [OJCO2] Apply Object oriented approach to design software.
- [OJCO3] Ability to formulate the problem, come up with object oriented design.
- [OJCO4] Practicing use of different features of Object Oriented Methodology like templates, exception handling, reflection etc.
- [OJCO5] Study different systems and apply different design methodologies based on the problem specification and objectives.

CO to PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
OJCO1	x		x							
OJCO2					x					
OJCO3				x						
OJCO4			x	x						
OJCO5	x		x	x						x

Unit I

Introduction to Computers and Java: Introduction, Computers: Hardware and Software, Data Hierarchy, Computer Organization, Machine Languages, Assembly Languages and High-Level Languages, Introduction to Object Technology, Operating Systems, Programming Languages, Java and a Typical Java Development Environment, Your First Program in Java: Printing a Line of Text, Modifying Your First Java Program, Displaying Text with printf, Another Application: Adding Integers, Memory Concepts, Arithmetic, Decision Making: Equality and Relational Operators.

Unit II

Introduction to Classes, Objects, Methods and Strings: Introduction, Declaring a Class with a Method and Instantiating an Object of a Class, Declaring a Method with a Parameter, Instance Variables, set Methods and get Methods, Primitive Types vs. Reference Types, Initializing Objects with Constructors Floating-Point Numbers and Type double.

Unit III

Control Statements: Introduction, Algorithms, Pseudocode, Control Structures, if Single-Selection Statement, if...else Double-Selection Statement, while Repetition Statement, Formulating Algorithms: Counter-Controlled Repetition, Formulating Algorithms: Sentinel-Controlled Repetition, Formulating Algorithms: Nested Control Statements, Compound Assignment Operators, Increment and Decrement Operators, Primitive Types, Essentials of Counter-Controlled Repetition, for Repetition Statement, Examples Using the for Statement, do...while Repetition Statement, switch Multiple-Selection Statement, break and continue Statements, Logical Operators.

Unit IV

Array: Introduction, Declaring and Creating Arrays, Examples Using Arrays, Case Study: Card Shuffling and Dealing Simulation, Enhanced for Statement, Passing Arrays to Methods, Case Study: Class GradeBook Using an Array to Store Grades, Multidimensional Arrays, ase Study: Class GradeBook Using a Two-Dimensional Array, Variable-Length Argument Lists, Using Command-Line Arguments, Class Arrays.

Unit V

Classes and Objects: Introduction, Controlling Access to Members, Referring to the Current Object's Members with the this Reference, Time Class Case Study: Overloaded Constructors, Time, Default and No-Argument Constructors, Notes on Set and Get Methods, Composition, Enumerations, Garbage Collection and Method finalize, static Class Members, static Import, final Instance Variables, Time Class Case Study: Creating Packages, Package Access.

Unit VI

Inheritance: Introduction, Superclasses and Subclasses, protected Members, Relationship between Superclasses and Subclasses, Hierarchy Using private Instance Variables, Constructors in Subclasses Software Engineering with Inheritance, Class Object.

Polymorphism: Introduction, Polymorphism Examples, Demonstrating Polymorphic Behavior, Abstract Classes and Methods, Case Study: Payroll System Using Polymorphism, final Methods and Classes, Case Study: Creating and Using Interfaces.

Reference Book:

1. *Java: How to Program*, 9th Edition, Paul Deitel and Harvey Detail, Pearson's Publication.
2. Joel Murach and Michael Urban, *Murach's Beginning Java with Eclipse*, Murach's Publication.
3. Doug Lowe, *Java All-in-One For Dummies*, 4th Edition, Wiley Publication.
4. Herbert Schildt, *Java The Complete Reference*, 8th Edition, McGraw-Hill Publication.
5. Patrick Niemeyer, Daniel Leuck, *Learning Java, 4th Edition A Bestselling Hands-On Java Tutorial*, O'Reilly Media.

CE306 Numerical Methods

Course Objectives and Outcomes:

- [NMCO1] Determine an interpolating function for data.
- [NMCO2] Solve initial value problems.
- [NMCO3] aware of the use of numerical methods in modern scientific computing.
- [NMCO4] Students would be able to assess the approximation techniques to formulate and apply appropriate strategy to solve real world problems.

CO to PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
NMCO1		x		x						
NMCO2	x	x								
NMCO3	x	x		x						
NMCO4		x		x	x					

Unit I

Solution of Algebraic and Transcendental Equation: Bisection method, Method of false position, Newton's method and Newton-Raphson method, Approximate solution of equation – Horner's method.

Unit II

Solution of Linear Simultaneous Equation: Gauss elimination method, Gauss-Jordan method, Crout's triangular method, Iterative method of solution- Jacobi iteration method, Gauss-Seidal iteration method, Relaxation method.

Unit III

Finite Differences: Forward difference operator, Backward difference operator, Central difference operator, Newton's interpolation formula, Newton's forward–backward-central interpolation formula, Sterling formula, Bessel's formula, Interpolation with unequal intervals.

Unit IV

Differentiation and Integration: Newton-Cortes formula, Trapezoidal rule, Simpson one–third rule, Simpson three- eighth rule, Weddle's rule.

Unit V

Numerical Solution of ODE: Picard's methods, Taylor series method, Euler's method, Modified Euler's method, Runge – Kutta method, Predictor–corrector method, Milne's method. Adams-Bash fourth method, Second–order differential equation, Numerical solution for elliptical partial differential equation.

Text Books:

1. B.S Grewal, *Higher Engineering Mathematics*, 40th Edition, Khanna Publication.
2. S. S. Shastri, *Introduction to Numerical Methods*, PHI Publication.
3. V. Rajaraman, *Computer Oriented Methods*, 3rd Edition, PHI Publication.
4. Raymond P. Canale and Steven C. Chapra, *Numerical Methods for Engineers*, 7th Edition, McGraw-Hill Publication.

Reference Books:

1. Conte and De boor, *Elementary Numerical Analysis*, BPB Publication.
2. E. Kreyszig, *Advanced Engineering Mathematics*, Wiley Publication.
3. Steven C Chapra, *Numerical Methods for Engineers*, 5th Edition, McGraw Hill Publication.
4. James F. Epperson, *An Introduction to Numerical Methods and Analysis*, 2nd Edition, Wiley Publication.

CE307 Digital Circuits Laboratory

(1) Simplification, realization of Boolean expressions using logic gates/universal gates.

(2) Realization of half/full adder & half/full subtractors using logic gates.

(3) Realization of parallel adder/subtractors using 7483 chip, BCD to Excess-3code conversion & vice versa.

(4) Realization of binary to gray code conversion & vice versa.

(5) MUX/DEMUX – use of 74153,74139 for arithmetic circuits & code converter.

(6) Realization of one/two bit comparator and study of 7485 magnitude comparator.

(7) Use of a) Decoder chip to drive LED display & b) Priority encoder.

(8) Truth table verification of flip-flops: i) JK Master Slave ii) T type iii) D type.

(9) Realization of 3-bit counters as a sequential circuit & MOD-N counter design (7476,7490,74192,74193).

(10) Writing & testing of sequence generator.

(11) Design of FSM: Moore machine, Mealy machine.

CE308 Object-Oriented Programming Laboratory

(1) Simple programs in C++/Java

(2) Matrix multiplication in C++/Java.

(3) Operator overloading exercises.

(4) Matrix manipulation using dynamic memory allocation.

(5) Overloading dynamic memory allocation operators.

(6) Implementation of virtual function, friend function.

(7) String/text processing programs.

(8) Error and Exception handling.

(9) Inheritance based exercise.

(10) File handling using streams

(11) Practice on templates.

(12) Implementation of sorting algorithms using templates.

CE309 Web Page Design

Course Objectives and Outcomes:

- [WPCO1] Use a variety of strategies and tools to create websites.
- [WPCO2] Create a functioning web application suitable for portfolio presentation.
- [WPCO3] Learn the language of the web: HTML and CSS.
- [WPCO4] Understand and apply effective web design principles.

CO to PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
WPCO1			x							
WPCO2				x						
WPCO3			x							
WPCO4					x					

Web Site development Essentials

Overview of Web Design Concepts, Web Development Teams, Web Project Management Fundamentals, Web Site Development Process, Web Page Layout and Elements, Web Site Usability and Accessibility, Configure Browsers Setting, Navigation Concepts, Web Graphics, Multimedia and the Web.

Hyper Text Markup Language (HTML)

HTML and the Evolution of Markup languages, Create Hyperlinks, Create Tables, Create Web Forms, Image Inserting Techniques, Create Frames, GUI HTML Editors, Site Content and Metadata.

Introduction to Client-Server Model

Features of Dreamweaver Interface, Setting Up a Site with Dreamweaver, FTP -Site Upload Feature of Dreamweaver, Create various types of Links, Insert multimedia including text, image, animation & video, Finding a Home for your WordPress Site, Installing WordPress on Your Site, Content Management using WordPress, Selecting the Right Tools, Image Formats, Fonts and Colors, Designing Your WordPress Site, The WordPress Default Layout, Creating a Custom Site.

Cascading Style Sheets

Cascading Style Sheets for Web page design, Creating CSS rules in Dreamweaver, Format Text with CSS, Use of CSS Selectors, Embed Style Sheets, Attach External Style Sheets.

Using CSS with Tables

Insert and Styling Tables, Import Table Data, Style Tables with CSS, Sort Data in Table.

*Programming assignments are mandatory.

Reference Books:

1. J. N. Robbins, *Learning Web Design*, Fourth Edition, O'Reilly Media.
2. Steven M. Schafer, *HTML, XHTML, and CSS Bible*, 5th Edition, Wiley India.
3. John Duckett, *Beginning HTML, XHTML, CSS, and JavaScript*, Wiley India.
4. Hal Stern, David Damstra, Brad Williams, Professional WordPress: Design and Development, Wrox Publication.
5. E. Robson, E. Freeman, *Head HTML & CSS*, O'Reilly Media.

CE401 Data Communication

Course Objectives and Outcomes:

- [DCCO1] Build an understanding of the fundamental concepts of computer networking.
- [DCCO2] Introduce students to the digital and analogue representations and channels.
- [DCCO3] Describe the mechanism and techniques of encoding.
- [DCCO4] To understand the concept of data communication and modulation techniques.
- [DCCO5] To understand the error detection and correction in transmission of data.
- [DCCO6] Understand, explain and calculate digital transmission over different types of communication media.

CO to PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
DCCO1										x
DCCO2	x									
DCCO3					x					
DCCO4	x									
DCCO5	x									
DCCO6		x		x						

Unit I

Introduction: Components of communication, Data representation, Data flow, Communication model, Network, Network topologies, Network connection, Network categories, LAN, WAN, MAN, Internet, Addressing.

Unit II

Data and Signals: Analog and digital data, Analog and digital signals, Periodic and non-periodic signals, Sine wave, Parameters of sine wave, Time and frequency domain, Composite signals, Bandwidth, Digital signal-bit rate, Baseband and broadband transmission, Transmission impairments, Nyquist bit rate, Shannon capacity, Performance: Throughput, Latency, Bandwidth-delay product, Jitter.

Unit III

Analog Transmission: Digital to analog conversion- Amplitude shift keying, Frequency shift keying, Phase shift keying, Quadrature amplitude Modulation, Analog to analog Conversion – Amplitude modulation, Frequency modulation, Phase modulation.

Multiplexing: Need of multiplexing, Introduction, Multiplexer and demultiplexer, Frequency division multiplexing, Wavelength division multiplexing, Time division multiplexing, Statistical TDM, Synchronous TDM, Data rate management in TDM.

Unit IV

Digital Transmission: Digital to digital conversion, Signals element, Data element, Signal rate, Data rate, DC-component, Self synchronization, Line coding schemes – NRZ, NRZI, Bipolar AMI, Pseudo-ternary, Manchester, Differential Manchester. Block coding schemes – 4B/5B, 8B/10B, Scrambling –HDB3, B8ZS.

Analog to digital conversion: Pulse code modulation, Delta modulation, Transmission modes- serial and parallel transmission.

Unit V

Transmission Media: Guided Media – Twisted pair cable, Co-axial cable, Fiber optic cable, Performance of each, Unguided media – Radio waves, Microwaves, Infrared.

Introduction to fiber optics: Nature of light, Fiber characteristics, Sources and detectors, Connectors and splices.

Unit VI

Error Detection and Correction: Introduction, Types of errors, Redundancy, Detection versus correction, Forward error correction and re-transmission, Modular arithmetic, Block Coding: error detection, error correction, Hamming distance, Minimum hamming distance, Linear block codes, Cyclic Codes: Cyclic Redundancy check, Hardware implementation, Polynomials, Cyclic code analysis, Checksum: Concept, One‟s component, Internet checksum.

Text Books:

1. Behrouz Forouzan, *Data Communications and Networking*, 4th Edition, McGraw-Hill Publication, 2010.
2. William Stalling, *Data Communications and Computer Network*, PHI Publication.

Reference Books:

1. Schweber, *Data Communication*, McGraw Hill Publication.
2. Irvine & Harle, *Data Communications and Networking*, Wiley Publication.

CE402 Data Structures

Course Objectives and Outcomes:

- [DSCO1] Student should able to know fundamentals of data structures like array, list, linked list, stack, queue, tree, graph, hashing.
- [DSCO2] Student should able to identify suitable data structure for application.
- [DSCO3] Student should able to use data structure to solve problems.
- [DSCO4] Student should able to implement various data structures and algorithm essential for implementing computer based solutions.

CO to PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
DSCO1	x		x							
DSCO2				x						
DSCO3			x	x						
DSCO4				x	x					

Unit I

Introduction: Data, Data types, Data structure, Abstract Data Type (ADT), representation of Information, characteristics of algorithm, program, analyzing programs.

Unit II

Arrays and Hash Tables: Concept of sequential organization, linear and non-linear data structure, storage representation, array processing sparse matrices, transpose of sparse matrices. Hash Tables, Direct address tables, Hash tables, Hash functions, Open addressing, Perfect hashing.

Unit III

Searching and Sorting: Sequential, binary searching, skip lists – dictionaries, linear list representation, skip list representation, operations – insertion, deletion and searching. Insertion sort, selection sort, radix sort, File handling.

Unit IV

Linked Lists: Concept of linked organization, singly and doubly linked list and dynamic storage management, circular linked list, operations such as insertion, deletion, concatenation, traversal of linked list, dynamic memory management, garbage collection.

Unit V

Stacks and Queues: Introduction, stack and queue as ADT, representation and implementation of stack and queue using sequential and linked allocation, Circular queue and its implementation, Application of stack for expression evaluation and expression conversion, recursion, priority queue.

Unit VI

Trees and Graphs: Basic terminology, binary trees and its representation, insertion and deletion of nodes in binary tree, binary search tree and its traversal, threaded binary tree, Heap, Balanced Trees. Terminology and representation of graphs using adjacency matrix, Warshall's algorithm.

Text Books:

1. Mark Allen Weiss, *Data structures and algorithms analysis in C++*, Second Edition, Pearson Education.
2. S. Lipschutz, *Data Structures*, McGraw-Hill Publication.
3. Y. Langsm, M. Augenstin, A. Tanenbaum, *Data Structure using C and C++*, Pearsons Education Asia Publication.
4. Trembley and Sorenson, *Introduction to Data Structures*, PHI Publication.

Reference Books:

1. E. Horowitz, S. Sahani, *Data Structure and Algorithms*, Galgotia Publication.
2. Thomas Cormen, *Introduction to Algorithms*, PHI Publication.
3. Venkatesan & Rose, *Data Structure*, Wiley Publication.
4. Goodrich & Tamassia, *Data Structure & Algorithm in C++*, Wiley Publication.
5. Rod Stephens, *Learning Data Structures and Algorithms: Implementation and Analysis for Increased Software Performance*, O'Reilly Media.
6. Kyle Loudon, *Mastering Algorithms with C: Useful Techniques from Sorting to Encryption*, O'Reilly Media.

CE403 Operating System

Course Objectives and Outcomes:

- [OSCO1] Understand functional architecture of an operating system.
- [OSCO2] To provide a detailed discussion of the various memory management techniques.
- [OSCO3] Learn about and understand theoretical concepts and programming constructs used for the operation of modern operating systems.
- [OSCO4] Gain practical experience with software tools available in modern operating systems such as semaphores, system calls, sockets and threads.

CO to PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
OSCO1	x									x
OSCO2							x			
OSCO3	x		x							
OSCO4			x		x					

Unit I

Introduction and Operating system structures: Definition, Types of Operating system, Real-Time operating system, System Components- System Services, Systems Calls, System Programs, System structure. Virtual Machines, System Design and Implementation, System Generations.

Unit II

Processes and CPU Scheduling: Process Concept, Process Scheduling, Operation on a process, Cooperating processes. Threads, Interprocess Communication, Scheduling criteria, scheduling Algorithms, Multiple-Processor Scheduling, Real-Time Scheduling, Scheduling Algorithms and performance evaluation.

Unit III

Process Synchronization The critical-section problem, Critical regions, Synchronization Hardware, Semaphores, Classical Problems of synchronization, Monitors Synchronizations in Solaris.

Unit IV

Deadlocks: Systems Model, Deadlock characterization, Methods for handling Deadlocks, Deadlock Prevention, Deadlock Avoidance, Deadlock Detection, Recovery from Deadlock, Combined approach to deadlock Handling. Logical versus Physical address space, Swapping, Contiguous allocation, Paging, Segmentation with Paging, Demand Paging, Page replacement algorithms, Thrashing.

Unit V

File System and Secondary storage devices, Real-Time Operating Systems, RT Linux and Case Studies: MS-DOS and UNIX.

Text Books:

1. Abraham Silberschatz, Peter B. Galvin and Greg Gagne, *Operating System Concepts*, Addison Wesley Publishing Company, 1993.
2. Andrew S. Tanenbaum, *Modern Operating System*, PHI Publication, 1995.

Reference Books:

1. D. M. Dhamdhere, *Systems Programming and Operating Systems*, 2nd Edition, McGraw Hill, 1996.
2. Garry Nutt, *Operating Systems Concepts*, Addison Wesley Publication.
3. Harvey M. Deitel, *An Introduction to Operating Systems*, Addison Wesley Publication.
4. Doeppner, *Operating System in Depth*, Wiley Publication.

CE404 Micro-Processors (Elective 401)

Course Objectives and Outcomes:

- [MPCO1] To understand the concepts of Architecture of 8086 Microprocessor.
- [MPCO2] Ability to write assembly language programs to realize various high level language constructs, considering the architectural features, memory design of the underlying hardware. To realize the issues in computer architecture and organization.
- [MPCO3] Ability to interface various programmable devices to the microprocessor and program them to perform data transfer in real life applications.
- [MPCO4] Understand concept of interfacing of peripheral devices and their applications.

CO to PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
MPCO1	x									
MPCO2			x							
MPCO3				x	x					
MPCO4	x									

Unit I

Architecture of Microprocessors: General definitions of mini computers, Microprocessors, Micro controllers and digital signal processors. Overview of 8085 microprocessor, Overview of 8086 microprocessor, Signals and pins of 8086 microprocessor.

Unit II

Assembly language of 8086: Description of Instructions, Assembly directives, Assembly software programs with algorithms.

Unit III

Interfacing with 8086: Interfacing with RAMs, ROMs along with the explanation of timing diagrams, Interfacing with peripheral IC like 8255, 8254, 8279, 8259, 8259 etc., Interfacing with keyboards, LED, LCD, ADC, and DAC etc.

Co-processor 8087: Architecture of 8087, Interfacing with 8086, Data types, Instructions and programming.

Unit V

Architecture of Micro controllers: Overview of the architecture of 8051 micro-controller, Overview of the architecture of 8096 16 bit micro-controller. Assembly language of 8051: Description of Instructions, Assembly directives, Assembly software programs with Algorithms.

Unit VI

Interfacing with 8051: Interfacing with keyboards, LED, 7-segment LED, LCD, Interfacing with

ADC, Interfacing with DAC, etc.

High end processors: Introduction to 80386 and 80486.

Text Books:

1. Douglas Hall, 8086 *Microprocessor, Architecture and Programming*, PHI Publication.
2. Muhammad Ali Mazidi, *The 8051 Micro-controllers & Embedded System*, Pearson Education India Publication.
3. Turley, *Advanced 80386 Programming*, McGraw-Hill Publication.

Reference Books:

1. Liu, Gibson, *Microcomputer System – The 8086/8088 Family*, PHI Publication.
2. John F. Uffenbeck, *The 8086/8088 Family Design, Programming and Interfacing*, PHI Publication.
3. *Intel 8086, 80386, 80486 manuals*.
4. A. K. Ray and K. M. Bhurchandi, *Advanced Microprocessors and Peripherals*, McGraw-Hill Publication.

CE405 Probability, Statistics and Queueing Theory (Elective 402)

Course Objectives and Outcomes:

- [PQCO1] Develop appropriate probabilistic model for a given problem of algorithmic nature and computation of its statistical parameters.
- [PQCO2] Learning of different methods of statistics for data analysis.
- [PQCO3] Modeling of various real life problems of operation research.
- [PQCO4] Determine service time and waiting time in a queue.
- [PQCO5] To understand elementary queuing concepts and apply elsewhere in computer science.

CO to PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
PQCO1				x						
PQCO2	x									
PQCO3				x	x					
PQCO4							x			
PQCO5					x		x			

Unit I

Probability Theory: Definition of probability: classical, empirical and axiomatic approach of probability, Addition theorem of probability, Multiplication theorem of probability, Bayes' theorem of inverse probability, Properties of probabilities with proofs, Examples.

Unit II

Random Variable and Mathematical Expectation: Definition of random variables, Probability distributions, Probability mass function, Probability density function, Mathematical expectation, Join and marginal probability distributions, Properties of expectation and variance with proofs, Examples.

Unit III

Theoretical Probability Distributions: Binomial distribution, Poisson distribution, Normal distribution, Fitting of binomial distributions, Properties of binomial, Poisson and normal distributions, Relation between binomial and normal distributions, Relation between Poisson and normal distributions, Importance of normal distribution, Examples.

Unit IV

Correlation: Introduction, Types of correlation, Correlation and causation, Methods of studying correlation, Karl Pearson's correlation coefficient, Spearman's rank correlation, Coefficient, Properties of Karl Pearson's correlation coefficient, Properties of Spearman's rank correlation coefficient, Probable errors, Examples.

Unit V

Linear Regression Analysis: Introduction, Linear and non-linear regression, Lines of regression, Derivation of regression lines of y on x and x on y, Angle between the regression lines, Coefficients of regression, Theorems on regression coefficient, Properties of regression coefficient, Examples.

Unit VI

Queuing Theory: Introduction, Queuing systems, The input or arrival pattern, The service pattern and service discipline, Notation, Performance measures, Little's formula, Relation between the probabilities of states, M/M/1/∞ systems, Examples.

Text Books:

1. S. C. Gupta, *"Fundamentals of Statistics"*, 46th Edition, Himalaya Publishing House.
2. G. V. Kumbhojkar, *"Probability and Random Processes"*, 14th Edition, C. Jamnadas and co.
3. G. Haribaskaran, *"Probability, Queuing Theory and Reliability Engineering"*, 6th Edition, Laxmi Publications.
4. Murray Spiegel, John Schiller, R. ALU Srinivasan, *Probability And Statistics*, Schaum's Outlines.

Reference Books:

1. Kishor S. Trivedi, *"Probability, Statistics with Reliability, Queuing and Computer Science Applications"*, 2nd Edition, Wiley India Pvt. Ltd.
2. Vijay K. Rohatgi, A. K. Md. Ehsanes Saleh, *An Introduction To Probability And Statistics*, 3rd Edition, Wiley Publication.

CE405 Engineering Mathematics-III (Elective 402)

Unit I

Laplace Transform: Transform of elementary functions, Transform periodic function, Transform of special function, Transform of derivative, Transform of integral, Properties of Laplace transform, Evaluation of integrals of Laplace transform.

Unit II

Inverse Laplace Transform: Properties of inverse Laplace transform, Other methods for finding inverse Laplace transform, Convolution theorem for inverse Laplace transform, Application to the differential equations, Simultaneous linear equations with constant coefficients.

Unit III

Partial Differential Equations and Applications: Formation of Partial differential equations, Linear equations of the first order, Homogeneous linear equations with constant coefficients, Rules for finding complementary and particular integrals, Working procedure to solve the equations, Non-homogeneous linear equations, Wave equations, One dimensional heat flow equation, Laplace equation.

Unit IV

Series Solution of Differential Equations and Special Functions: Validity of series solution, Series solution when x = 0 is an ordinary point, Frobenius method, Bessel's equation, Recurrence relation for Jn(x), Crthogonality of Bessel function.

Unit V

Fourier Transform: Fourier integral: Fourier sine and cosine integral – complexity forms of Fourier integral, Fourier transform – Fourier sine and cosine transform – finite Fourier sine and cosine transform, Properties of F- transform, Convolution theorem for F- transform, Parseval's identity for F-transform.

Unit VI

Integral Equations: Conversion of linear differential equation to an integral equation and vice versa, Conversion of boundary value problem to integral equation using Green's functions, Solution of an integral equations, Integral equations of the convolution type, Abel's integral equation, Intergro-differential equation, Solution of Fredhlom and Volterra equations by the methods of successive approximations.

Text Books:

1. B. S. Grewal, *Higher Engineering Mathematics*, Khanna Publication.
2. Kreszig, *Advanced Engineering Mathematics*, 6th Edition, Wiley Eastern Publication.
3. Ravish R. Singh and Mukul Bhatt, *Engineering Mathematics*, McGraw-Hill Publication.

Reference Books:

1. Ray C. Wylie, *Advanced Engineering Mathematics*, 4th Edition. McGraw-Hill Publication.
2. E. Kreyszig, *Advanced Engineering Mathematics*, Wiley Publication.

CE406 Data Structure Laboratory

1. Write a program to implement stack using arrays.
2. Write a program to evaluate a given postfix expression using stacks.
3. Write a program to convert a given infix expression to postfix form using stacks.
4. Write a program to implement circular queue using arrays.
5. Write a program to implement double ended queue (dequeue) using arrays.
6. Write a program to implement a stack using two queues such that the push operation runs in constant time and the pop operation runs in linear time.
7. Write a program to implement a stack using two queues such that the push operation runs in linear time and the pop operation runs in constant time.
8. Write a program to implement a queue using two stacks such that the enqueue operation runs in constant time and the dequeue operation runs in linear time.
9. Write programs to implement the following data structures: (a) Single linked list (b) Double linked list.
10. Write a program to implement a stack using a linked list such that the push and pop operations of stack still take O(1) time.
11. Write a program to create a binary search tree(BST) by considering the keys in given order and perform the following operations on it. (a) Minimum key (b) Maximum key (c) Search for a given key (d) Find predecessor of a node (e) Find successor of a node (f) delete a node with given key.
12. Write a program to construct an AVL tree for the given set of keys. Also write function for deleting a key from the given AVL tree.
13. Write a program to implement hashing with (a) Separate Chaining and (b) Open addressing methods.
14. Implement the following sorting algorithms: (a) Insertion sort (b) Merge sort (c) Quick sort (d) Heap sort.
15. Write programs for implementation of graph traversals by applying: (a) BFS (b) DFS.

CE407 Operating System Laboratory

1. Hands on Unix Commands
2. Shell programming for file handling.
3. Shell Script programming using the commands grep, awk, and sed.
4. Implementation of various CPU scheduling algorithms (FCFS, SJF, Priority).
5. Implementation of various page replacement algorithms (FIFO, Optimal, LRU).
6. Concurrent programming; use of threads and processes, system calls (fork and v-fork).
7. Study pthreads and implement the following: Write a program which shows the performance improvement in using threads as compared with process.(Examples like Matrix Multiplication, Hyper Quick Sort, Merge sort, Traveling Sales Person problem).
8. Implementation of Synchronization primitives – Semaphore, Locks and Conditional Variables.
9. Implementation of Producer-Consumer problem, Bankers algorithm.
10. Implementation of various memory allocation algorithms, (First fit, Best fit and Worst fit), Disk Scheduling algorithms (FCFS, SCAN, SSTF, C-SCAN).
11. Kernel reconfiguration, device drivers and systems administration of different operating systems.
12. Writing utilities and OS performance tuning.

CE408 Web Application Development

Course Objectives and Outcomes:

- [WACO1] Develop skills in client-side web application development technologies including HTML, CSS, Javascript, and Javascript libraries.
- [WACO2] Program, access, and manipulate data through the adoption of accepted standards, mark-up languages, client-side programming, and server-side programming
- [WACO3] Understand and customize an existing open source application.
- [WACO4] Design and implement an interactive web site(s) with regard to issues of usability, accessibility and internationalization.

CO to PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
WACO1			x							
WACO2				x						
WACO3			x		x					
WACO4				x	x					

I. Client Side Scripting / Coding – Client Side Scripting is the type of code that is executed or interpreted by browsers. Client Side Scripting is generally view-able by any visitor to a site (from the view menu click on "View Source" to view the source code).
Below are some common Client Side Scripting technologies:

- HTML (HyperText Markup Language)
- CSS (Cascading Style Sheets)
- JavaScript
- Ajax (Asynchronous JavaScript and XML)
- jQuery (JavaScript Framework Library – commonly used in Ajax development)
- MooTools (JavaScript Framework Library – commonly used in Ajax development)
- Dojo Toolkit (JavaScript Framework Library – commonly used in Ajax development)

II. Server Side Scripting / Coding – Server Side Scripting is the type of code that is executed or interpreted by the web server.
Server Side Scripting is not view-able or accessible by any visitor or general public.
Below are the common Server Side Scripting technologies:

- PHP (very common Server Side Scripting language – Linux / Unix based Open Source – free redistribution, usually combines with MySQL database)
- Zend Framework (PHP's Object Oriented Web Application Framework)
- ASP (Microsoft Web Server (IIS) Scripting language), ASP.NET (Microsoft's Web Application Framework – successor of ASP)

- ColdFusion (Adobe's Web Application Framework)
- Ruby on Rails (Ruby programming's Web Application Framework – free redistribution)
- Perl (general purpose high-level programming language and Server Side Scripting Language – free redistribution – lost its popularity to PHP)

*Programming assignments are mandatory.

Reference Books:

1. Santosh Kumar K., Kogent Learning Solutions Inc., *JDBC, Servlets, and JSP (Includes JSF and Design Patterns) Black Book*, Dreamtech Press/Wiley India.
2. Vivek Chopra, Jon Eaves, Rupert Jones, Sing Li, John T. Bell, *Beginning JavaServer Pages*, Wrox Publication.
3. Janet Valade, *PHP and MySQL For Dummies*, 4th Edition.
4. Rasmus Lerdorf, *Programming PHP*, Third Edition, O'Reilly Media.
5. Bruce W. Perry, *JAVA Servlet & JSP Cookbook*, O'Reilly Media.
6. Gorge Reese, *Database Programming with JDBC & JAVA*, O'Reilly Media.

CE409 Python Programming

Course Objectives and Outcomes:

- [PPCO1] Develop a basic understanding of the Python programming language.
- [PPCO2] To learn how to design and program Python applications.
- [PPCO3] Demonstrate significant experience with Python program development environment.
- [PPCO4] Solve problems requiring the writing of well-documented programs in the Python language, including use of the logical constructs of that language.

CO to PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
PPCO1	x		x							
PPCO2	x			x	x					
PPCO3			x							
PPCO4			x		x					

Informal introduction to programming, algorithms and data structures, Downloading and installing Python, run a simple program on Python interpreter.

Variables, operations, control flow – assignments, conditionals, loops, functions: optional arguments, default values, Passing functions as arguments.

Statements, Expressions, Strings: String processing. Exception handling, Basic input/output, Handling files.

Class and Object, Data Structure: List, Tuple and Sequences, Set, Dictionaries.

Using Database and Structured Query Languages (SQL): SQLite manager, Spidering Twitter using a Database, Programming with multiple tables, JOIN to retrieve data.

*Programming assignments are mandatory.

Text Books:

1. Michael Urban and Joel Murach, *Murach's Python Programming*, Murach's Publication.
2. *"Python for Informatics: Exploring Information"*, Charles Severance, University of Michigan.
3. *"Core Python Programming"*, Dr. R. Nageswara Rao, Dreamtech Press.

Reference Books:

1. Mark Lutz, *Learning Python*, Fifth Edition, O'Reilly Media.
2. *"Dive into Python 3"*, Mark Pilgrim, Apress Publication.
3. *"Think Python"*, Allen B. Downey, 2nd Edition, O'Reilly Media.
4. *"Algorithm Design"*, Jon Kleinberg and Eva Tardos, Pearson (2013).

CE501 Database Management System

Course Objectives and Outcomes:

- [DBCO1] Model, design and normalize databases for real life applications.
- [DBCO2] To learn data models, conceptualize and depict a database system using ER diagram.
- [DBCO3] Query Database applications using Query Languages like SQL.
- [DBCO4] Understand validation framework like integrity constraints, triggers and assertions.
- [DBCO5] Understand various storage structures and query optimization.

CO to PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
DBCO1			x	x	x					x
DBCO2	x		x							
DBCO3			x	x						
DBCO4				x	x					
DBCO5	x			x			x			

Unit I

Introduction to DBMS: Historical perspective, File Versus a DBMS, Advantages of DBMS, Describing and storing data in DBMS, Architecture of a DBMS, Different Data Models.

Unit II

Introduction to the Relational Model: Structure of Relational Databases, Database Schema, Keys, Schema Diagrams, Relational Query Languages, Relational Operations.

Database Design and the E-R Model: features of ER model, conceptual design using ER model, design for large enterprises, Relational model-structure and operations, Integrity constraints over relations, Extended E-R Features.

Unit III

Query Language: Overview, SQL Data Definition, Basic Structure of SQL Queries, Additional Basic Operations, Set Operations, Null Values, Aggregate Functions, Nested Subqueries, Modification of the Database, Join Expressions, Views, Integrity Constraints, SQL Data Types and Schemas, Authorization, Functions and Procedures, Triggers, The Relational Algebra, The Tuple Relational Calculus, The Domain Relational Calculus.

Functional Dependency: Closer of functional dependencies, closer of attributes, canonical cover and Properties of Decomposition, Normalization process- 1NF, 2NF, 3NF and BCNF, Multivalued dependency: Closer properties of Multi-valued dependency and 4NF.

Unit IV

Database Application Development: Accessing Databases from Applications, An Introduction to JDBC, JDBC Classes and Interfaces, SQLJ, Stored Procedures.

Storage and File Structure: Overview of Physical Storage Media, Magnetic Disk and Flash Storage, RAID, Tertiary Storage, File Organization, Organization of Records in Files, Data-Dictionary Storage, Database Buffer.

Unit V

Indexing and Hashing: Intuition For Tree Indexes, Indexed Sequential Access Method (ISAM), B+ Trees: A Dynamic Index Structure, Search, Insert, Delete, Duplication, B+ Trees in Practice, Static Hashing, Extendable Hashing, Linear Hashing, Extendable vs. Linear Hashing.

Unit VI

Query Processing: Overview of Query Evaluation, operator evaluation, Algorithms for relational operations- Selection operation, General selection condition, Projection operation, Join operation, set operation and aggregate operation, Evaluation of relational operations.

Query optimization: Alternative plans, functions of query optimizer, translating SQL queries into relational algebra, estimating the cost of a plan, relational algebra equivalences, and other approaches to query optimization.

Text Books:

1. C. J. Date, *Introduction to Database Management*, Narosa Publication.
2. Henry Korth, Abraham Silberschatz & S. Sudarshan, *Database System Concepts*, 6th Edition, McGraw Hill Publication.
3. *Database Management Systems*, Raghu Ramakrishnan & Johannes Gehrke, McGraw-Hill Publication.
4. James Martin, *Principles of Database Management*, McGraw Hill Publication.

Reference Books:

1. Joel Murach, *Murach's Oracle SQL and PL/SQL for Developers*, 1st Edition, Mike Murach & Associates.
2. Wiederhold, *Database Design*, McGraw Hill Publication.
3. Navathe, *Fundamentals of Database System*, Addison Wesley Publication.
4. Mark L. Gillenson, *Fundamental of Database Management System*, Wiley Publication.

CE502 Design and Analysis of Algorithms

Course Objectives and Outcomes:

- [DACO1] Analyzing the amortized time complexity of a given algorithm and data structure operations.
- [DACO2] Decide the appropriate design methodology for a given problem from among the paradigms of Divide and Conquer, Dynamic Programming, Greedy, Branch and Bound.
- [DACO3] Design algorithms for network flows.
- [DACO4] Distinguish between P and NP classes of problems.

CO to PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
DACO1		x								
DACO2				x	x					
DACO3					x		x			
DACO4							x			

Unit I

Introduction to Algorithms: Definition of Algorithms, Properties of Algorithms, Expressing Algorithm, Flowchart, Algorithm Design Techniques, Performance Analysis of Algorithms, Types of Algorithm's Analysis, Order of Growth, Asymptotic Notations, Recursion, Recurrences Relation, Substitution Method, Iterative Method, Recursion Tree, Master Theorem, Changing Variable, Heap Sort.

Unit II

Divide and Conquer: Introduction to Divide and Conquer Technique, Binary Search, Merge Sort, Quick Sort, Strassen's Matrix Multiplication.

Unit III

Greedy Algorithms: Introduction to Greedy Technique, Greedy Method, Optimal Merge Patterns, Huffman Coding, Knapsack Problem, Activity Selection Problem, Job Sequencing with Deadline, Minimum Spanning Tree, Single-Source Shortest Path Algorithm.

Unit IV

Dynamic Programming: Introduction, Characteristics of Dynamic Programming, Component of Dynamic Programming, Comparison of Divide-and-Conquer and Dynamic Programming Techniques, Longest Common Sub-sequence, matrix multiplication, shortest paths: Bellman Ford, Floyd Warshall, Application of Dynamic Programming.

Unit V

Backtracking: Backtracking Concept, N–Queens Problem, Four–Queens Problem, Eight–Queen Problem, Hamiltonian Cycle, Sum of Subsets Problem, Graph Coloring Problem.

Branch and Bound: Introduction, Traveling Salesperson Problem, 15-Puzzle Problem, Comparisons between Backtracking and Branch and Bound.

Unit VI

Tree: Introduction, B-tree, Red-Black Tree (RBT): Insertion, Deletion.

NP Completeness: Introduction, The Complexity Class P, The Complexity Class NP, Polynomial-Time Reduction, The Complexity Class NP-Complete.

Text Books:

1. Cormen, *Introduction to Algorithms*, 2nd Edition, PHI Publication.
2. Elise Horowitz, Sartaj Sahni, S. Rajasekaran, *Fundamentals of Computer Algorithms*, 2nd Edition, University Press (India) Private Ltd.
3. Sara Base, *Computer algorithms: Introduction to Design and Analysis*, 2nd Edition, Addison Wesley Publication, 1988.

Reference Books:

1. Aho, Ullman, Data Structure and Algorithms, Addison Wesley Publication.
2. Michel Goodrich, Roberto Tamassia, *Algorithm Design – Foundation, Analysis & Internet Examples*, Wiley Publication.
3. George T. Heineman, Gary Pollice, Stanley Selkow, *Algorithms in a Nutshell*, 2nd Edition A Practical Guide, O'Reilly Media.

CE503 Theory of Computation

Course Objectives and Outcomes:

- [TCCO1] Design finite state machines, regular expressions and grammars for given languages.
- [TCCO2] Understand formal machines, languages and computations
- [TCCO3] Develop analytical thinking and intuition for problem solving situations in related areas of theory of computation.
- [TCCO4] To know the limitations of computation, i.e. the unsolvability of problems.

CO to PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
TCCO1	x	x								
TCCO2		x								
TCCO3		x		x	x					
TCCO4							x			

Unit I

Finite Automata and Regular Expressions: Definition of deterministic finite automata, Non-deterministic finite automata, Moore and Mealy machines and their conversions, Regular expressions, Recursive definition, NFA with e-moves, Inter-conversion between NFA and DFA, Regular expression and FA, Pumping lemma.

Unit II

Context Free Grammars: Definition, Production rules, Ambiguous grammar, Removal of ambiguity, Chomsky hierarchy, Context Free Grammar (CFG) – definition, Simplification of CFG.

Unit III

Context Free Languages: Definition of context free languages, Regular grammar definition, Left linear, Right linear grammar, Interconversion between left linear and right linear regular grammar, Regular grammar and finite automata, CNF, GNF, Derivation graphs, Type 0 and Type 1 grammars.

Unit IV

Pushdown Automata: Formal definition, Pushdown automata (PDA), Deterministic Pushdown automata (DPDA) – definition, Non-deterministic Pushdown automata (NPDA)-definition, relative powers of DPDA and NPDA.

Unit V

Turing Machines: The definition of a Turing machine, Computing with Turing machine, Extensions of Turing machines, Random access Turing machines, Non-deterministic Turing machines, Grammars, The Church's Turing hypothesis, Universal Turing machines, The Halting problem, Unsolvable problems about Turing machines.

Unit VI

Applications: Applications of RE and FA – Lexical analyzer, Text editor and searching using RE, Applications of PDA – Expression conversion, Applications of CFG – syntax analysis, Language definition.

Text Books:

1. Hopcroft, Ullman, Motwani, *Introduction to Automata Theory*, Languages, and Computation, Addison Wesley Publication.
2. Daniel I. A. Cohen, *Introduction to Computer Theory*, Wiley Publication.

Reference Books:

1. John C. Martin, *Introduction to Languages and Theory of Computation*, McGraw Hill Publication.
2. Krithivasan Kamala, *Introduction to Formal Languages, Automata Theory and Computation*, Pearson Education.
3. Papadimitriou, Lewis, *Elements of the Theory of Computations*, PHI Publication.
4. E. V. Krishnmurthy, *Theory of Computer Science*, EWP Publication.

CE504 Object Oriented Analysis and Design (Elective 501)

Course Objectives and Outcomes:

- [OOCO1] Develop a working understanding of formal Object-Oriented Analysis and Design processes.
- [OOCO2] Analyze real problems/requirements and design systems by developing specifications and abstractions to make development of complex systems easy.
- [OOCO3] Develop the skills to determine which processes and OOAD techniques should be applied to a given project.
- [OOCO4] Develop an understanding of the application of OOAD practices from a software project management perspective.

CO to PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
OOCO1	x									
OOCO2				x	x	x				
OOCO3			x		x					
OOCO4	x									x

Unit I

Introduction Overview of object oriented system, Object orientation, Objects, attributes, object behavior, Object respond to messages, encapsulation, Inheritance, Polymorphism, object relationships and association, aggregation, Object identity static and dynamic binding, Object persistence, meta classes. Object oriented system development life cycle.

Unit II

Object oriented modeling Modeling, UML Modeling, class diagram, activity diagram, Sequence diagram, collaboration diagram state chart diagram, interaction diagram, Implementation diagram, use case diagram.

Unit III

Object oriented analysis Use case analysis, CRC card analysis

Unit IV

Object Oriented Design Design Patterns.

Unit V

Implementation From Design to Implementation, Programming Style, Object-Oriented languages, Non- Object- Oriented languages, Object Oriented Databases. Computer animation, Electrical Distribution design System, Future of Object-Oriented Technology.

Text Books:

1. Grady, Booch, *Object Oriented analysis and design with applications,* 2nd Edition, PHI.
2. James Rumbaugh, *Object-Oriented Modeling And Design*, 1st Edition, PHI Publication.
3. Ali Bahrami, *Object Oriented Systems Development*, 1st Edition, McGraw-Hill Publication.

Reference Books:

1. Robert Lafore, *Object Oriented Programming*, Galgotia Publication.
2. Dan Pilone, Neil Pitman, *UML 2.0 in a Nutshell: A Desktop Quick Reference*, O'Reilly Media.
3. E. Balagurusamy, *Object Oriented Programming*, McGraw-Hill Publication.
4. S. Koshafian, *Object Orientation*, Wiley Publication.
5. Mike O'Docherty, *Object-Oriented Analysis Design: Understanding System Development with UML 2.0*, Wiley Publication.

CE504 Introduction to Data Analytics (Elective 502)

Course Objectives and Outcomes:

- [IDCO1] Understand big data challenges in different domains including social media, transportation, finance and medicine.
- [IDCO2] Use data analytics to explore and gain a broad understanding of a dataset.
- [IDCO3] Use data analytics methods to make predictions for a dataset.
- [IDCO4] Predict outcomes with supervised machine learning techniques.
- [IDCO5] Apply basic machine learning algorithms Linear Regression, k-Nearest Neighbors (k-NN), k-means, Naive Bayes for predictive modeling to solve various real-life examples.

CO to PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
IDCO1		x			x					
IDCO2				x						
IDCO3		x		x	x					
IDCO4					x	x				
IDCO5				x	x					

Descriptive Statistics: Introduction to the course, Descriptive Statistics, Probability Distributions. **Inferential Statistics:** Inferential Statistics through hypothesis tests. **Regression & ANOVA:** Regression, ANOVA(Analysis of Variance).

Machine Learning: Introduction and Concepts: Differentiating algorithmic and model based frameworks, Regression: Ordinary Least Squares, Ridge Regression, Lasso Regression, K Nearest Neighbours Regression & Classification.

Supervised Learning with Regression and Classification techniques-1: Bias-Variance Dichotomy, Model Validation Approaches, Logistic Regression, Linear Discriminant Analysis, Quadratic Discriminant Analysis, Regression and Classification Trees, Support Vector Machines.

Supervised Learning with Regression and Classification techniques-2: Ensemble Methods: Random Forest, Neural Networks, Deep learning.

Unsupervised Learning and Challenges for Big Data Analytics: Clustering, Associative Rule Mining, Challenges for big data analytics.

Prescriptive analytics: Creating data for analytics through designed experiments, Creating data for analytics through Active learning, Creating data for analytics through Reinforcement learning.

Reference Books:

1. Michael Milton, *Head First Data Analysis A learner's guide to big numbers, statistics, and good decisions*, O'Reilly Media.
2. Hastie, Trevor, et al., *The elements of statistical learning. Vol. 2. No. 1*, New York: Springer.
3. Montgomery, Douglas C., and George C. Runger, *Applied statistics and probability for engineers*, John Wiley & Sons.
4. Anil Maheshwari, *Data Analytics*, McGraw-Hill Publication.
5. EMC Education Services, *Data Science & Big Data Analytics: Discovering, Analyzing, Visualizing and Presenting Data*, Wiley Publication.
6. Philipp K. Janert, *Data Analysis with Open Source Tools A Hands-On Guide for Programmers and Data Scientists*, O'Reilly Media.

CE504 Digital Image Processing (Elective 501)

Course Objectives and Outcomes:

- [DICO1] To understand the fundamentals of Digital imaging and Image Processing techniques.
- [DICO2] Apply various filtering techniques and segmentation methods for image enhancement and image segmentation.
- [DICO3] Image restoration techniques and methods used in digital image processing.
- [DICO4] To be familiar with image compression and segmentation.

CO to PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
DICO1	x									
DICO2				x	x					
DICO3	x				x					
DICO4	x		x		x					

Introduction: Light, Brightness adaption and discrimination, Pixels, coordinate conventions, Imaging Geometry, Perspective Projection, Spatial Domain Filtering, sampling and quantization.

Spatial Domain Filtering: Intensity transformations, contrast stretching, histogram, equalization, Correlation and convolution, Smoothing filters, sharpening filters, gradient and Laplacian.

Filtering in the Frequency domain: Hotelling Transform, Fourier Transforms and properties, FFT (Decimation in Frequency and Decimation in Time Techniques), Convolution, Correlation, 2-D sampling, Discrete Cosine, Transform, Frequency domain filtering.

Image Restoration: Basic Framework, Interactive Restoration, Image deformation and geometric transformations, image morphing, Restoration techniques, Noise characterization, Noise restoration filters, Adaptive filters, Linear, Position invariant degradation, Estimation of Degradation functions, Restoration from projections.

Image Compression: Encoder-Decoder model, Types of redundancies, Lossy and Lossless compression, Entropy of an information source, Shannon's 1st Theorem, Huffman Coding, Arithmetic Coding, Golomb Coding, LZW coding, Transform Coding, Sub-image size selection, blocking artifacts, DCT implementation using FFT, Run length coding, FAX compression (CCITT Group-3 and Group-4), Symbol-based coding, JBIG-2, Bit-plane encoding, Bit-allocation, Zonal Coding, Threshold Coding, JPEG, Lossless predictive coding, Lossy predictive coding, Motion Compensation.

Wavelet based Image Compression: Expansion of functions, Multi-resolution analysis, Scaling functions, MRA refinement equation, Wavelet series expansion, Discrete Wavelet Transform (DWT), Continuous Wavelet Transform, Fast Wavelet Transform, 2-D wavelet Transform, JPEG-2000 encoding, Digital Image Watermarking.

Morphological Image Processing: Basics, SE, Erosion, Dilation, Opening, Closing, Hit-or-Miss Transform, Boundary Detection, Hole filling, Connected components, convex hull, thinning, thickening, skeletons, pruning, Geodesic Dilation, Erosion, Reconstruction by dilation and erosion.

Image Segmentation: Boundary detection based techniques, Point, line detection, Edge detection, Edge linking, local processing, regional processing, Hough transform, Thresholding, Iterative thresholding, Otsu's method, Moving averages, Multi-variable thresholding, Region-based segmentation, Watershed algorithm, Use of motion in segmentation.

Reference Books:

1. *Digital Image Processing*, 3rd Edition, by Rafael C. Gonzalez and Richard E. Woods, Pearson Education.
2. Ramesh R. Manza, Yogesh M. Rajput, Deepali Rathod, Manjiri B. Patwari, *Understanding Digital Image Processing Using MATLAB*, SPD Publication.
3. William K. Pratt, *Digital Image Processing*, PIKS Scientific Inside, Fourth Edition, Wiley Publication.
4. J. R. Parker, *Algorithms for Image Processing and Computer Vision*, 2nd Edition, O'Reilly Media.
5. S. Jayaraman, S. Esakkirajan, T. Veerakumar, *Digital Image Processing*, McGraw-Hill Publication.

CE505 Management Sciences (Elective 502)

Management: Managing in global environment, Principles of Management, Management Theory, Management Levels & Skills.

Ethics: Ethical issues in management, ethical challenges and social responsibility of business.

Planning and organizing: Strategic & operational plans, process of planning, organizational design & structure, decentralization, departmentation, Types of organization, Delegation of authority.

Human resource management: Staffing, selection, placement, Orientation & training, Performance appraisal, Career planning.

Leadership: Managers Vs Leaders, leadership styles, Foundation of leadership, Role and functions of leaders, Motivation, Essence of motivation, issues in motivation, Approaches to motivation, Theories of motivation.

Decision Making & Information Systems: Decision making process, Individual & group decisions, Decision making models, Decision making tools, Management information system for decision making, Communication – Interpersonal, grapevine–process, Technology & communication.

Group Behavior: Group Behavior and Team Building, Individual vs. Group Behavior, Group dynamics, team building, Conflict Management – Kinds & causes of conflict, Settlement of conflict.

Controlling: Process, Methods, Use of MIS for control.

NPTEL CONTENT:

1. Management Science-*I* by Prof. M. Thenmozhi, IIT Madras (WEB CONTENT)
2. Management Science-*I* by Prof. Anuradha Sharma, IIT Delhi (VIDEO CONTENT)

CE505 Development Engineering (Elective 502)

Introduction to Development Engineering: Introduction to development engineering; need of development engineering; core disciplines and concept; major issues in development; urban development; rural development; socioeconomic development; scientific social research, formulation of research problem, field work and data collection, report drafting.

Design of Sustainable Communities: Concept and development of sustainable communities; Sustainable design principles, building regulations, codes and standards – ANSI, ASTM, ASHRAE, approval process; green buildings – green building techniques-energy solutions, site solutions, site solutions, exterior and interior solutions, Certification – BREEAM, GRIHA, NAHB, LEED, IGBC.

Town/City Planning: Town Planning, history of town planning in India, characteristics of city/town, town planning at national, regional and local levels, planning standards, master plan, site layout and development, zoning and density control, green belt, slum redevelopment; Smart city planning introduction to city planning, infrastructure elements of smart city planning, d imensions of smart cities global standards and performance benchmark; smart solutions e-governance, waste management, water management, energy management, urban mobility, citizen services, other services such as telemedication and education, trade facilitation, skill development; GIS for Planning.

Planning and Development of Rural Areas: District administration, District Planning, introduction to various sectors of rural areas such as drinking water, Waste water treatment, electricity, public transport, irrigation, sanitation and cooking energy; issues and challenges associated with these sectors; People's participation and role in development of rural areas; various schemes and policies floated by state and central government – phases in the schemes; life cycle costing of these schemes.

Geoinformatics for Planning and Development: Introduction to Geoinformatics; Advantages, benefits and limitations; Interdisciplinary applications; Data extraction; use of Geoinformatics for planning, mapping and preparation of layouts.

Development aspects: Urban and Rural: Planning and designing of a model town / city and using Auto-CAD and/or GIS, Visit to a village or small town – The project will be carried out in groups. Problem faced by the villagers pertaining to various sectors or existing schemes; define the need, method, tools and techniques for development; deliver technology based solution.

Text Books:

1. Chand M. and Purr U.K. (1983), *'Regional Planning in India'*, Allied Publisher, New Delhi.
2. Kaiser E. J., et.at., *'Urbun Landuse Planning'*, 4th Edition Urbana, University of Illinois Press.
3. Sundaram K. V., *'Geography Planning'*, Concept Publishing Co., New Delhi.
4. Ayyar C.P.V., *'Town Planning in Early South India'*, Mittal Publications, Delhi.
5. Reeder, Hoboken, *'Guide to green building rating systems'*, John Wiley & sons, Inc.
6. Longley, et.al, *'Geographic Information Systems and Science'*, John Wiley & Sons, New York.
7. Desai V., *'Rural Development of India'*, Himalaya publishing house, Mumbai.
8. Rau S. K., *'Global Search for Rural Development'*, NIRD, Hyderabad.

Reference Books:

1. *Institute of Town Planners, India, Ministry of Urban Affairs & Employment*, Government of India, New Delhi, UDPFI Guidelines, 1996.
2. Miles R. Simon, 1970, *'Metropolitan Problems'*, Methuen Publications, Canada.
3. B.I.S., 1980, *'National Building Code of India'*, ISI, New Delhi.
4. *ANSI/ASHRAE/USGBC/IES Standard 189.1, Standard for the Design of High – Performance Green Buildings Except Low-Rise Residential Buildings*.
5. *ASHRAE Standard 90.1, Energy Standard for Buildings Except Low-Rise Residential Buildings*.

CE505 National Service Scheme – I (NSS-I) (Elective 502)

Unit I
Introduction and Basic Concepts of NSS

History, Philosophy, Aims & objectives of NSS Organizational structure, Concept of regular activities, Special camping, Day Camps. Basis of adoption village/slums, Methodology of conducting Survey.

Unit II
Youth and community mobilization

Definition, Profile of youth, Categories of youth, Issues, Challenges and opportunities for youth, Youth as an agent of social change, Youth-adult partnership, Mapping of community stakeholders, Identifying methods of mobilization, Needs & importance of volunteerism.

Unit III
Importance and Role of Youth Leadership

Meaning and types of leadership, Qualities of good leaders; Traits of leadership, Importance and role of youth leadership.

Unit IV
Life Competencies and skill

Definition and importance of life competencies, Communication, Inter Personal, Problem solving and decision making, Positive thinking, Self-confidence and self-esteem, Life goals, Stress and time management.

Unit V
Social Harmony and National Integration

Indian history and culture, Role of youth in peace-building and conflict resolution, Role of youth in Nation building.

Unit VI
Youth Development Programmes in India

National Youth Policy, Youth development programmes at the National Level, State Level and voluntary sector, Youth-focused and Youth-led organizations.

References Books:

1. *National Service Scheme Manual (Revised) 2006, Government of India, Ministry of Youth Affairs and Sports, New Delhi*.
2. *University of Mumbai National Service Scheme Manual, 2009*.
3. Avhan Chancellor's Brigade – NSS Wing, *Training camp on Disaster Preparedness Guidelines*, March 2012.
4. *Rashtriya Seva Yojana Sankalpana* – Prof. Dr. Sankay Chakane, Dr. Pramod Pabrekar, Diamond Publication, Pune.
5. *National Service Scheme Manual for NSS District Coordinators*, National Service Scheme Cell, Dept. of Higher and Technical Education, Mantralaya.
6. *Annual report of National Service Scheme (NSS)* published by Dept. of Higher and Technical

Education, Mantralaya,
7. *NSS Cell*, Dept. of Higher and Technical Education, Mantralaya, UTKARSHA- Socio and cultural guidelines.
8. *Case material as a Training Aid for Field Workers*, Gurmeet Hans.
9. *Social service opportunities in hospitals*, Kapil K. Krishnan, TISS.
10. *New Trends in NSS*, Research papers published by University of Pune.
11. *ANOOGUNJ Research Journal*, published by NSS Unit C. K. Thakur college.
12. *Training Manual for Field Work* published by RGNIYD, Shreeperumbudur.
13. Prof. Ghatole R. N., *Rural Social Science and Community Development*.
14. Purushottam Sheth, Dr. Shailaja Mane, *National Service Scheme.*
15. *Joint programme of National Service Scheme*, University of Mumbai &DISHA – DEEPSHIKHA Projects, Nair Hospital, 2011-12.
16. *National Service Scheme in India: A Case study of Karnataka*, M. B. Dishad, Trust Publications, 2001.
17. *http://www.thebetterindia.com/140/national-service-scheme-nss/*
18. *http://en.wikipedia.org/wiki/national-service-scheme*
19. *http://nss.nic.in*

CE506 Database Management System Laboratory

1. Defining schema for applications.
2. Creating tables, Renaming tables, Data constraints (Primary key, Foreign key, Not Null), Data insertion into a table.
3. Grouping data, aggregate functions, Oracle functions (mathematical, character functions).
4. Sub-queries, Set operations, Joins.
5. Creation of databases, writing SQL and PL/SQL queries to retrieve information from the databases.
6. Triggers & Cursors.
7. Normal Forms: First, Second, Third and Boyce Codd Normal Forms.
8. Assignment in Design and Implementation of Database systems or packages for applications such as office automation, hotel management, hospital management;
9. Deployment of Forms, Reports Normalization, Query Processing Algorithms in the above application project;
10. Large objects – CLOB, NCLOB, BLOB and BFILE,
11. Distributed data base Management, creating web-page interfaces for database applications using servlet.

CE507 Design and Analysis of Algorithm Laboratory

1. Divide and conquer method (quick sort, merge sort, Strassen's matrix multiplication).
2. Greedy method (knapsack problem, job sequencing, optimal merge patterns, minimal spanning trees).
3. Dynamic programming (multistage graphs, OBST, 0/1 knapsack, traveling sales person problem).
4. Obtain the Topological ordering of vertices in a given digraph.
5. Back tracking (n-queens problem, graph coloring problem, Hamiltonian cycles).
6. Selection: Minimum/ Maximum, K^{th} smallest element.
7. Find optimal ordering of matrix multiplication. (Note: Use Dynamic programming method).
8. Use dynamic programming algorithm to solve the optimal binary search tree problem.
9. Compute the transitive closure of a given directed graph using Warshall's algorithm.
10. Write programs to find out a minimum spanning tree of a simple connected undirected graph by applying: (a) Prim’s algorithm (b) Kruskal’s algorithm.
11. Write a program to implement Dijkstra’s algorithm for solving single source shortest path problem using priority queue.
12. Write a program to implement Floyd-Warshall algorithm for solving all pairs shortest path problem.

CE508 Smart Phone Application Development

Course Objectives and Outcomes:

- [SPCO1] To learn the basics of mobile application development.
- [SPCO2] To get accustomed to different Mobile Operating System platforms.
- [SPCO3] To develop skills in developing applications on different flavors of Mobile Operating System.

CO to PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
SPCO1	x		x							
SPCO2			x							
SPCO3				x	x	x				x

(a) Introduction to mobile computing, installing of required software and preparing the working environment, creating your first Android Application;
(b) Layouts, Views, Resources, Activities, Intents, Background tasks, Connecting to the Internet, Fragments, Preferences;
(c) User Interaction – input, menu items, custom views;
(d) User Experience – themes and styles, material design, adaptive layouts, accessibility, localization, debugging the UI;
(e) Storing Data, SQLite database, Sharing Data, content resolver and providers, loaders to load data Services, background work, alarms, broadcast receivers;
(f) Notification, widgets, transferring data efficiently, publishing app, Multiple form factors, sensors, Google cloud messaging, monetizing your app.

Experiments:

1. Install the Android SDK and developer tools and build a test project to confirm that those tools are properly installed and configured.
2. Write a program using a Table Layout for our restaurant data entry form, add a set of radio buttons to represent the type of restaurant.
3. Write a program using activity class to show different events.
4. Write a program to send user from one application to another. (For example redirection to map).
5. Write a program to play audio files.
6. Write a program to play video files.
7. Write a program to capture image using built in camera.
8. Write a program to send SMS.
9. Write a program to convert text to speech.
10. Write a program to call a number.

Reference Books:

1. Brian Fling, *Mobile Design & Development*, O'Reilly Media.
2. Meier, *Android 4 Application Development: Professional*, Wrox Publication.
3. Lee, *Beginning Android™ 4 Application Development*, Wrox Publication.
4. J.F. DiMarzio, *Android A Programmers Guide*, McGraw-Hill Publication.
5. Ian F. Darwin, *Android Cookbook*, 2nd Edition, O'Reilly Media.
6. Dawn Griffiths, David Griffiths, *Head First Android Development*, 2nd Edition, O'Reilly Media.
7. Vandad Nahavandipoor, *iOS 10 Swift Programming Cookbook*, O'Reilly Media.
8. Craig Clayton, *iOS 10 Programming for Beginners*, O'Reilly Media.
9. Dan Pilone, Tracey Pilone, *Head First iPhone and iPad Development: A Learner's Guide to Creating Objective-C Applications for the iPhone and iPad*, 3rd Edition, O'Reilly Media.

CE601 Compiler Construction

Course Objectives and Outcomes:

- [CCCO1] To inform students about different parsing techniques, techniques to generate intermediate code and different optimization techniques.
- [CCCO2] To enrich the knowledge in various phases of compiler and its use.
- [CCCO3] To introduce the concepts underlying the design and implementation of language processors.
- [CCCO4] To provide practical programming skills necessary for constructing a compiler.

CO to PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CCCO1	x		x							
CCCO2			x			x				
CCCO3	x									x
CCCO4			x	x						

Unit I

Introduction to Compiling and Lexical Analysis: Definition, analysis of the source program, the phases of a compiler, the grouping of phases, Compiler Construction tools, A simple one-pass compiler, The role of the Lexical analyzer, Input buffering, Specification of Tokens, A Language for Specifying Lexical Analyzers, Design of a Lexical Analyzer generator.

Unit II

Syntax Analysis: The role of the Parser, Context-free grammars, Writing a Grammar, Top-Down Parsing, Bottom- Up Parsing, Operator-precedence Parsing, LR-Parsers, Using Ambiguous Grammars, Parser Generators.

Syntax-Directed Translation: Definitions, Construction of Syntax Trees, Bottom-Up Evaluation of S-Attributed definitions, Top-Down Translation, Bottom-Up Evaluation of Inherited attributes.

Unit III

Intermediate Code Generation: Intermediate Languages, Declarations, Assignment Statements, Boolean Expressions, Case Statements, Back patching, Procedure Calls.

Unit IV

Code Generation: Issues in the Design of a Code Generator, The target Machine, Run-Time Storage Management, Basic Blocks and Flow Graphs, Next-Use Information, Simple Code Generator, Register allocation and Assignment, The DAG Representation of Basic Blocks, Generating Code from DAGs, Dynamic Programming, Code-Generation Algorithm, Code-Generators.

Unit V

Code Optimization: Peephole Optimization, Principal sources of optimization, Introduction to Global data flow analysis.

Text Books:

1. Aho, Sethi, Ullman, *Compilers Principles, Techniques and Tools*, Addison Wesley, 1987.
2. Hopcroft, Motwani and Ullman, *Introduction to Automata Theory, Languages and Computation*, Pearson Publication.
3. Dick Grune, Kees van Reeuwijk, Henri E. Bal, Ceriel J. H. Jacobs and Koen Langendoen, *Modern Compiler Design*, Wiley Publication.

Reference Books:

1. Paul G. Sorenson, *Compiler Writing*, McGraw-Hill Publication.
2. Hunter, *The Essence of Compilers*, Pearson Publication.
3. Lewis, *Elements of the Theory of Computation*, Pearson Publication.
4. Jean Paul Tremblay, Paul Gordon Sorenson, *Theory and Practice of Compiler Writing*, BS Publications, 2008.
5. Ronald Mak, *Writing Compilers and Interpreters: A Software Engineering Approach*, 3rd Edition, Wiley Publication.
6. Doug Brown, John Levine, Tony Mason, *lex & yacc*, 2nd Edition, O'Reilly Media.

CE602 Computer Networks

Course Objectives and Outcomes:

- [CNCO1] To develop an understanding of modern network architectures from a design and performance perspective.
- [CNCO2] Analyze the requirements for a given organizational structure and select the most appropriate networking architecture and technologies.
- [CNCO3] To study protocols, network standards, the OSI model, IP addressing, cabling, networking components, and basic LAN design.
- [CNCO4] Ability to write program using socket programming.

CO to PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CNCO1							x			x
CNCO2				x	x					
CNCO3	x		x							x
CNCO4			x							x

Unit I

INTRODUCTION: Applications of computer networks, Network hardware, Network software: Protocol Hierarchy, Design Issue, connection oriented versus connectionless, Service Primitives, Reference models: OSI and TCP/IP, Example networks: Internet, Network standardization, Performance: Bandwidth and Latency, Delay and bandwidth product, High-Speed Network, Application Performance Needs.

Unit II

PHYSICAL LAYER: X.25, Frame relay, ATM, Ethernet (802.3), FDDI, Token Rings, Resilient Packet Rings, Wireless LANs: Wi-Fi (802.11), Cell Phone Technologies, Broadband Wireless: Wi-MAX (802.16), Bluetooth (802.15.1), RFID.

Unit III

DATA LINK LAYER Data Link Layer Design Issues: Service provided to network layer Framing, Error Control, Flow Control, Error Detection and Correction: error correcting codes, error detecting codes, Elementary Data Link Protocols: utopian Simplex Protocols, Stop-and-Wait Protocol, Sliding Window Protocols: One-bit Sliding Window Protocol, Go-Back-N, Selective Repeat, Example Data Link Protocols.

Unit IV

MEDIUM ACCESS CONTROL SUB LAYER: The Channel Allocation Problem, Multiple Access Protocols: ALOHA, CSMA, Collision-free protocol, Limitation Contention Protocol, Data Link Layer Switching, What is frame? Why framing is needed?, Hardware Building Blocks, Different framing techniques. Bit, byte and clock oriented Protocols: PPP, HDLC, DDCMP, Broadcast and Multicast.

Unit V

NETWORK LAYER: Design issues, Connectionless and connection-oriented services, Virtual circuit and datagram subnets, Routing algorithms, Interior and Exterior Gateway Routing Protocols.

Congestion Control and QOS: General principles, Congestion prevention policies, Load shading, Jitter control, Quality of service: Packet scheduling, Traffic shaping, integrated Services.

Unit VI

SOCKET PROGRAMMING: Introduction to IP address, Port Addresses, What is Sockets? (Barkley's Socket), socket address, Socket types, Client-Server Communication, System Calls used in UNIX for client-server communication, Socket Program using JAVA.NET Class, TCP and UDP Socket Programming.

Text Books:

1. A. Tanenbaum, *Computer Networks*, 4th Edition, PHI Publication.
2. B. Forouzan, *Data Communications and Networking*, 3rd Edition, McGraw Hill Publication, 2004.
3. *Computer Networks: A Systems Approach*, Larry Peterson and Bruce Davie, Elsevier.

Reference Books:

1. S. Keshav, *An Engineering Approach to Computer Networking*, Pearson education.
2. D. Comer, *Computer Networks and Internet*, Pearson education.
3. M. Gallo, W. Hancock, *Computer Communications and Networking Technologies*, Course Technology.
4. Natalia Olifer, Victor Olifer, *Computer Networks: Principles, Technologies and Protocols for Network Design*, Wiley Publication.

CE603 Computer Graphics (Elective 601)

Course Objectives and Outcomes:

- [CGCO1] To understand the basics of various inputs and output computer graphics hardware devices.
- [CGCO2] To provide students with a foundation in graphics applications programming.
- [CGCO3] Ability to understand various graphics packages.
- [CGCO4] Understand display, manipulation and storage of pictures and experimental data for proper visualization using a computer.
- [CGCO5] To know 2D raster graphics techniques, 3D modelling, geometric transformations, 3D viewing and rendering.

CO to PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CGCO1	x									
CGCO2			x							
CGCO3			x			x				
CGCO4	x		x			x				
CGCO5	x		x			x				

Unit I

Basic Concepts: Introduction to computer graphics, lines, line segments, pixels and frame buffers, anti-aliasing techniques and character generation methods. Graphics Display devices (monochrome, color) interactive devices, Scanners and digitizers, touch panels, tablets, mouse, joysticks, trackball, light pen.

Unit II

2-D Transformation: Line and circle plotting using Breshemham's and other algorithms, transformation matrices, scaling, rotation, translation, picture transformation, mirror image.

Window and Clipping: Introduction, viewing transforms, 2-D clipping, Sutherland Cohen approach, Cyrus Beck Method, Midpoint subdivision algorithm, Liang-Barsky line clipping algorithm, polygon clipping, text clipping, generalized clipping.

Unit III

3-D Graphics: Introduction, 3-D geometry, Co-ordination system, 3D transformation , rotation about an arbitrary axis, orthogonal projections, multiple views, isomeric projection, perspective projections, 3-D clipping.

Unit IV

Hidden Surfaces and Lines: Introduction, Back face removal algorithm, Z-buffers, Scan line and

Painters algorithm hidden surface removal, curved surface generation, generation of solids, sweep method, interpolation.

Unit V

Graphical User Interface: X-Windows, use of graphics tools like OPENGL, DirectX, Windows and Motif, Graphic Standards.

Animation: Introduction, devices for producing animation, computer assisted animation, real time animation, method for controlling animation (fully explicit control, procedural).

Text Books:

1. Peter Shirley, Michael Ashikhmin, Steve Marschner, *Fundamental Of Computer Graphics*, 4th Edition, CRC Press.
2. Newman, Sprouall, *Interactive Computer Graphics*, McGraw-Hill Publication.
3. Hearn, Baker, *Computer Graphics*, PHI Publication.
4. Krishnamurthy, *Introduction to Computer Graphics*, McGraw-Hill Publication.
5. ISRD Group, *Computer Graphics*, McGraw-Hill Publication.

Reference Books:

1. Harrington, *Computer Graphics*, McGraw Hill Publication.
2. Rogers, *Procedural Elements of Computer Graphics*, McGraw Hill Publication.

CE603 Database Implementation Techniques (Elective 601)

Course Objectives and Outcomes:

- [DTCO1] To provide the students with a better understanding of the essential techniques used in Database Management System, either by revisiting them or by studying new approaches.
- [DTCO2] To understand the different database models and language queries to access databases.
- [DTCO3] To protect the data and the database from unauthorized access and manipulation.
- [DTCO4] To handle large concurrent operations.

CO to PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
DTCO1	x					x				x
DTCO2			x	x	x					
DTCO3					x				x	
DTCO4				x						

Transaction: Transaction Concept, Transaction Model, Storage Structure, Transaction Atomicity and Durability, Transaction Isolation, Serializability, Transaction Isolation and Atomicity, Transaction Isolation Levels, Implementing Isolation Levels, Transaction as SQL Statements.

Concurrency Control: Lock Based Protocols, Deadlock Handling, Multiple Granularity, Time-Stamp Based Protocols, Validation Based Protocols, Multi-Version Schemes, Insert-delete Operations and Predicate Reads.

Recovery System: Failure Classification, Storage, Recovery and Atomicity, Recovery Algorithm, Buffer Management, Failure with Loss of Non Volatile Storage, Early Lock Release and Logical Undo Operations, Remote Backup Systems.

Database System Architectures and Parallel Databases: Centralized and Client Sever Architecture, Server System Architectures, Parallel Systems, Distributed Systems. Introduction to Parallel Databases, Inter-Query and Intraquery Parallelism, Intraoperation and Inter-Operation Parallelism, Query Optimization, Parallelism on Multi-Core Processors, Design of Parallel System.

Distributed Database: Homogeneous and Heterogeneous Databases, Distributed Data Storage, Distributed Transactions, Commit Protocols, Concurrency Control In Distributed Environment, Distributed Query Processing, Heterogeneous Distributed Databases, Cloud Based Databases.

Dataware Housing and Data Mining: Decision support systems, Dataware Housing, Data Mining, Classification, Association Rules, Other Types of Associations, Clustering, Other Forms of Data Mining.

Text Books:

1. C. J. Date, *Introduction to Database Management*, Narosa Publication.
2. Henry Korth, Abraham Silberschatz & S. Sudarshan, *Database System Concepts*, 6th Edition, McGraw Hill Publication.
3. *Database Management Systems*, Raghu Ramakrishnan & Johannes Gehrke, McGraw-Hill Publication.
4. James Martin, *Principles of Database Management*, McGraw Hill Publication.

Reference Books:

1. Stefano Ceri & Giuseppe Pelagatti, *Distributed Databases-Principles and System*, McGraw-Hill Publication.
2. Desai Bipin, *An Introduction to Database Systems*, Galagotia Publication.
3. Edward Sciore, *Database Design & Implementation*, Wiley Publication.
4. Monte F. Hancock, Jr, *Practical Data Mining*, CRC Press.

CE604 Human Computer Interface (Elective 602)

Course Objectives and Outcomes:

- [HCCO1] Demonstrate an understanding of guidelines, principles, and theories influencing human computer interaction.
- [HCCO2] Describe the key design principles for user interfaces.
- [HCCO3] Carry out the steps of experimental design, usability and experimental testing, and evaluation of human computer interaction systems.
- [HCCO4] Develop and implement a process to gather requirements for, engage in iterative design of, and evaluate the usability of a user interface.

CO to PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
HCCO1	x									
HCCO2			x		x	x				
HCCO3			x	x		x				
HCCO4				x	x	x				

Unit I

Introduction: Course objective and overview, Historical evolution of the field, The Human, The Computer, The Interaction.

Design processes: Interaction Design basics, Concept of usability – definition and elaboration, HCI in the Software Process, Design Rules.

Unit II

Implementation and Evaluation: Implementation Support, Evaluation Techniques, Universal Design, Use Support.

Unit III

Models: Cognitive Models, Socio – Organizational Issues and Stakeholders Requirements, Communication and Collaboration models.

Theories: Task Analysis Dialog notations and Design Models of the system Modeling Rich Interactions.

Unit IV

Modern Systems: Group ware, Ubiquitous Computing computing and Augmented Realities Hypertext Multimedia and World Wide web.

Text Books:

1. Alan Dix, Janet Finlay, Gregory Abowd, Russell Beale, *Human Computer Interaction*, 3rd Edition Pearson Education.
2. Preece J., Rogers Y., Sharp H., Baniyon D., Holland S. and Carey T., *Human Computer Interaction*, Addison-Wesley, 1994.
3. B. Shneiderman, *Designing the User Interface*, Addison Wesley 2000 (Indian Reprint).

Reference Books:

1. Jenny Preece, Helen Sharp, Yvonne Rogers, *Interaction Design: Beyond Human-Computer Interaction*, 4th Edition, Wiley Publication.
2. Gerard Jounghyun Kim, *Human–Computer Interaction: Fundamentals and Practice*, CRC Press.
3. Jenifer Tidwell, *Designing Interfaces 2nd Edition, Patterns for Effective Interaction Design*, O'Reilly Media.

CE604 Real-Time System (Elective 602)

Course Objectives And Outcomes:

- [RTCO1] To study issues related to the design and analysis of systems with real-time constraints.
- [RTCO2] Appreciation of the need for integrated mechanism for resource allocation and scheduling.
- [RTCO3] To study the difference between traditional and real time databases.
- [RTCO4] To learn about various real time communication protocols.

CO to PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
RTCO1	x									x
RTCO2		x								x
RTCO3	x									
RTCO4					x			x		x

Unit I

Introduction: What is Real Time System?, Application of Real Time System, A Basic Model of Real Time System, Characteristics of Real Time System, Safety and Reliability, Types of Real-Time Tasks, Timing Constraints, Modelling Timing Constraints.

Unit II

Real-Time Task Scheduling: Concept, Types of real time task and their characteristics, Task scheduling, Clock-Driven Scheduling, Hybrid Schedulers, Event-driven scheduling, EDF scheduling, Rate monotonic System, Issue associate with RMA, Issue in using RMA in practical situations.

Unit III

Handling Resource Sharing and Dependencies Among Real-Time Tasks: Resource Sharing Among Real-time Tasks, Priority Inversion, Priority Inheritance Protocol (PIP), Higher Locker Protocol (HLP), Priority Ceiling Protocol (PCP), Difference types of Priority Inversion under PCP, Important features of PCP, Some issues in Using A Resource Sharing Protocol.

Unit IV

Scheduling Real-Time Tasks in Multiprocessor and Distributed Systems: Multiprocessor task Allocation, Dynamic Allocation of Tasks, Fault Tolerant Scheduling of Tasks, Clocks in Distributed Real Time Systems, Centralized Clock Synchronization, Distributed Clock Synchronization.

Commercial Real-Time Operating Systems: Time Services, Features of Real Time Operating System, Unix as a Real Time Operating System, UNIX-based Real-Time Operating System, Windows as a Real-Time Operating System, POSIX, A Survey of contemporary Real-Time Operating System, Benchmarking Real-Time System.

Unit V

Real-Time Communication: Examples of Real-Time Communication in Applications, Basic Concepts, Real-Time Communication in LAN, Soft Real-Time Communication in LAN, Hard Real-Time Communication in LAN, Bounded Access Protocol, Performance Comparison, Real-Time Communication over Internet, Routing, Multi-cast Routing, Resource Reservation, Traffic Shaping and Policing, Scheduling Mechanism, QoS Models.

Real-Time Databases: Examples applications of Real-Time Databases, Review of Basic Database Concepts, Real-Time Databases, Real-Time Databases Application Design Issues, Characteristics of Temporal Data, Concurrency Control in Real-Time Databases, Commercial Real-Time Databases.

Text Books:

1. Rajib Mall, *"Real-Time Systems: Theory and Practice"*, Pearson Publication, 2008.
2. Jane W. Liu, *"Real-Time Systems"*, Pearson Education, 2001.
3. Krishna and Shin, *"Real-TIme Systems"*, McGraw Hill Publication, 1999.

Reference Books:

1. Alan C. Shaw, *Real-Time Systems and Software*, Wiley, 2001.
2. Philip Laplante, *Real-Time Systems Design and Analysis*, 2nd Edition, Prentice Hall of India.

CE605 Bio-Metrics (Elective 603)

Course Objectives And Outcomes:

- [BMCO1] Design and working of a generic biometric system.
- [BMCO2] The features used to represent and match individual biometric traits.
- [BMCO3] The performance metrics used to evaluate a biometric system.
- [BMCO4] To learn and implement some of the biometrics authentication.

CO to PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
BMCO1	x	x	x							
BMCO2			x	x	x				x	
BMCO3				x						
BMCO4	x			x	x				x	

Introduction of bio-metric traits and its aim, Image processing/pattern recognition/statistics, Error types. Image processing basic: what is image, acquisition, type, point operations, Geometric transformations. Linear interpolation, brightness correction, histogram, Fourier Series, DFT, inverse of DFT.

Basic image operations: Convolution, linear/non-linear filtering, Gaussian, Median, Min, gray level reduction. Special filters, enhancement filter, Edge detection, derivatives, Laplacian, unsharp masking, high boot filtering, sharpening special filtering, Edge detection.

First and second derivative, steps in edge detection, smoothening, enhancement, threshold, localization, Robert's method, Sobal's method, Pervitt and sobal, Laplacian of Gaussian, Zero crossing. Canny edge detection, Fourier Series, DFT, inverse of DFT. Bio-metric system, authentication, physiological and behavioral properties, properties of bio-metric system, application areas. Identification/verification, Threshold, Score distribution, FAR/FRR, System design issues.

Positive/negative identification, Bio-metric system security, Authentication protocols, Authentication methods. Matching, null and alternative hypothesis h0, h1, Error type I/II, Matching score distribution, FM/FNM, ROC curve, DET curve, FAR/FRR curve. Comparing two systems using ROC curve, Expected overall error, EER, available best error rates, cost function, bio-metric myths and misrepresentations, negative authentication, trade-offs between security and convenience. Selection of suitable bio-metric, Bio-metric attributes, Zephyr charts, types of multi bio-metrics.

Verification on multi-model system, normalization strategy, Fusion methods, Multi-model identification, Bio-metric system security. Bio-metric system vulnerabilities, circumvention, covert acquisition, quality control, template generation, interoperability, data storage. Signature recognition system, cropping, enhancement, signature parameters, matching and decision, recognition.

Discrete Haar wavelet transform, Face detection, feature template, matching. Fingerprint recognition, Enhancement, Thinning, minutiae, CN number, matching. Ear and Iris recognition, why ear, image acquisition, cropping ear and iris, normalization, matching and decision.

Reference Books:

1. *Digital Image Processing using MATLAB*, Rafael C. Gonzalez, Richard Eugene Woods, *2nd Edition, McGraw-Hill Education 2010.*
2. *Guide to Biometrics*, Ruud M. Bolle, Sharath Pankanti, Nalini K. Ratha, Andrew W. Senior, Jonathan H. Connell, *Springer 2009.*
3. *Pattern Classification*, Richard O. Duda, David G. Stork, Peter E. Hart, *Wiley 2007.*
4. Ramesh R. Manza, Yogesh M. Rajput, Deepali Rathod, Manjiri B. Patwari, *Understanding Digital Image Processing Using MATLAB*, SPD Publication.

CE605 Operating System Design (Elective 603)

Course Objectives And Outcomes:

- [ODCO1] To understand key mechanisms in design of operating systems modules.
- [ODCO2] To use modern operating system calls such as Linux process and synchronization libraries.
- [ODCO3] Gain some practical experience with systems programming and tools.
- [ODCO4] Write systems level programs and scripts.

CO to PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
ODCO1	x	x				x	x			x
ODCO2	x									x
ODCO3			x				x			x
ODCO4			x	x	x		x			

General Overview Of The System: History, System Structure, User Perspective, Operating System Services, Assumptions About Hardware.

Introduction To The Kernel: Architecture Of The Unix Operating System, Introduction To System Concepts, Kernel Data Structures, System Administration.

The Buffer Cache: Buffer Headers, Structure Of The Buffer Pool, Scenarios For Retrieval Of A Buffer, Reading And Writing Disk Blocks, Advantages And Disadvantages Of The Buffer Cache.

Internal Representation Of Files: Inodes, Structure Of A Regular File, Directories, Conversion Of A Path Name To An Inode, Super Block, Inode Assignment To A New File, Allocation Of Disk Blocks, Other File Types.

System Calls For The File System: Open, Read, Write, File And Record Locking, Adjusting The Position Of File I/O LSEEK, Close, File Creation, Creation Of Special Files, Change Directory And Change Root, Change Owner And Change Mode, STAT And FSTAT, Pipes, Dup, Mounting And Unmounting File Systems, Link, Unlink, File System Abstractions, File System Maintenance.

The Structure Of Processes: Process States And Transitions, Layout Of System Memory, The Context Of A Process, Saving The Context Of A Process, Manipulation Of The Process Address Space, Sleep.

Process Control: Process Creation, Signals, Process Termination, Awaiting Process Termination, Invoking Other Programs, The User Id Of A Process, Changing The Size Of A Process, The Shell, System Boot And The Init Process.

Process Scheduling And Time: Process Scheduling, System Calls For Time, Clock.

Memory Management Policies: Swapping, Demand Paging, A Hybrid System With Swapping And Demand Paging.

The I/0 Subsystem: Driver Interfaces, Disk Drivers, Terminal Drivers, Stream.

Interprocess Communication: Process Tracing, System V IPC, Network Communications, Sockets.

Reference Books:

1. *The Design of The UNIX Operating System*, Maurice J. Bach, PHI Publication.
2. *Operating Systems: Design and Implementation*, Tanenbaum, Andrew, Prentice Hall, 1997.
3. Thomas W. Doeppner, *Operating System in Depth: Design and Programming*, Wiley Publication.
4. William Stalling, *"Operating System: Internals and Design Principles"*, 4th Edition Prentice Hall, 2005.

CE606 Computer Network Laboratory

1. Study of router and other inter-networking devices.
2. Implementation of UTP cables-cross over, straight through, roll over.
3. Implementation of basic Client Server program using TCP Socket (e.g. Day time server and client).
4. Implementation of basic Client Server program using UDP Socket.
5. Implementing a program with TCP Server and UDP Client.
6. Implementation of TCP Client Server program with concurrent connection from clients.
7. Implementing fully concurrent application with a TCP server acting as a directory server and client programs allowing concurrent connection and message transfer (e.g. Chat system).
8. Experiments with open source firewall/proxy packages like iptables, squid etc.
9. Experiments with Emulator like Netkit, Emulab etc.
10. Experiments with Simulator like NS2, NCTU NS etc.

CE607 Compiler Construction Laboratory

1. LEX and YACC – Generation of Intermediate Code for Expression Grammar – Construction of Predictive Parsing Table – LR Parsing Tables – Parsing Actions.
2. Implement CYK algorithm (from Motwani's book).
3. Using LEX/YACC tools generate assembly language code for a block of assignment and arithmetic statements.
4. Implement elimination of left recursion and left factoring algorithms for any given grammar and generate predictive parsing table.
5. Write a program for generating a parser program using LEX and YACC for a language with integer identifiers, binary arithmetic expressions and assignments. (Input is grammar and output is parser in C language).
6. Write a program for generating SLR Parsing table and also write a parser.
7. Write a program for generating derivation sequence for a given terminal string using parsing table.
8. Using back–patching method generate three address code for while, if and Boolean expressions.

CE608 System Administration

1. Installations of various Linux flavors (Optionally using Virtualbox): Centos (with LVM, without LVM), Ubuntu (with LVM, without LVM), Debian (with LVM, without LVM)
2. SSH Server (CentOS and Ubuntu): enable/disable root login
3. Telnet server (CentOS and Ubuntu)
4. FTP Server (CentOS and Ubuntu)
5. Using command upload/download files from FTP Server
6. Samba Server (CentOS and Ubuntu)
7. Http Server (CentOS and Ubuntu)
8. Configuration of Proxy Server

Reference Books:

1. Tom Adelstein, Bill Lubanovic, *Linux System Administration: Solve Real-life Linux Problems Quickly*, O'Reilly Media.
2. Æleen Frisch, *Essential System Administration*, Third Edition, O'Reilly Media.
3. Terry Collings, Kurt Wall, *Red Hat Linux Networking and System Administration*, 3rd Edition, Wiley Publication.

CE701 Software Engineering

Course Objectives and Outcomes:

- [SECO1] To understand the Software Engineering Practice & Process Models.
- [SECO2] To understand Design Engineering, Web applications, and Software Project Management.
- [SECO3] An understanding of some ethical and professional issues that are important for software engineers.
- [SECO4] To develop an ability to look at the Computer Science discipline from Software Engineering Systems perspective.

CO to PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
SECO1	x		x							
SECO2	x		x							x
SECO3	x								x	
SECO4					x		x			

Unit I

Software Engineering and The Software Process: Introduction, Process models.

Modeling Part-I: Principles that guide practice, Understanding Requirements, Requirements modeling: Scenarios, Information, and analysis classes, Requirements modeling: Flow, Behavior, Patterns, and web applications.

Unit II

Modeling Part-II: Design concepts, Architectural design, Component level design, User interface design, Pattern based design, Web page design.

Quality Management: Quality concepts, Review techniques, Software quality assurance, Software testing strategies, Testing conventional applications.

Unit III

Quality Management Part-II: Testing Object-Oriented applications, Testing web applications, Software configuration management, Product metrics.

Unit IV

Managing Software projects: Project management concepts, Process and project Metrics, Estimation for software projects, Project scheduling, Risk management, Maintenance and re-engineering.

Text Books:

1. Roger Pressman, *Software Engineering: A Practitioners Approach*, 7th Edition, McGraw Hill Publication.
2. Jalota Pankaj, *An Integrated Approach to Software Engineering*, 3rd Edition, Narosa Publication.
3. Rod Stephens, *Beginning Software Engineering*, Wiley Publication.
4. Shailesh Mehta, *Project Management and Tools & Technologies – An overview*, SPD Publication.

Reference Books:

1. Jawadekar, *Software Engineering*, 5th Edition, McGraw-Hill Publication.
2. Sommerville, *Software Engineering*, 7th Edition, Pearson Education, 2007.
3. Hans van Vliet, *Software Engineering: Principles and Practice*, 3rd Edition, Wiley Publication.

CE702 Artificial Intelligence

Course Objectives and Outcomes:

- [AICO1] To understand the notions of rational behavior and intelligent agents.
- [AICO2] To develop a general appreciation of the goals, subareas, achievements and difficulties of AI.
- [AICO3] To provide the knowledge of methods of blind as well as informed search and ability to practically apply the corresponding techniques.
- [AICO4] To develop general understanding of major concepts and approaches in knowledge representation, planning, learning, robotics and other AI areas.
- [AICO5] To developing programming skills for AI applications & exposure to logic programming with Prolog.

CO to PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
AICO1	x	x	x							
AICO2		x								
AICO3	x		x	x	x	x				
AICO4	x	x	x							
AICO5			x	x	x					

Unit I

Introduction: Definition of A.I, Foundation of A.I., History, intelligent Agents, Agent Architecture, A.I. A.I. Representation, Properties of internal representation, Futures of A.I, A.I Techniques, Importance of A.I – Representation of Knowledge, Knowledge Base Systems, State Space Search – Production Systems – Problem Characteristics.

Unit II

Heuristics Search Techniques: Generate and test – Hill Climbing, Depth First Search, Breadth First Search, Best First Search, A* and AO* Algorithm, Problem reduction – Constraint satisfaction – Means-Ends Analysis. Game playing – Minimax and Alpha-Beta Cutoffs, waiting for Quiescence, Secondary search.

Unit III

Predicate Logic: Using predicate logic, Predicate Calculus, Predicate and arguments, ISA Hierarchy, Frame notation, Resolution, Natural Deduction representing simple facts in Logic – Logic Programming, computable functions in predicates, resolution – unification, Forward and Backward reasoning, Forward and Backward chaining rules.

Unit IV

Structured Knowledge Representation: TMS (Truth maintenance system),Statistical and

probabilistic reasoning, Associative Networks, Semantic Nets, Frames Structures, Conceptual Dependencies and Scripts Learning – Concept of Learning – Learning Automata, Genetic Algorithm, Learning by induction, Planning: Block world, strips, Implementation using goal stack, Non linear planning with goal stacks, Hierarchical planning, least commitment strategy.

Unit V

Natural Language Processing: Overview of Linguistics, Grammars and Languages, basic Parsing techniques, Semantic analysis and representation structures. Natural Language generation and Natural Language Systems. Syntactic Processing, ATN, RTN.

Unit VI

Expert Systems: Architecture – Need and Justification of Expert Systems – knowledge representation, Knowledge acquisition and validation. Utilization and functionality, Perception and Action, real time search, perception, action, vision, robot architecture, Basics of PROLOG.

Text Books:

1. Eugene, Charniak, Drew Mcdermott, *"Introduction to artificial intelligence"*, Addison Wesley, 1985.
2. Eiaine Rich and Kerin Knight, *"Artificial Intelligence"*, McGraw-Hill, Second Edition.
3. Anindita Das Bhattacharjee, *Artificial Intelligence and Soft Computing for Beginners*, 2nd Edition, SPD Publication.

Reference Books:

1. Stuart Russell and Peter Nerving, *"Artificial Intelligence: A Modern Approach"*, Prentice Hall, 2nd Edition.
2. Ivan Bratko, *"Prolog Programming For Artificial Intelligence"*, 2nd Edition Addison Wesley, 1990.
3. Herbert A. Simon, *"The Sciences of the Artificial "*, MIT Press, 3rd Edition (2nd Printing), 1995.
4. Tim Jones, *"Artificial Intelligence Application Programming"*, Dreamtech Publication.

CE703 Internetworking Protocol

Course Objectives and Outcomes:

- [IPCO1] To gain comprehensive knowledge about the layered communication architectures.
- [IPCO2] To understand the principles, key protocols, design issues, and significance of each layers in TCP/IP.
- [IPCO3] To gain comprehensive knowledge about the layered communication architectures in TCP/IP and its functionalities.

CO to PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
IPCO1	x		x							x
IPCO2		x	x	x			x			x
IPCO3	x	x					x			x

Unit I

Review of Networking Technologies and Inter-networking Concepts and Architectural Model: Application level and network level interconnection, Properties of the Internet, Internet architecture, Interconnection through IP routers.

Unit II

Internet Addresses, Mapping Internet Addresses to Physical Addresses (ARP) & Determining an Internet Addresses at Startup (RARP): Universal identifiers, Three primary classes of IP addresses, Network and broadcast addresses, Limited broadcast, Dotted decimal notation, Weakness in Internet addressing, Loop-back addresses, Address resolution problem, Two types of physical addresses, Resolution through direct mapping, Resolution through dynamic binding, Address resolution cache, ARP to other protocols, Reverse address resolution protocol, Timing RARP transaction, Primary and backup RARP servers.

Unit III

Internet Protocol Connectionless Datagram Delivery and Internet Protocol: Routing IP Datagram: The concepts of unreliable delivery, Connectionless delivery system, Purpose of the Internet protocol, The Internet datagram, Routing in an Internet, Direct and indirect delivery, Table driven IP routing, Next hop routing, Default routes, Host specific routes, The IP routing algorithm, Handling incoming datagrams, Establishing routing tables.

Unit IV

Internet Protocol Error and Control Message (ICMP) and Subnet and Supernet Address Extension: The Internet, Control message protocols, Error reporting versus error detection, ICMP message format, Detecting and reporting various network problems through ICMP, Transparent router, Proxy ARP, Subnet addressing, Implementation of subnets with masks representation, Routing in the presence of subnets, A unified algorithm.

Unit V

User Datagram Protocol (UDP): Format of UDP message, UDP pseudo header, UDP encapsulation and protocols layering and the UDP checksum computation, UDP multiplexing, De-multiplexing and ports.

Reliable Stream Transport Service (TCP): The transmission control protocol, Ports, Connections and endpoint, Passive and active opens, The TCP segment format, TCP implementation issues.

Unit VI

Application Layer World Wide Web, Real-time Audio and Video, Content Delivery and Peer-To-Peer, SMTP and HTTP Protocol, Domain name systems (DNS), and DNS server, Electronic mail architecture and services, Message formats, MIME, message transfer, SMTP, Mail gateways, Relays, Configuration mail servers, File transfer protocol, General model commands, TFTP.

Text Books:

1. Douglas E. Comer, *Inter-networking with TCP/IP: Principles, Protocols and Architecture*, PHI Publication.
2. Behrouz A. Forouzan, *TCP-IP Protocol Suite*, McGraw Hill Publication.

Reference Books:

1. *Unix Network Programming Interprocess Communications*, W. Richard Stevens, PHI Publication.
2. William Stalling, *SNMP SNMPv2, SNMPv3, and RMON 1 and 2*, Pearson Education.
3. Hunt Craig, *TCP-IP Network Administration*, O'Reilly Media.
4. D. Comer, *Computer Networks and Internet*, Pearson education.
5. Natalia Olifer, Victor Olifer, *Computer Networks: Principles, Technologies and Protocols for Network Design*, Wiley Publication.

CE704 Distributed System (Elective 701)

Course Objectives and Outcomes:

- [DSCO1] To learn the principles, architectures, algorithms and programming models used in distributed systems.
- [DSCO2] Ability to write distributed programs using sockets, RPC/RMI, etc.
- [DSCO3] Appreciation of the differences in the handling of issues like mutual exclusion, deadlock detection, fault handling, etc. in a centralized system and a distributed system.
- [DSCO4] To gain experience in the application of fundamental Computer Science methods and algorithms in the development of distributed systems and distributed systems applications.

CO to PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
DSCO1			x							x
DSCO2		x	x	x						
DSCO3	x						x			x
DSCO4		x	x	x			x			x

Unit I

Introduction: Introduction to Distributed Computing System, Evolution of Distributed Computing System, Distributed Computing System models, Distributed Computing System Gaining Popularity, Distributed Operating System, Introduction to Distributed Computing Environment (DCE), network Types, LAN Technologies, WAN technologies, Communication Protocols, Inter-networking, ATM Technology, Desirable Features of a Good Message- Passing System, Issues in IPC by Message-Passing, Synchronization, Buffering, Multi-datagram message, Encoding and Decoding of message data, Process addressing, Failure Handling, Group Communication, Case Study: BSD UNIX IPC Mechanism.

Unit II

Remote Procedure Calls: Introduction, the RPC model, Transparency of RPC, Implementing RPC Mechanism, Stub Generation, RPC messages, Marshaling arguments and Results, Server Management, Parameter Passing Semantics, Call Semantics, Communication Protocols for RPCs, Complicated RPCs, Client- Server Binding, Exception Handling, Security, Some Special Types of RPCs, RPC in Heterogeneous Environments, Lightweight RPC, Optimization for Better Performance, Case studies: Sun RPC, DCE, RPC.

Unit III

Distributed Shared Memory: Introduction, general Architecture of DSM Systems, Design and Implementation Issues of DSM, Granularity, Structure of Shared Memory Space, Consistency Models, Replacement Strategy, Thrashing, Other Approaches to DSM, Heterogeneous DSM, Advantages of DSM.

Synchronization: Introduction, Clock Synchronization, Event Ordering, Mutual Exclusion, Deadlock, Election Algorithms.

Unit IV

Resource Management And Process Management: Introduction, Desirable Features of a Good Global Scheduling Algorithm, Task assignment Approach, Load-Balancing Approach, load Sharing Approach, Process Migration, Threads.

Distributed File System: Introduction, Desirable Features of a Good Distributed File System, File Models, File Accessing Models, File Sharing Semantics, File Caching Schemes, File Replication, Fault Tolerance, Atomic Transactions, Design Principles, Case Study: DCE Distributed File Service.

Text Books:

1. P. K. Sinha, *Distributed Operating System*, PHI Publication.
2. Colorouis, *Distributed Systems*, Addison Wesley Publication.
3. M. L. Liu. *Distributed Computing: Principles and Applications*, Addison-Wesley, 2004.

Reference Books:

1. Tanabaum, *Distributed Systems*, PHI Publication.
2. Arun Kulkarni, Nupur Prasad Giri, Nikhilesh Joshi, Bhushan Jadhav, *Parallel and Distributed Systems*, Wiley Publication.
3. Ajay D. Kshemkalyani and Mukesh Singhal, *Distributed Computing: Principles, Algorithms, and Systems*, Cambridge University Press, 2008.
4. Joel M. Crichlow, *The Essence of Distributed Systems*, Pearson Education Limited, 2000.

CE704 Cloud Computing (Elective 701)

Course Objectives and Outcomes:

- [CLCO1] Understand various basic concepts related to cloud computing technologies.
- [CLCO2] To demonstrate an understanding of Service models, deployment models, Virtualization.
- [CLCO3] Understand different cloud programming platforms and tools.
- [CLCO4] Create application by utilizing cloud platforms such as Google app Engine and Amazon Web Services (AWS)
- [CLCO5] Be familiar with cloud programming using Google's 'Go' programming language.

CO to PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CLCO1	x						x			
CLCO2	x	x		x			x			
CLCO3	x		x				x			x
CLCO4			x	x	x					x
CLCO5	x		x							

Unit I

Overview of Distributed Computing, Cluster Computing and Grid Computing – Technologies for Network based systems – Software environments for Distributed Systems and Clouds – Overview of Services and Service oriented Architecture, Motivation for cloud computing, Cloud Computing principles.

Unit II

Virtual Machines and Virtualization–Implementation levels of Virtualization–Virtualization structures/tools and Mechanisms–Virtualization of CPU, Memory and I/O Devices–Storage Virtualization. Cloud system architectures, Delivery models – infrastructure-as-a-service, platform-as-a-service and software-as-a-service, Types of Clouds – public, private and hybrid clouds, Infrastructure and Data storage Management, Architecture and design of storage and compute clouds.

Unit III

Authentication, Authorization and Accounting, Cloud Security, privacy, policy and compliance, Cloud reliability, disaster recovery and fault-tolerance, Cloud Economics – Metering, Monitoring and Pricing, Viability of Cloud.

Unit IV

Cloud programming frameworks, cloud interfaces, Interoperability and standards, Case studies such as Amazon Web Services, Windows Azure and Google AppEngine.

Text Books:

1. Kai Hwang, Geoffrey C. Fox and Jack J. Dongarra, *"Distributed and Cloud Computing from Parallel Processing to the Internet of Things"*, Morgan Kaufmann, Elsevier, 2012.
2. Antohy T Velte, *Cloud Computing: A Practical Approach*, McGraw Hill.

Reference Books:

1. Tim Mather, Subra Kumaraswamy, and Shahed Latif, *"Cloud Security and Privacy An Enterprise Perspective on Risks and Compliance"*, O'Reilly 2009.
2. John W. Rittinghouse, James F. Ransome, *Cloud Computing: Implementation, Management, and Security*, CRC Press.
3. Barrie Sosinsky, *"Cloud Computing Bible"* John Wiley & Sons, 2010.
4. Buyya R., Broberg J., Goscinski A. M., *Cloud Computing – Principles and Paradigms*, Wiley Publication.

CE705 Computer Vision (Elective 702)

Course Objectives and Outcomes:

- [CVCO1] Be familiar with both the theoretical and practical aspects of computing with images.
- [CVCO2] Understand the geometric relationships between 2D images and the 3D world.
- [CVCO3] Developed the practical skills necessary to build computer vision applications.
- [CVCO5] Analyze and evaluate critically the building and integration of computer vision algorithms and systems.

CO to PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CVCO1	x		x			x				
CVCO2	x					x				
CVCO3		x	x	x		x				
CVCO4		x		x						

Unit I

Digital Image Formation and low-level processing: Overview and State-of-the-art, Fundamentals of Image Formation, Transformation: Orthogonal, Euclidean, Affine, Projective, etc; Fourier Transform, Convolution and Filtering, Image Enhancement, Restoration, Histogram Processing.

Depth estimation and Multi-camera views: Perspective, Binocular Stereopsis: Camera and Epipolar Geometry; Homography, Rectification, DLT, RANSAC, 3-D reconstruction framework; Auto-calibration.

Unit II

Feature Extraction: Edges – Canny, LOG, DOG; Line detectors (Hough Transform), Corners – Harris and Hessian Affine, Orientation Histogram, SIFT, SURF, HOG, GLOH, Scale-Space Analysis- Image Pyramids and Gaussian derivative filters, Gabor Filters and DWT.

Unit III

Image Segmentation: Region Growing, Edge Based approaches to segmentation, Graph-Cut, Mean-Shift, MRFs, Texture Segmentation; Object detection.

Pattern Analysis: Clustering: K-Means, K-Medoids, Mixture of Gaussians, Classification: Discriminant Function, Supervised, Un-supervised, Semi-supervised; Classifiers: Bayes, KNN, ANN models; Dimensionality Reduction: PCA, LDA, ICA; Non-parametric methods.

Unit IV

Motion Analysis: Background Subtraction and Modeling, Optical Flow, KLT, Spatio-Temporal Analysis, Dynamic Stereo; Motion parameter estimation.

Shape from X: Light at Surfaces; Phong Model; Reflectance Map; Albedo estimation; Photometric

Stereo; Use of Surface Smoothness Constraint; Shape from Texture, color, motion and edges.

Unit V

Miscellaneous: Applications: CBIR, CBVR, Activity Recognition, computational photography, Biometrics, stitching and document processing; Modern trends – super-resolution; GPU, Augmented Reality; cognitive models, fusion and SR&CS.

Text Books:

1. Richard Szeliski, *Computer Vision: Algorithms and Applications*, Springer – Verlag London Limited 2011.
2. *Computer Vision: A Modern Approach*, D. A. Forsyth, J. Ponce, Pearson Education, 2003.
3. Kurt Demaagd, Anthony Oliver, Nathan Oostendorp, Katherine Scott, *Practical Computer Vision with SimpleCV: The Simple Way to Make Technology See*, O'Reilly Media.

Reference Books:

1. Richard Hartley and Andrew Zisserman, *Multiple View Geometry in Computer Vision*, Second Edition, Cambridge University Press, March 2004.
2. K. Fukunaga, *Introduction to Statistical Pattern Recognition*, Second Edition, Academic Press, Morgan Kaufmann, 1990.
3. R.C. Gonzalez and R.E. Woods, *Digital Image Processing*, Addison- Wesley, 1992.

CE705 Natural Language Processing (Elective 702)

Course Objectives and Outcomes:

- [NLCO1] To understand the application of computational methods in linguists.
- [NLCO2] To apply statistical and probabilistic methods for parameter estimation and inference.
- [NLCO3] Apply various important tasks in natural language processing such as language modeling, information extraction, named entity recognition, information retrieval, text classification, word sense disambiguation, automatic question answering and text summarization.
- [NLCO4] Use natural language processing (NLP) tools and libraries (such as python, nltk) and develop software for various NLP tasks such as tagging, parsing and text classification.

CO to PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
NLCO1	x		x							
NLCO2		x		x						
NLCO3		x	x	x	x					
NLCO4			x	x	x					

Unit I

Introduction, Machine Learning and NLP, ArgMax Computation, WSD: WordNet, Wordnet; Application in Query Expansion, Wiktionary; Semantic relatedness, Measures of WordNet Similarity, Similarity Measures, Resnick's work on WordNet Similarity, Parsing Algorithms, Evidence for Deeper Structure.

Unit II

Top Down Parsing Algorithms, Noun Structure; Top Down Parsing Algorithms, Non-noun Structure and Parsing Algorithms, Probabilistic parsing; sequence labeling, PCFG, Training issues; Arguments and Adjuncts, Probabilistic parsing; inside-outside probabilities, Speech: Phonetics, HMM, Morphology, Graphical Models for Sequence Labeling in NLP, Phonetics, Consonants (place and manner of articulation) and Vowels, Forward Backward probability.

Unit III

Viterbi Algorithm, Phonology, Sentiment Analysis and Opinions on the Web, Machine Translation and MT Tools – GIZA++ and Moses, Text Entailment, POS Tagging, Phonology; ASR, Speech Synthesis, HMM and Viterbi, Precision, Recall, F-score, Map, Semantic Relations; UNL; Towards Dependency Parsing, Universal Networking Language, Semantic Role Extraction, Baum Welch Algorithm, HMM training.

Text Books:

1. T. Siddiqui and U.S. Tiwary, *Natural Language Processing and Information Retrieval*, Oxford University Press, 2008.

2. Steven Bird, Ewan Klein, Edward Loper, *Natural Language Processing with Python: Analyzing Text with the Natural Language Toolkit*, O'Reilly Media.

Reference Books:

1. James Allen, *"Natural Language Understanding"*, Second Edition, Benjamin/Cumming, 1995.
2. Charniack, Eugene, *"Statistical Language Learning"*, MIT Press, 1993.
3. D. Jurafsky, and J. H. Martin, *Speech & Language Processing: An Introduction to Natural Language Processing, Speech Recognition, & Computational Linguistics*, Prentice-Hall, 2000.
4. Manning, Christopher and Heinrich, Schutze, *"Foundations of Statistical Natural Language Processing"*, MIT Press, 1999.

CE706 Internetworking Protocol Laboratory

List of Experiments:

1. **Introduction to WireShark and Layered Protocol:** Overview, WireShark, Networking Tools, Layered Protocol, Procedures, Installation, Getting familiar with WireShark, Layered Protocol, Running WireShark, Networking Tools, Layered Protocol.
2. **Ethernet and IEEE 802.11:** Objective, Introduction, Ethernet, IEEE 802.1, Procedures and Discussions, Ethernet, Procedures and Discussions, IEEE 802.11.
3. **ARP, IP, and ICMP:** Objective, Address Resolution Protocol (ARP), Internet Protocol (IP), Internet Control Message Protocol (ICMP), Procedures and Discussion: Exploring ARP Functions, Analyzing IP frames, Exploring ICMP Functions.
4. **TCP:** Objective, Introduction: TCP Header Format, TCP Connection Setup, TCP Data Flow, TCP Connection Release, TCP Congestion Control, TCP Flow Control, Re-transmission in TCP, Procedures and Discussions: TCP Header Format, TCP Connection Setup, TCP Data Flow, TCP Connection Release, TCP Congestion Control, TCP Flow Control, Re-transmission in TCP (Optional).
5. **UDP:** Capture a Trace, Inspect the Trace, UDP Message Structure, UDP Usage.
6. **HTTP:** The Basic HTTP GET/response interaction, The HTTP CONDITIONAL GET/response interaction, Retrieving Long Documents, HTML Documents with Embedded Objects, HTTP Authentication.
7. **DNS:** DNS Commands: nslookup, ipconfig, Tracing DNS with Wireshark, Inspect the Trace, DNS Message Structure, DNS Usage.

CE707 Software Engineering Laboratory

List of experiments:

1. Give detailed Problem Statement
2. Perform Software scoping activity
3. Estimate required Resources
4. Perform Software Estimation
5. Perform Risk Analysis and Management
6. Carry out Project Scheduling and Tracking
7. Prepare Project Plan
8. Prepare Software Quality Assurance Plan (SQA plan)
9. Carry out Requirement Analysis Modeling
10. Carry out Design
11. Perform Software Testing

CE708 Artificial Intelligence Laboratory

State Space Search – Water Jug Problem, Missionaries and cannibals, Tower of HANOI, Eight puzzle, Implementation of these problems using both uninformed and informed search. – BFS, DFS, Best First Search, A*.

Two-agent Games – Tic-Tac-Toe using Min-Max search and Alpha-Beta pruning, Constraint Satisfaction Problems – N-Queens using Heuristic repair and constraint propagation.

Logic-Unification, Resolution, Answer Extraction Using Resolution.

Machine Learning – Decision Tree, Candidate Elimination, Clustering (K-means), Neural net learning (Perception), Genetic algorithms (2SAT), Expert Systems, Natural Language Processing.

CE710 Hadoop Platform Development

Course Objectives and Outcomes:

- [HDCO1] To design and develop Hadoop and Map Reduce Framework.
- [HDCO2] The basics of Analytics – Concepts, Data preparation – merging, managing missing numbers sampling, Data visualization, Basic statistics.
- [HDCO3] To Developed the skills necessary for utilizing tools (including deploying them on Hadoop/MapReduce) to handle a variety of big data analytics, and to be able to apply the analytics techniques on a variety of applications.

CO to PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
HDCO1	x	x		x						x
HDCO2	x	x		x	x		x			
HDCO3		x	x	x	x					x

Hadoop Basics: Hadoop Stack Basics, The Apache Framework: Basic Modules, Hadoop Distributed File System (HDFS), The Hadoop "Zoo", Hadoop Ecosystem Major Components, Apache Hadoop Ecosystem, Exploring the Cloudera VM.

Introduction to the Hadoop Stack: Overview of the Hadoop Stack, The Hadoop Distributed File System (HDFS) and HDFS2, MapReduce Framework and YARN, The Hadoop Execution Environment, YARN, Tez, and Spark, Hadoop Resource Scheduling, Hadoop-Based Applications, Introduction to Apache Pig, Introduction to Apache HIVE, Introduction to Apache HBASE.

Introduction to Hadoop Distributed File System (HDFS): Overview of HDFS Architecture, The HDFS Performance Envelope, Read/Write Processes in HDFS, HDFS Tuning Parameters, HDFS Performance and Robustness, Overview of HDFS Access, APIs, and Applications, HDFS Commands, Native Java API for HDFS, REST API for HDFS.

Introduction to Map/Reduce: Introduction to Map/Reduce, The Map/Reduce Framework, A MapReduce Example: Wordcount in detail, debugging map/reduce programs, MapReduce: Intro to Examples and Principles, MapReduce Example: Trending Wordcount, MapReduce Example: Joining Data, MapReduce Example: Vector Multiplication, Computational Costs of Vector Multiplication, MapReduce Summary.

Spark: Introduction to Apache Spark, Architecture of Spark, Setup PySpark on the Cloudera VM, Resilient Distributed Datasets, Spark Transformations, Wide Transformations, Directed Acyclic Graph (DAG) Scheduler, Actions in Spark, Memory Caching in Spark, Broadcast Variables, Accumulators, Simple Join in Spark, Advanced Join in Spark.

*Programming assignments are mandatory.

Text Books:

1. *The Hadoop – Definitive Guide*, Tom White, O'Reilly, 2009.
2. *Hadoop for Dummies*, Dirk deRoos, Paul C. Zikopoulos, Bruce Brown, Rafael Coss, and Roman B. Melnyk, Wiley Publication.
3. Eric Sammer, *Hadoop Operations A Guide for Developers and Administrators*, O'Reilly Media.

Reference Books:

1. *Hadoop in Action*, Chuck Lam, Manning Publication.
2. *Hadoop in Practice*, Alex Holmes, Manning Publication.
3. *Learn Spark In A Day, The Ultimate Crash Course to Learning the Basics of Spark In No Tim*e Authored by Acodemy.
4. *Learning Spark*, Holden Karau, Andy Konwinski, Patrick Wendell & Matei Zaharia, O'Reilly Media.

CE801 Software Quality Assurance (Elective 801)

Course Objectives and Outcomes:

- [SQCO1] To understand software quality management process and quality management models.
- [SQCO2] To learn software quality metrics, assurance and various software standards.
- [SQCO3] To gain the techniques and skills on how to use modern software testing tools to support software testing projects.
- [SQCO4] To train the students to apply quality assurance techniques in different activities of software development and maintenance.

CO to PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
SQCO1	x	x		x						
SQCO2	x	x	x							
SQCO3	x		x	x						
SQCO4		x		x						

Principles of Testing: The pesticide paradox, Software Development Life Cycle Model, Phases of software project, Quality, Quality assurance and quality control, Testing, Verification and validation, Process models to represent various phases, Life cycle models, Software testing life cycle.

White Box Testing (WBT): Static testing: by human, Static Analysis Tool; Structural testing: unit/code functional testing, Code coverage Testing, code complexity Testing; Challenges in White Box Testing.

Black Box Testing: What, Why and When used black box testing How to do Black Box Testing: Requirement based testing, Positive and negative testing, Boundary value analysis, Decision Tables, Equivalence Partitioning, State based or graph based testing, Compatibility Testing, Domain Testing.

Integration Testing: Integration Testing as a type of testing: Top-down, Bottom-up Integration, Bi-directional Testing, System Integration, choosing Integration method; As a phase testing; Scenario testing: System and use case scenario, Defect bash.

System and Acceptance Testing: What, Why is system testing done?, Functional Versus Non Functional testing, Functional system testing: Design/Architecture verification, Business Vertical Testing, Deployment Testing, Beta Testing, Certification, Standards and Testing for compliance; Non-functional system testing: setting up the configuration, Coming up with Entry/Exit criteria, Balance Key Resources, Scalability Testing, Reliability Testing, Stress Testing, Inter-operability Testing;

Acceptance testing: Acceptance Criteria, Selecting Test Cases, Executing Test cases; Summary of Testing Cases.

Performance Testing: Introduction, Factor Governing performance Testing, Methodology of Performance Testing, Tools for Performance Testing, Process for performance Testing.

Regression Testing: What and When to do regression Testing, Types, How to do regression testing? Best Practices in regression testing.

Internationalization testing: Introducing, Primer on Internationalization, Test Phases, Enabling Testing, Local Testing, Internationalization Validation, Fake Language Testing, Language Testing, Localization Testing, Tools.

Ad-hoc Testing: Overview, Buddy Testing, Pair Testing, Exploratory Testing, Iterative Testing, Agile and Extreme Testing, Defect Seeding.

Testing Object Oriented Software: Introduction, Comparison of OO and Procedural software, System testing example, Unit testing of classes, Tools for testing OO software. Testing Web Application.

Text Books:

1. Paul C. Jorgensen, *Software Testing: A Craftsman's Approach*, Fourth Edition, CRC Press.
2. Shriniwasan Desikan, Gopalswamy Ramesh, *"Software Testing – Principles and Practices"*, Pearson Education.
3. Loise Tamres, *"Introducing Software Testing"*, Pearson Education.
4. Aditya P. Mathur, *"Foundations of Software Testing"*, Pearson Education, 2008.
5. Cem Kaner, Jack Falk, Hung Quoc Nguyen, *Testing Computer Software*, 2nd Edition, Wiley Publication.

Reference Books:

1. Boris Beizer, *"Software Testing Techniques"*, Dream Tech. Publication.
2. Ross Patton, *"Software Testing"*, Pearson Education.
3. Elfriede Dustin, *"Effective Software Testing"*, First Edition, Pearson Education, 2003.
4. Renu Rajani, Pradeep Oak, *"Software Testing – Effective Methods, Tools and Techniques"*, McGraw Hill, 2004.
5. Kshirasagar Naik, Priyadarshi Tripathy, *Software Testing and Quality Assurance: Theory and Practice*, Wiley Publication.

CE801 Software Architecture (Elective 801)

Course Objectives and Outcomes:

- [SACO1] To appreciate relationships between system qualities and software architectures.
- [SACO2] To understand the software architectural patterns and tactics, and their relationship to system qualities.
- [SACO3] To write software architecture documentation.
- [SACO4] To understand architectural reuse via software product lines.

CO to PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
SACO1	x	x								
SACO2		x		x		x				
SACO3								x		
SACO4		x		x						

Introduction to Software Architecture, The 4+1 View of Software Architecture, Examples of Software Architecture, Architecture Design: Quality attributes.

Attribute Driven Design; Architecture Centric Software Development Methodology, Design Patterns, Software Design Function Oriented versus Object Oriented, Documenting Software Architecture Stakeholders, Views, View-sets, View-based documentation, IEEE 1471, ISO 42010.

Architecture Description Languages, Architecture Evaluation, Product line architectures, Enterprise Architecture, Architecture Knowledge Management.

Reference Books:

1. *"Software Architecture in Practice"*, Len Bass, Paul Clements, Rick Kazman.
2. *"Documenting Software Architectures: Views and Beyond"*, Paul Clements, Felix Bachmann, Len Bass, David Garlen, James Ivers, Reed Little, Robert Nord and Judith Stafford.
3. Jan Bosch, *"Design and Use of Software Architectures"*, Addision-Wesley-Pearson Education.
4. Frank Buschmann, Regine Meunier, Hans Rohnert, Peter Sommerlad, MiachelStal, Douglas Schmidt, *"Pattern oriented software architecture"*, Volumes 1 &2, Wiley Publication.

CE802 Data Science with R (Elective 802)

Course Objectives and Outcomes:

- [DRCO1] Explain the key differences between the tasks of classification, clustering, regression, and dimensionality reduction.
- [DRCO2] To appreciate supervised and unsupervised learning and their applications.
- [DRCO3] Understand concepts around Business Intelligence and Business Analytics.
- [DRCO4] Work on a real-life project, implementing supervised and unsupervised machine learning techniques to derive business insights.
- [DRCO5] Propose a suitable visualization design for a particular combination of data characteristics and application tasks.

CO to PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
DRCO1	x	x								
DRCO2		x		x	x					
DRCO3	x	x		x						
DRCO4		x	x	x	x					
DRCO5		x	x	x	x					

Data Mining Patterns: Cluster Analysis: K-means Clustering, K-medoids Clustering, Hierarchical Clustering, Expectation Maximization, Density estimation; Anomaly Detection: Show outliers, Calculating Anamolies; Association Rules: Mine for Association; Data Mining Sequences: Eclat, arulesNBMiner, Apriori, Determining Sequences using TraMineR, Similarity in sequences.

Text Mining: Text mining, Text Clusters.

Data Analysis: Regression Analysis – Simple regression, Multiple Regression, Multivariate Regression Analysis, Robust Regression, Correlation, Clustering: K-means Clustering, medoids cluster, The CascadeKM function, selecting cluster based on Bayesian information, Affinity propagation clustering, Gap Statistic to estimate the number of clusters, Hierarchical clustering.

Data Visualization: R graphics – Interactive graphics, The latticist package, The ggplot2 package; Plotting -Scatter Plots, Bar Charts and Plots; 3D graphics – Lattice Cloud- 3D scatterplot, Big Data, Research Areas.

Machine Learning: Data Partitioning Model, The Train Model, Predicting events with machine learning – automatic forecasting package; Supervised and Unsupervised learning.

Reference Books:

1. Dan Toomey, *"R for Data Science"*, PACKT Publication, First Edition, 2014.
2. *Data Science from Scratch: First Principles with Python*, O'Reilly Media.
3. Hadley Wickham, Garrett Grolemund, *R for Data Science Import, Tidy, Transform, Visualize, and Model Data*, O'Reilly Media.
4. *Data Science & Big Data Analytics: Discovering, Analyzing, Visualizing and Presenting Da*ta, Wiley Publication.
5. Julia Silge, David Robinson, *Text Mining with R: A Tidy Approach*, O'Reilly Media.

CE802 Cryptography and Network Security (Elective 802)

Course Objectives and Outcomes:

- [NSCO1] To understand the network security, services, attacks, mechanisms, types of attacks.
- [NSCO2] To understand cryptographic techniques for encryption, hashing, signature.
- [NSCO3] Develop an understanding of security policies (authentication, integrity and confidentiality), as well as protocols to implement such policies in the form of message exchanges.
- [NSCO4] Deploy the cryptographic techniques to detect and prevent basic security threats.

CO to PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
NSCO1	x						x		x	
NSCO2		x		x			x		x	
NSCO3	x		x	x					x	
NSCO4		x	x	x					x	

Introduction and Mathematical Foundations: Introduction, Overview on Modern Cryptography, Number Theory, Probability and Information Theory.

Classical Cryptosystems: Classical Cryptosystems, Crypt-analysis of Classical Cryptosystems, Shannon's Theory.

Symmetric Key Ciphers: Symmetric Key Ciphers, Modern Block Ciphers (DES), Modern Block Cipher (AES).

Crypt-analysis of Symmetric Key Ciphers: Linear Crypt-analysis, Differential Crypt-analysis, Other Crypt-analytic Techniques, Overview on S-Box Design Principles, Modes of operation of Block Ciphers.

Stream Ciphers and Pseudo-randomness: Stream Ciphers, Pseudo-random functions.

Hash Functions and MACs: Hash functions: The Merkle Damgard Construction, Message Authentication Codes (MACs).

Asymmetric Key Ciphers: Construction and Crypt-analysis: More Number Theoretic Results, The RSA Cryptosystem, Primality Testing, Factoring Algorithms, Other attacks on RSA and Semantic Security of RSA, The Discrete Logarithm Problem (DLP) and the Diffie Hellman Key Exchange algorithm, The ElGamal Encryption Algorithm, Crypt-analysis of DLP.

Digital Signatures: Signature schemes: I, Signature schemes: II.

Modern Trends in Asymmetric Key Cryptography: Elliptic curve based cryptography: I, Elliptic curve based cryptography: II.

Network Security: Secret Sharing Schemes, A Tutorial on Network Protocols, Kerberos, Pretty Good Privacy (PGP), Secure Socket Layer (SSL), Intruders and Viruses, Firewalls.

Text Books:

1. Douglas Stinson, *"Cryptography Theory and Practice"*, 2nd Edition, Chapman & Hall/CRC.
2. B. A. Forouzan, *"Cryptography & Network Security"*, McGraw Hill Publication.
3. William Stallings, *"Cryptography and Network Security"*, Pearson Education.
4. Dr. B. B. Meshram, *TCP/IP & Network Security*, SPD Publication.

Reference Books:

1. Wenbo Mao, *"Modern Cryptography, Theory & Practice"*, Pearson Education.
2. Hoffstein, Pipher, Silvermman, *"An Introduction to Mathematical Cryptography"*, Springer.
3. Alang.Konheim, *Computer Security and Cryptography*, Wiley Publication.
4. A. Joux, *"Algorithmic Crypt-analysis"*, CRC Press.
5. S. G. Telang, *"Number Theory"*, McGraw Hill.
6. Matt Bishop, *"Computer Security"*, Pearson Education.

CE803 Bio-Informatics (Elective 803)

Course Objectives and Outcomes:

- [BICO1] To Understand the theoretical basis behind bioinformatics.
- [BICO2] To know algorithms and programming techniques like dynamic programming, hashing, and suffix trees.
- [BICO3] To help in developing multidisciplinary approach to the systematic analysis and modeling of complex biological phenomena.
- [BICO4] Serving as an introduction to computational and systems biology, this course emphasizes the fundamentals of nucleic acid and protein sequence analysis, structural analysis, and the analysis of complex biological systems.

CO to PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
BICO1	x									
BICO2		x	x	x						
BICO3		x		x			x			
BICO4	x	x					x			

Introduction to Bioinformatics: What is a Data Base, Types of Databases, Biological Databases, Pitfalls of Biological Databases, Information Retrieval from Biological Databases.

Pair wise Sequence Alignment: Evolutionary Basics, Sequence homology versus similarity, Sequence similarity versus Identity, Scoring Matrices, Statistical Significance of Sequence alignment.

Database similarity searching: Unique requirement of Database searching, Heuristic Database searching, Basic alignment search tool: Comparison of FASTA and BLAST, Multiple Sequence Alignment, Scoring Function, Exhaustive Algorithms, Heuristic Algorithms, Gene Prediction, Categories of gene prediction programs, Gene prediction in prokaryotes and Eukaryotes, Phylogenetics Basics Molecular phylogenetics and molecular basics Gene phylogeny versus species phylogeny, Forms of tree representation, Why finding a true tree is difficult, Phylogenetic tree construction methods and programs.

Protein structure basics: Amino acid, peptide formation, Dihedral Angles, Hierarchy, Secondary structures, Tertiary structure, Determination of protein 3-D structure, Protein structure data base, Genome mapping, assembly and comparison, Genome mapping, Genome sequencing, Genome sequence assembly, Genome Annotation, Comparative genomics, Functional Genomics, Sequence based approaches, Microarray based approaches, Comparisons of SAGE and DNA micro-array.

Reference Books:

1. Jin Xiong, *Essential Bioinformatics*, 1st Edition, Cambridge University Press, 2011.
2. Arthur M Lesk, *Introduction to Bioinformatics*, 2nd Edition, Oxford University Press, 2007.
3. *"An Introduction to Bioinformatics Algorithms"*, Jones, Pevzner, MIT Press.
4. Cynthia Gibas, Per Jambeck, *Developing Bioinformatics Computer Skills: An Introduction to Software Tools for Biological Applications*, O'Reilly Media.
5. Andreas D. Baxevanis, *Bioinformatics A Practical Guide to the Analysis of Genes and Proteins, Second Edition*, Wiley Publication.

CE803 Internet of Things (Elective 803)

Course Objectives and Outcomes:

- [ITCO1] To learn the basic issues, policy and challenges in the Internet.
- [ITCO2] To get an idea of some of the application areas where Internet of Things can be applied.
- [ITCO3] To understand the cloud and Internet environment.
- [ITCO4] To understand the various modes of communications with Internet.

CO to PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
ITCO1	x	x								x
ITCO2		x		x			x			x
ITCO3	x									x
ITCO4	x	x								

IoT Definition: IoT Applications in different domain, IoT Market in different domains, Challenges for IoT Industry, IoT Business, IoT Opportunities, IoT Architecture, Technology Stack, Protocols, Hardware Requirements-Cloud Communication, Data streaming, Data stores.

Micro controller Basics M2M & IOT: Micro controller & Microprocessor, STM32F401RE schematic – Mbed Compiler, Interfaces (UART/SPI/I2C), Introduction to development boards like Raspberry pi, Arduino, STM32, CS3200, Nodemcu, Blend micro M2M to IoT, An Architectural Overview, Building an architecture, Main design principles and needed capabilities, An IoT architecture outline, standards considerations.

Sensors and Actuators: Definition, Sensors Properties and types of sensors, Reading Technical data sheet, Actuators properties, Sensor manufacturers & data sheets – Gate ways (GSM/Wi-fi).

IOT Protocols & wireless sensor networking: Communication channels, communication protocols, wireless/RF Protocols, ZigBee, ANT and ANT+, BLE, Z Wave, WiFi, Bluetooth, Introduction to IP protocols – TCP/IP, UDP, HTTP, HTTPS, MQTT, CoAP, 6LoWPAN, Usage, comparison or protocols in IoT.

IOT software, RTOS & Cloud networking: RTOS & IOT Applications, Introduction to RTOS, Vxworks, ThreadX, Coocox, Task creation and task prioritization, Memory management and interrupts, Task Synchronization, Semaphores and mutex, Inter task Communication.

IOT Cloud: Introduction to cloud, Connecting to External Data Sources with cloud, Implementing cloud Data Structures, Transferring Files between cloud Components, Configuring Mashup Displays with cloud, Implementing cloud Security, Introduction to amazon aws, Microsoft azure, thingworkx.

Text Books:

1. Vijay Madisetti and Arshdeep Bahga, *"Internet of Things (A Hands-on-Approach)"*, 1st Edition, VPT, 2014
2. Honbo Zhou, *"The Internet of Things in the Cloud: A Middleware Perspective"*, CRC Press-2012.
3. Dieter Uckelmann, Mark Harrison, *"Architecting the Internet of Things"*, Springer-2011.
4. Olivier Hersent, David Boswarthick, Omar Elloumi, *"The Internet of Things–Key applications and Protocols"*, Wiley, 2012.
5. Dirk Slama, Frank Puhlmann, Jim Morrish, Rishi M Bhatnagar, *Enterprise IoT: Strategies and Best Practices for Connected Products and Services*, O'Reilly Media.

Reference Books:

1. Luigi Atzori, Antonio Lera, Giacomo Morabito, *"The Internet of Things: A Survey"*, Journal on Networks, Elsevier Publications, October, 2010.
2. Francis daCosta, *"Rethinking the Internet of Things: A Scalable Approach to Connecting Everything"*, 1st Edition, Apress Publications, 2013.
3. Cuno Pfister, *Getting Started with the Internet of Things*, O"Reilly Media.
4. Nitesh Dhanjani, *Abusing the Internet of Things: Blackouts, Freakouts, and Stakeouts*, O'Reilly Media.
5. Simon Monk, *Raspberry Pi Cookbook, 2nd Edition, Software and Hardware Problems and Solutions*, O'Reilly Media.

CE803 Cyber Law

Course Objectives and Outcomes:

- [CLCO1] Critically evaluate ongoing developments in law relating to Information Technologies.
- [CLCO2] Display an understanding of how these developments relate to one another.
- [CLCO3] Examine areas of doctrinal and political debate surrounding rules and theories.
- [CLCO4] Evaluate those rules and theories in terms of internal coherence and practical outcomes.
- [CLCO5] Draw on the analysis and evaluation contained in primary and secondary sources.

CO to PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CLCO1		x		x			x			
CLCO2	x	x								
CLCO3	x							x	x	
CLCO4		x		x					x	
CLCO5		x		x					x	

Unit I

Internet, E-Commerce And E-Governance With Reference To Free Market Economy

Understanding Computers, Internet and Cyber Laws, Conceptual Framework of E-commerce: E-governance, The Role of Electronic Signatures in E-commerce with Reference to Free Market Economy in India.

Unit II

Law Relating To Electronic Records And Intellectual Property Rights In India

Legal Aspects of Electronic Records/Digital Signatures, The Rules and Regulations of Certifying Authorities in India, Protection of Intellectual Property Rights in Cyberspace in India.

Unit III

International Efforts Relating To Cyberspace Laws And Cyber Crimes

International Efforts Related to Cyberspace Laws, Council of Europe (COE) Convention on Cyber Crimes.

Unit IV

Penalties, Compensation And Offenses Under The Cyberspace And Internet In India

Penalties, Compensation and Adjudication of Violations of Provisions of IT Act and Judicial Review, Some Important Offenses under the Cyberspace Law and the Internet in India, Other Offenses under the Information Technology Act in India.

Unit V

Miscellaneous Provisions Of It Act And Conclusions

The Role of Electronic Evidence and the Miscellaneous Provisions of the IT Act, Information Technology Act as Amended up to 2008, The Information Technology (Certifying Authorities) Rules, 2000, The Information Technology (Certifying Authorities) Rules, 2000, Ministerial Order on Blocking of Websites.

Reference Books:

1. Harish Chander, *Cyber Laws and It Protection*, PHI Publication.
2. Faiyaz Ahamad, KLSI, *Cyber Law and Information Security*, Dreamtech Press.
3. Murray, *Information Technology Law: Law and Society*, 3rd Edition, Oxford University Press, Oxford 2016.
4. Sunit Belapure Nina Godbole, *Cyber Security*, Wiley India Pvt. Ltd.
5. Vivek Sood, *Cyber Law Simplified*, McGraw-Hill Publication.

CE804 Principles of Management (Elective 804)

Introduction to management theory, Characteristics of management, Management as an art – profession, Systems approach to management, Task and responsibilities of a professional manager, Levels of managers and skill required. Management process – planning – mission – objectives – goals – strategy – policies – programmes – procedures.

Organizing – principles of organizing – organization structures, Directing – delegation – span of control – leadership – motivation – communication, Controlling.

Decision making process – decision making under certainty – risk – uncertainty – models of decision making, Project management – critical path method – programme evaluation and review technique – crashing.

Introduction to functional areas of management, Operations management, Human resources management, Marketing management, Financial management.

Text Books:

1. Koontz H., and Weihrich H., *Essentials of Management: An International Perspective*, 8th Edition, McGraw Hill Publication, 2009.
2. Hicks, *Management: Concepts and Applications*, Cengage Learning, 2007.
3. Mahadevan B., *Operations Management: Theory and Practice*, Pearson Education Asia, 2009.
4. Kotler P., Keller K. L, Koshy A., and Jha M., *Marketing Management*, 13th Edition, 2009.
5. Khan M.Y., and Jain P.K., *Financial Management*, McGraw-Hill Publication, 2008.

CE604 Business Intelligence

Business Intelligence Introduction: Definition, Leveraging Data and Knowledge for BI, BI Components, BI Dimensions, Information Hierarchy, Business Intelligence and Business Analytics. BI Life Cycle. Data for BI – Data Issues and Data Quality for BI.

BI Implementation: Key Drivers, Key Performance Indicators and operational metrics, BI Architecture/Framework, Best Practices, Business Decision Making.

Business Analytics: Objective Curve, Web Analytics and Web Intelligence, Customer Relationship Management.

Business/Corporate Performance Management: Dash Boards and Scorecards, Business Activity Monitoring, Six Sigma.

Advanced BI: Big Data and BI, Social Networks, Mobile BI, emerging trends.

Working with BI Tools: Pentaho etc.
Overview of managerial, strategic and technical issues associated with Business Intelligence and Data Warehouse design, implementation, and utilization. Critical issues in planning, physical design process, deployment and ongoing maintenance.

Data Warehousing (DW): Introduction & Overview; Data Marts, DW architecture – DW components, Implementation options; Meta Data, Information delivery.

ETL: Data Extraction, Data Transformation – Conditioning, Scrubbing, Merging, etc., Data Loading, Data Staging, Data Quality.

Dimensional Modeling: Facts, dimensions, measures, examples; Schema Design – Star and Snowflake, Fact constellation, Slow changing Dimensions.

OLAP: OLAP Vs OLTP, Multi-Dimensional Databases (MDD); OLAP – ROLAP, MOLAP, HOLAP;

Data Warehouse Project Management: Critical issues in planning, physical design process, deployment and ongoing maintenance.

Reference Books:

1. Efraim Turban, Ramesh Sharda, Jay Aronson, David King, Decision Support and Business Intelligence Systems, 9th Edition, Pearson Education, 2009.
2. David Loshin, Business Intelligence – The Savy Manager's Guide Getting Onboard with Emerging IT, Morgan Kaufmann Publishers, 2009.

CE804 National Service Scheme (NSS-II) (Elective 804)

Unit 1
Citizenship

Basic Features of Constitution of India, Fundamental Rights and Duties, Human Rights, Consumer awareness and the legal rights of the consumer, RTI.

Unit 2
Health, Hygiene & Sanitation

Definition, Needs and scope of health education, Food and Nutrition, Safe drinking water, Water borne diseases and sanitation, National Health Programme, Reproductive health, Healthy Lifestyles, HIV AIDS, Drugs and Substance abuse, Home Nursing, First Aid.

Unit 3
Youth and Yoga

History, Philosophy and concept of Yoga, Myths and misconceptions about yoga, Different Yoga traditions and their Impacts Yoga as a preventive, pro-motive, and curative method, Yoga as a tool for healthy lifestyle.

Unit 4
Environment Issues

Environment conservation, Enrichment and Sustainability, Climate change, Waste management, Natural resource management, Rain water harvesting, Energy conservation, Waste land development, Soil conversations and forestation.

Unit 5
Disaster a Management

Introduction to Disaster Management, Classification disaster, Role of youth in Disaster Management.

Unit 6
Youth and crime

Sociological and psychological factors influencing youth crime, Peer mentoring in preventing crime, Awareness about anti-ragging, Cybercrime and its prevention, Juvenile justice.

Reference Books:

1. *National Service Scheme Manual (Revised) 2006, Government of India, Ministry of Youth Affairs and Sports*, New Delhi.
2. *University of Mumbai National Service Scheme Manual, 2009*.
3. *Avhan Chancellor's Brigade – NSS Wing, Training camp on Disaster Preparedness Guidelines*, March 2012.
4. *Rashtriya Seva Yojana Sankalpana* – Prof. Dr. Sankay Chakane, Dr. Pramod Pabrekar, Diamond Publication, Pune.
5. *National Service Scheme Manual for NSS District Coordinators*, National Service Scheme Cell, Dept. of Higher and Technical Education, Mantralaya.
6. *Annual report of National Service Scheme (NSS)* published by Dept. of Higher and Technical

Education, Mantralaya,
7. *NSS Cell*, Dept. of Higher and Technical Education, Mantralaya, UTKARSHA- Socio and cultural guidelines.
8. *Case material as a Training Aid for Field Workers*, Gurmeet Hans.
9. *Social service opportunities in hospitals*, Kapil K. Krishnan, TISS.
10. *New Trends in NSS*, Research papers published by University of Pune.
11. *ANOOGUNJ Research Journal*, published by NSS Unit C. K. Thakur college.
12. *Training Manual for Field Work published by RGNIYD*, Shreeperumbudur.
13. Prof. Ghatole R. N., *Rural Social Science and Community Development.*
14. Purushottam Sheth, Dr. Shailaja Mane, *National Service Scheme.*
15. *Joint programme of National Service Scheme*, University of Mumbai & DISHA – DEEPSHIKHA Projects, Nair Hospital, 2011-12.
16. *National Service Scheme in India: A Case study of Karnataka*, M. B. Dishad, Trust Publications, 2001.
17. *http://www.thebetterindia.com/140/national-service-scheme-nss/*
18. *http://en.wikipedia.org/wiki/national-service-scheme*
19. *http://nss.nic.in*

CE807 Continuous Integration

Course Objectives And Outcomes:

- [CICO1] Set up and navigate a CI environment that enables automated testing & automated builds.
- [CICO2] Execute releases in test environments prior to product delivery.
- [CICO3] Identify the most efficient CI tools for quick release & reliable maintenance of products.
- [CICO4] Integrate Continuous Integration methods & techniques into current workflow for a SCM environment

CO to PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CICO1	x	x								
CICO2		x	x	x						
CICO3			x	x						
CICO4		x	x	x						

Unit I

Build Software at Every Change, Features of CI: Source Code Compilation, Database Integration, Testing, Inspection, Deployment, Documentation and Feedback.

What Is the Value of CI?, What Prevents Teams from Using CI?, How Do I Get to “Continuous” Integration?, When and How Should a Project Implement CI?, The Evolution of Integration, How Does CI Complement Other Development Practices?, How Long Does CI Take to Set Up?, CI and You, Commit Code Frequently, Don’t Commit Broken Code, Fix Broken Builds Immediately, Write Automated Developer Tests, All Tests and Inspections Must Pass, Run Private Builds, Avoid Getting Broken Code.

Unit II

Risk: Lack of Deployable Software, Risk: Late Discovery of Defects, Risk: Lack of Project Visibility, Risk: Low-Quality Software.

Automate Builds, Perform Single Command Builds, Separate Build Scripts from Your IDE, Centralize Software Assets, Create a Consistent Directory Structure, Fail Builds Fast, Build for Any Environment, Build Types and Mechanisms, Use a Dedicated Integration Build Machine, Use a CI Server, Run Manual Integration Builds, Run Fast Builds, Stage Builds, How Will This Work for You?.

Unit III

Automate Database Integration, Use a Local Database Sandbox, Use a Version Control Repository to Share Database Assets, Continuous Database Integration, Give Developers the Capability to Modify the

Database, The Team Focuses Together on Fixing Broken Builds, Make the DBA Part of the Development Team, Database Integration and the Integrate Button.

Automate Unit Tests, Automate Component Tests, Automate System Tests, Automate Functional Tests, Categorize Developer Tests, Run Faster Tests First, Write Tests for Defects, Make Component Tests Repeatable, Limit Test Cases to One Assert.

Unit IV

Release Working Software Any Time, Any Place, Label a Repository's Assets, Produce a Clean Environment, Label Each Build, Run All Tests, Create Build Feedback Reports, Possess Capability to Roll Back Release.

All the Right Stuff: The Right Information, The Right People, The Right Time, The Right Way; Use Continuous Feedback Mechanisms: E-mail, SMS (Text Messages), Ambient Orb and X10 Devices, Windows Taskbar, Sounds, Wide-Screen Monitors.

Unit V

CI Resources: Continuous Integration Web Sites/Articles, CI Tools/Product Resources, Build Scripting Resources, Version Control Resources, Database Resources, Testing Resources, Automated Inspection Resources, Deployment Resources, Feedback Resources, Documentation Resources.
Evaluating CI Tools: Considerations When Evaluating Tools, Functionality, Compatibility with Your Environment, Reliability, Longevity, Usability, Automated Build Tools, Build Scheduler Tools.

Unit VI

Tools for Continuous Integration: Lab sessions with Devops or Jenkin

Reference Books:

1. Paul M. Duvall, Steve Matyas and Andrew Glover, Continuous Integration: Improving Software Quality and Reducing Risk, Addison-Wesley.
2. John Ferguson Smart, Jenkins: The Definitive Guide: Continuous Integration for the Masses, O'Reilly Media.
3. Len Bass, Ingo Weber, Liming Zhu, DevOps: A Software Architect's Perspective, Pearson Education.

SEMESTER – III

Course: Digital Circuits

Week	Lecture No.	Topic
1	1	Binary number system, Signed binary numbers, Binary arithmetic, Decimal number system
	2	Hexadecimal number system, Octal number system, Arithmetic operations using 1's complement, 2's complement
	3	Arithmetic operations using 9's complement, 10's complement
	4	Codes: Numeric codes, Weighted and non-weighted codes
2	5	Codes: Sequential codes, Self complimenting codes
	6	Codes: Cyclic codes, Reflective codes, BCD code
	7	Codes: Excess-3 code, Gray code, Error detecting and correcting codes
	8	Numericals On Above Topics
3	9	Introduction to analog and digital signal, Logic gates and switching functions: AND, OR, NOT
	10	EX-OR, EX-NOR, NAND, NOR. Implementation of universal gates using logic gates
	11	De Morgan's theorem, Boolean algebra
	12	Representation of logic functions using POS form
4	13	Representation of logic functions using SOP form
	14	Minimization of completely and incompletely specified switching functions Karnaugh map (2,3,4,5,6 variable)
	15	Minimization of completely and incompletely specified switching functions Karnaugh map (2,3,4,5,6 variable)
	16	Numerical On Above Topics
5	17	Quine – McCluskey method, TTL and CMOS logic families
	18	Half and full adder, Half and full subtractor
	19	Binary parallel adder, Binary parallel subtractor
	20	Look ahead carry header, BCD to 7-segment decoder
6	21	Binary to Gray code converter, Gray to Binary code converter
	22	Numericals On Above Topics
	23	Multiplexer, Demultiplexer
	24	BCD arithmetic: BCD adder, BCD subtractor

7	25	Arithmetic logic unit, Digital comparators
	26	Parity generators. Design of PAL
	27	Design of PLA, Design of PROM
	28	Numericals On Above Topics
8	29	Comparison between sequential and combinational circuit, Synchronous sequential circuits and asynchronous sequential circuits
	30	Registers, Shift registers, Counters: asynchronous counters and synchronous counters
	31	Sequential circuit's implementation. Flip flops: Edge triggered flip-flops, S-R flip flop
	32	Flip flops: -K flip flop, T flip flop, D flip flop.
9	33	Flip flops Conversions
	34	Flip flops Conversions
	35	Regular expressions using FSM, Optimization using FSM
	36	Reduction of states, Mealy Machines
10	37	Moore Machines, Representation of sequential circuits using ASM charts
	38	Synthesis of output and next state functions
	39	Data path and control path
	40	Partition-based design

Course: Digital Circuits

Week	Lecture No.	Topic
1	1	Fundamental Structures and Basic Logic: Introduction to set and various basic definition
	2	Venn Diagram and examples on Venn diagram, Algebra of set operation and numerical
	3	Cartesian product, Power sets, Cardinality and countability, Numerical on Cardinality
	4	Propositional logic, Logical connectives, Truth tables, Normal Forms
2	5	Validity, Predicate logic, Universal and existential quantification
	6	Numerical On Above Topics
	7	Numerical On Above Topics
	8	Functions and Relations: Subjective, Injective, Bijective and inverse functions.
	9	Composition of function, Reflexivity, Symmetry, Transitivity and equivalence relations

3	10	Numerical on Function and Relations
	11	Numerical on Function and Relations
	12	Numerical on Function and Relations
4	13	Combinatorics: Counting
	14	Recurrence relations
	15	generating functions
	16	Numerical On Above Topics
5	17	Numerical On Above Topics
	18	Graph Theory: Basic terminology, Multi graphs and weighted graphs
	19	Paths and circuits, Shortest path problems
	20	Euler and Hamiltonian paths, Representation of graph
6	21	Isomorphic graphs, Planar graphs
	22	Numerical On Above Topics
	23	Numerical On Above Topics
	24	Numerical On Above Topics
7	25	Trees: Rooted trees, Path length in rooted tree, Basic Terminology in Tree
	26	Binary search trees
	27	Spanning trees and cut set
	28	Minimal spanning trees
8	29	Kruskal's algorithms for minimal spanning tree
	30	Prim's algorithms for minimal spanning tree
	31	Matching Coloring
	32	Numerical On Above Topics
9	33	Numerical On Above Topics
	34	Algebraic Systems: Algebraic systems
	35	Groups, Semi group, Monoid, Subgroup
	36	Isomorphism and homomorphism, Rings and fields, Lattices
10	37	Boolean lattices, Boolean algebra
	38	Numerical On Above Topics
	39	Numerical On Above Topics
	40	Numerical On Above Topics

Course: Computer Architecture and Organization

Week	Lecture No.	Topic
1	1	Concept of computer organization and architecture, Fundamental unit
	2	Computer function and interconnection, CPU structure and function
	3	Instruction Sets: Characteristics, Types of operands, Types of operations
	4	Assembly language, Addressing modes,
2	5	Instruction format, Types of instruction, Instruction execution
	6	Machine state and processor status, Structure of program
	7	Introduction to RISC and CISC architecture
	8	The arithmetic and logic Unit
3	9	Integer representation
	10	Integer arithmetic
	11	Floating-point representation
	12	Floating-point arithmetic
4	13	Introduction of arithmetic co-processor
	14	Internal Memory: Semiconductor main memory
	15	Error correction
	16	Advanced DRAM organization
5	17	Virtual memory systems and cache memory systems
	18	External Memory: Organization and characteristics of magnetic disk, Magnetic tape
	19	Optical memory, RAID
	20	Memory controllers
6	21	Control unit operation: Micro-operations
	22	Control of the processor
	23	Hardwired implementation
	24	Micro – programmed Control Unit: Basic concepts
7	25	Micro-instruction sequencing
	26	Micro-instruction execution
	27	Applications of micro-programming
	28	External devices, I/O module
	29	Programmed I/O
	30	Interrupt driven I/O

8	31	Direct memory access
	32	I/O channels and processors
9	33	External interface
	34	Instruction pipelining: Concepts
	35	Parallel processing: Multiple processor organization
	36	Symmetric multiprocessor
10	37	Cache coherence
	38	MESI protocol

Course: Numerical Methods

Week	Lecture No.	Topic
1	1	Bisection method
	2	Iterative method
	3	Condition of convergence and order of convergence
	4	Regula Fasli method
2	5	Newton Raphson method
	6	Horner's method
	7	Solution of simultaneous linear algebraic equations
	8	Gauss elimination method
3	9	Gauss elimination method
	10	Condition of convergence of iteration method
	11	Gauss Jacobi method
	12	Gauss Seidel method
4	13	Simple problem
	14	Interpolation with equal intervals
	15	Newton forward interpolation formula
	16	Newtons backward interpolation formula
5	17	Stirling's formula central interpolation
	18	Bessels formula central interpolation
	19	Interpolation with unequal intervals
	20	Divided difference
6	21	Newton's divided difference method
	22	Lagrange's interpolation formula
	23	Lagrange's formula for inverse interpolation

	24	Numerical integration
7	25	Numerical integration
	26	Trapezoidal rule
	27	Simposon's 1/3 rule
	28	Simposon's 3/8 rule
8	29	Weddle's rule
	30	Solution to ordinary differential first order equations
	31	Solution to ordinary differential first order equations
	32	Taylor's series
9	33	Taylor's series
	34	Euler's method
	35	Improved Euler's method
	36	Runge kutta 2 and 4 th order
10	37	Runge kutta 2 and 4 th order
	38	Simple problem

Course: Probability, Statistics And Queueing Theory

Week	Lecture No.	Topic
1	1	General Discussion on Syllabus
	2	Definition of probability: classical, empirical and axiomatic approach of probability
	3	Permutation and combination theorems
	4	Problems based on Permutation and Combination
2	5	Classical and empirical probability and solved problems from solved examples
	6	Axiomatic probability, addition theorem of probability, theorem of compound probability
	7	Numerical on axiomatic probability and on compound probability
	8	Inverse Probability and solved numerical on it
3	9	Random variables, probability distribution of discrete random variable, examples on random variable
	10	Numerical on random variable
	11	Mathematical Expectation, theorems on Expectation, variance of x in term of Expectation
	12	Covariance and numerical on expectation, variance and Covariance.

4	13	Numerical on expectation, variance and Covariance
	14	Binomial probability distribution, mean and variance, numerical on binomial probability distribution.
	15	Numerical on binomial distribution
	16	Mode of binomial distribution, Fitting of binomial distribution, Numerical on binomial distribution and fitting of binomial distribution
5	17	Derivation of Poisson distribution from binomial distribution, mean and variance in Poisson distribution
	18	Mode in Poisson Distribution, numerical on Poisson Distribution
	19	Numerical on Poisson distribution
	20	Fitting of Poisson distribution, numerical on Poisson distribution
6	21	Normal probability, standard normal variate, properties of normal probability curve
	22	Area under normal probability curve, How to compute area under normal probability curve, computation of area to right and left of ordinates at X=a
	23	Numerical on Normal distribution
	24	Correlation analysis, types of correlation, Karl Pearson's coefficient correlation.
7	25	Numerical on Karl Pearson's Coefficient of correlation
	26	Numerical on Karl Pearson's Coefficient of correlation, properties of Karl Pearson's Coefficient of correlation.
	27	Numerical on properties of Karl Pearson's Coefficient of correlation.
	28	Properties of Karl Pearson's Coefficient of correlation. Numerical on properties of Karl Pearson's Coefficient of correlation.
8	29	Probable error, numerical on it, rank correlation method, computation of rank correlation methods, numerical on when rank is given.
	30	Numerical on when rank is not given and on repeated ranks.
	31	Introduction, Linear and non-linear regression, Lines of regression
	32	Derivation of line of regression of **y on x** and **x on y**, Angle between the regression lines
9	33	Linear regression analysis, line of regression
	34	Numerical on linear regression analysis, line of regression
	35	Numerical on linear regression analysis, line of regression
	36	Coefficients of regression, Theorems on regression coefficient, Properties of regression coefficient
	37	Introduction, Queuing systems, The input or arrival pattern, The service pattern and service discipline, Notation, Performance measures

10	38	Relation between the probabilities of states, M/M/1/∞ systems
	39	Numerical on Queueing Theory
	40	Numerical on Queueing Theory

Course: Object Oriented Programming in C++

Week	Lecture No.	Topic
1	1	Introduction to Object Oriented Programming: Need of object oriented programming, The object oriented approach
	2	Differentiate between OOPs and POP, Bottom up and Top down
	3	Characteristics of object oriented languages
	4	CLASS
2	5	Objects as data types
	6	Constructors
	7	Destructor
	8	Objects as function arguments
3	9	Returning objects
	10	Overloading unary operators
	11	Overloading binary operators
	12	Data conversion
4	13	Derived and base class
	14	Public and private inheritance
	15	Levels of inheritance, Single Inheritance Examples
	16	Multilevel Inheritance Examples
5	17	Multiple Inheritance Examples
	18	Hierarchical Inheritance Examples, Hybrid Inheritance Examples
	19	Constructors in derived class
	20	Virtual Function
6	21	Dynamic binding
	22	Operator Overriding
	23	Abstract classes and pure virtual functions
	24	Friend functions, this pointer
	25	Streams and File
	26	Stream output and input, Stream manipulators
	27	Stream manipulators

7	28	Creating, Reading sequential and random files
8	29	Updating sequential and random files
	30	File Position Pointer
	31	Function templates, Overloading function templates
	32	Class template
9	33	Exception handling overview, Need of exceptions
	34	An exception example, Multiple Exception, Exception specifications.
	35	Introduction to STL-Containers
	36	Iterators
10	37	Algorithms, Sequence containers
	38	Associative containers

Course: Operating System

Week	Lecture No.	Topic
1	1	Introduction and Operating system, Definition, General Discussion on Operating system
	2	Types of Operating system
	3	Real-Time operating system
	4	System Components- System Services
2	5	Systems Calls
	6	System Programs
	7	System structure
	8	Virtual Machines, System Design and Implementation
3	9	System Generations
	10	Process Concept
	11	Process Scheduling
	12	Operation on a process
4	13	Cooperating processes
	14	Threads, Inter-process Communication
	15	Scheduling criteria
	16	Scheduling Algorithms (FCFS)
	17	Scheduling Algorithms (SJF)
	18	Scheduling Algorithms (RR)
	19	Multiple-Processor Scheduling

5	20	Real-Time Scheduling
6	21	Scheduling Algorithms and performance evaluation
	22	The critical-section problem
	23	Critical regions
	24	Synchronization Hardware
7	25	Semaphores
	26	Classical Problems of synchronization
	27	Monitors Synchronizations in Solaris
	28	Systems Model
8	29	Deadlock Characterization, Methods for handling Deadlocks
	30	Deadlock Prevention, Deadlock Avoidance
	31	Deadlock Detection, Recovery from Deadlock, Combined approach to deadlock Handling
	32	Introduction, Basic concepts of Memory, Logical versus Physical address space, Swapping
9	33	Contiguous allocation, Paging, Segmentation with Paging, Demand Paging
	34	Page Replacement Algorithms
	35	Page Replacement Algorithms, Thrashing
	36	File System, Secondary storage devices
10	37	Secondary storage devices, Real-Time Operating Systems
	38	Real-time Linux
	39	Case Studies: MS-DOS
	40	Case Studies: UNIX

SEMESTER – V

Course: Database Management System

Week	Lecture No.	Topic
1	1	Introduction to DBMS: Historical perspective, File Versus a DBMS
	2	Advantages of DBMS, Describing and storing data in DBMS
	3	Architecture of a DBMS, Different Data Models
	4	Introduction to the Relational Model: Structure of Relational Databases, Database Schema, Keys
2	5	Schema Diagrams, Relational Query Languages, Relational Operations
	6	Database Design and the E-R Model: features of ER model, conceptual design using ER model
	7	Design for large enterprises, Relational model-structure and operations, Integrity constraints over relations, Extended E-R Features
	8	Examples on ER Diagrams
3	9	Query Language: Overview, SQL Data Definition, Basic Structure of SQL Queries
	10	Additional Basic Operations, Set Operations, Null Values, Aggregate Functions
	11	Nested Subqueries, Modification of the Database, Join Expressions, Views, Integrity Constraints
	12	SQL Data Types and Schemas, Authorization, Functions and Procedures, Triggers
4	13	Examples on SQL
	14	Relational Algebra
	15	Tuple Relational Calculus
	16	Domain Relational Calculus
5	17	Closer of functional dependencies, closer of attributes
	18	Canonical cover and Properties of Decomposition
	19	Normalization: 1NF, 2NF
	20	Normalization: 3NF and BCNF
6	21	Multivalued dependency: Closer properties of Multi-valued dependency and 4NF
	22	Database Application Development: Accessing Databases from Applications, An Introduction to JDBC
	23	JDBC Classes and Interfaces, Statement,

	24	prepared Statement
7	25	callable Statement
	26	SQLJ, Stored Procedures
	27	Overview of Physical Storage Media, Magnetic Disk and Flash Storage
	28	RAID, Tertiary Storage
8	29	File Organization, Organization of Records in Files
	30	Data-Dictionary Storage, Database Buffer
	31	Intuition For Tree Indexes, Indexed Sequential Access Method (ISAM)
	32	B+ Trees: A Dynamic Index Structure, Search, Insert
9	33	B+ Trees: Delete, Duplication, B+ Trees in Practice
	34	Static Hashing, Extendable Hashing, Linear Hashing, Extendable vs. Linear Hashing
	35	Examples on B+ Trees
	36	Overview of Query Evaluation, operator evaluation, Algorithms for relational operations: Selection operation
10	37	Algorithms for relational operations: General selection condition, Projection operation, Join operation, set operation and aggregate operation, Evaluation of relational operations
	38	Alternative plans, functions of query optimizer
	39	Translating SQL queries into relational algebra
	40	estimating the cost of a plan, relational algebra equivalences, and other approaches to query optimization

Course: Design and Analysis of Algorithm

Week	Lecture No.	Topic
1	1	Algorithm Design, Specifications, Analysis Need and Introduction
	2	Complexity, Asymptotic Notations (Big O Notation, Theta and Omega)
	3	Time Complexity calculation examples
	4	Recurrences, Homogeneous Recurrences Examples
2	5	Non-Homogeneous Recurrences Examples and problems
	6	Recursion tree and examples
	7	Master theorem, recursion tree and Proof
	8	Heap Sort

3	9	Divide and Conquer strategy, Definition, Introduction, general examples
	10	Binary search analysis, Minimum and Maximum Analysis
	11	Merge Sort
	12	Quick Sort
4	13	Strassen's matrix multiplication algorithm
	14	Introduction to Greedy Technique, Greedy Method
	15	Optimal Merge Patterns
	16	Huffman Coding
5	17	Knapsack Problem
	18	Activity Selection Problem
	19	Job Sequencing with Deadline
	20	Minimum Spanning Tree
6	21	Single-Source Shortest Path Algorithm
	22	Introduction to dynamic programming, steps, elements in dynamic programming, Comparison of Divide-and-Conquer and Dynamic Programming Techniques
	23	Longest Common Sub-sequence
	24	Matrix chain multiplication problem
7	25	Bellman Ford shortest path algorithm
	26	Floyd Warshall shortest path algorithm, Application of Dynamic Programming
	27	Backtracking Concept, N–Queens Problem
	28	Four–Queens Problem
8	29	Eight-Queens Problem
	30	Hamiltonian Cycle, Sum of Subsets Problem, Graph Coloring Problem
	31	Introduction to Branch and Bound, Traveling Salesperson Problem
	32	Traveling Salesperson Problem
9	33	15-Puzzle Problem, Comparisons between Backtracking and Branch and Bound
	34	Introduction to Tree, B-Tree: Insertion
	35	B-Tree: Deletion
	36	Red-Black Tree: Insertion
	37	Red-Black Tree: Deletion
	38	Introduction to NP completeness, P- class problem, NP-problem
	39	Reduction, optimization, NP complete

10	40	NP hard problems, NP hard graph problems

Course: Theory of Computation

Week	Lecture No.	Topic
1	1	Definition of deterministic finite automata, Non deterministic finite automata
	2	Examples on DFA
	3	Mealy Machine and examples on Mealy Machine
	4	Moore Machine and examples on Moore Machine
2	5	Conversion between Moore to Mealy Machine
	6	Conversion between Mealy to Moore Machine
	7	Regular expressions, Recursive definition
	8	NFA with e-moves, Inter-conversion between NFA and DFA
3	9	Regular expression and FA
	10	Pumping lemma and numeric based on Pumping Lemma
	11	Definition of Production rules, Ambiguous grammar
	12	Removal of ambiguity and its numeric
4	13	Chomsky hierarchy
	14	Context Free Grammar (CFG) – definition, Simplification of CFG
	15	Numeric based on simplification of CFG
	16	Removal of Unit Productions, Chomsky Normal Form for CFG and numeric based on it
5	17	Definition of context free languages, Regular grammar definition
	18	Left linear, Right linear grammar, Inter-conversion between left linear and right linear regular grammar
	19	Inter conversion between left linear and right linear regular grammar
	20	Regular grammar and finite automata
6	21	Inter-conversion between Type 0 and Type 1 grammars
	22	Derivation graphs
	23	CNF, GNF
	24	DFSA TO Regular Expressions
7	25	Formal definition, Pushdown automata (PDA), definition of NPDA and DPDA
	26	Equivalence between acceptance by empty store and Acceptance by final state

	27	Equivalence between Pushdown automata and context-free grammars
	28	Relative powers of DPDA and NPDA
8	29	The definition of a Turing machine, Computing with Turing machine
	30	Techniques of TM construction
	31	TM as acceptor and i/o device
	32	Church-Turing hypothesis and its foundation implications
9	33	Halting problems – Universal TM-recursive and recursively enumerable sets
	34	Problems on TM
	35	Problems on TM
	36	Applications of RE and FA – Lexical analyzer Text editor and searching using RE
10	37	Applications of PDA – Expression conversion
	38	Applications of CFG–syntax analysis, Language definition

Course: Object Oriented Analysis and Design

Week	Lecture No.	Topic
1	1	An Overview of Object Oriented Systems development
	2	Object Basics: Objects are grouped in classes, Attributes, Object behavior and methods, Object respond to messages
	3	Encapsulation and information hiding, Class hierarchy, polymorphism
	4	Object relationships and association, Aggregation and object containment, Advanced topics
2	5	Object Oriented Systems development life cycle
	6	Software development process, Building high quality Software
	7	Object Oriented Systems development: a use case driven approach, reusability
	8	Methodology, Modeling and Unified Modeling Language: Rambaugh et al.'s Modelling Technique, Booch Methodology
3	9	Jacobson et al. Methodologies
	10	Patterns: Generative and nongenerative, Pattern Template, Anti patterns, Capturing Patterns
	11	Frameworks, A Unified approach
	12	UML, Static and dynamic models, UML class diagram
	13	Use Case diagram, UML dynamic modeling
	14	Model management, UML Extensibility, UML meta model

4	15	OOA process: Why analysis is difficult activity, Business object Analysis, Use case Driven OOA
	16	Use case model, Developing effective documentation
5	17	Case Study
	18	Object analysis classification, Noun Phrase approach
	19	Common class pattern approach, Use case driven approach
	20	Classes, responsibilities and collaborators, Naming classes
6	21	Identifying object relationships, Identifying attributes
	22	Identifying methods
	23	Object Oriented design process and axioms
	24	Object Oriented design process and axioms, Design patterns
7	25	Design classes
	26	Design attributes, Design methods
	27	Access layer object storage and object interoperability
	28	Access layer object storage and object interoperability
8	29	Database Management Systems
	30	Logical and physical database organization and access control
	31	Logical and physical database organization and access control
	32	Distributed databases and client server computing
9	33	OODBMS, Object Relational Systems
	34	Multidatabase systems
	35	Design access layer classes
	36	Case Study
10	37	View layer: Designing interface objects
	38	The purpose of view layer interface
	39	Prototyping and user interface
	40	Case Study

SEMESTER – VI

Course: Database Implementation Techniques

Week	Lecture No.	Topic
1	1	Introduction to DBMS: Advantages of DBMS, File Processing System and Data Abstraction
	2	Database Languages, Data Independence
	3	Component and overall structure of DBMS
2	4	Multi-user DBMS Architecture
	5	Transaction management: Basic Concept of Transaction Management
	6	Properties of Transaction, Concept of Schedule
3	7	Serial Schedule
	8	Stabilizability: Conflict and view serializability
	9	Cascaded aborts and recoverability
4	10	Recoverable and non-recoverable schedule
	11	Concurrency control: Needs and locking method
	12	Deadlocks and time-stamping method
5	13	Optimistic techniques
	14	Multi version concurrency control
	15	Different crash recovery method such as shadow paging and lock based
6	16	Recovery: Deferred and immediate
	17	Checkpoints and its implementation
	18	Introduction to File System and Query processing
7	19	File System: File organization
	20	Organization of records in file, indices
	21	Static and dynamic hashing
8	22	B Tree and B+ tree
	23	Introduction to query processing: overview and measure of query cost
	24	Selection and join operation
9	25	Introduction to query optimization
	26	Transformation of relational expression
	27	Object oriented database and database architecture: need of OODBMS
10	28	Storing object in relational database, Introduction to OO data model
	29	Persistent programming language, Pointers swizzling techniques

	30	Centralized and client-server architecture, 2-tier architecture, 3-tier architecture
11	31	Distributed Database System, Data Mining Using Association Rule
	32	data warehousing, Data Warehousing and it's component
	33	Real Time Example Of Data Mining And Data Warehouse

SEMESTER – VIII

Course: Internetworking Protocol

Week	Lecture No.	Topic
1	1	Review of Network
	2	Introduction to Internetworking technologies
	3	Architectural model for Internetworking
2	4	Internet properties
	5	Internetworking through IP router
	6	Internet Addresses, Mapping Internet addresses to Physical addresses, Universal identifiers
3	7	IP address classes
	8	Resolution through direct mapping, dynamic binding
	9	ARP packet format
4	10	RARP packet format
	11	Internet datagram: connection-less delivery
	12	Routing of IP datagram
5	13	Direct and Indirect packet delivery
	14	Next hop, default, host specific routing
	15	Need of ICMP in TCP/IP
6	16	Subnet and Supernet Addresses
	17	Error reporting vs error detection
	18	ICMP message format
7	19	Detecting and reporting various network problems through ICMP
	20	Transparent router, ARP proxy
	21	Different error reporting messages in ICMP
8	22	Introduction to UDP, UDP message format
	23	UDP pseudo header, encapsulation
	24	UDP check-sum computation
9	25	UDP multiplexing and demultiplexing
	26	Need of reliable stream delivery, Ports
	27	Connections and end points, passive and active open
10	28	TCP segment format
	29	TCP segment format
	30	TCP state transition diagram, TCP implementation issues

Course: Software Architecture

Week	Lecture No.	Topic
1	1	Definitions of Software Architecture
	2	Software Architecture Examples
	3	Describing Software Architectures, Architecture Viewpoints
2	4	IEEE Standard
	5	Architecture Description Languages, Rapide, ACME, UML
	6	Architectural Abstractions
3	7	Architectural Patterns
	8	Architectural Patterns
	9	Quality Attributes and Architectures
4	10	Architecture Design Engineering Methods
	11	Deriving Architecture From Requirements
	12	Deriving OO Designs from Architectures
5	13	Architecture and Implementation
	14	Executable Architecture Languages
	15	Recovering Architecture From Programs
6	16	Module View
	17	OO View
	18	Architecture Evaluation
7	19	Processes and Methods
	20	Processes and Methods
	21	Architecture Decisions
8	22	Architecture Decisions
	23	Architecture Knowledge Management
	24	Architecture Knowledge Management
9	25	Technology Architecture CORBA
	26	J2EE/.NET
	27	GAE/Struts
	28	Formal languages for Architecture Description
10	29	Formal languages for Architecture Description
	30	Model Driven Architecture
	31	Service Oriented Architecture
	32	Software Architecture and Enterprise Architecture

	33	Architecture-Centric SE Processes/ Risk Analysis/ Project Management/ Cost Estimation/ Software Testing
11	34	Product Line Architecture
	35	Domain Specific Architecture
	36	Event-Driven Architecture

Week	Lecture No.	Topic
1	1	Introduction and History of Internet, Discussion on syllabus
	2	Client-Server Models, DNS
	3	Telnet, FTP
2	4	HTTP and working of HTTP with respect to browser and web server
	5	HTTP Commands, WWW Architecture
	6	Introduction to HTML and its basic tags (table, anchor, image)
3	7	Building a form, Text fields and value, size, maxlength, html buttons, radio, check boxes, prechecked, Selection lists
	8	HTML Embedded Multimedia tags
	9	Introduction to CGI Script, Action and Method-GET and POST
4	10	HTML form interface with CGI scripts
	11	Introduction to Java, jdk, jre, Classes and Object
	12	Examples on Classes and Objects
5	13	Introduction to Apache Tomcat and its directory structure, add tomcat in Eclipse
	14	Introduction to JDBC, Different JDBC API and its syntax
	15	Statement API and its program in JAVA
6	16	Prepared Statement API and its program in JAVA
	17	Callable Statement API and its program in JAVA, procedure and function.
	18	Web server and Application server
7	19	ArrayList and its different methods with programs, compare ArrayList and Array
	20	Package in JAVA and programs based on it.
	21	Introduction to python and its History, interpreter and compiler, types of errors
8	22	**Variables, expressions, and statements:** Values and types, Variables, Variable names and keywords, Statements, Operators and operand, Expressions, Order of operations, Asking the user for input
	23	**Conditional execution:** Boolean expressions, Logical operators, Conditional execution, Alternative execution, Nested conditionals, Chained conditionals, Catching exceptions using try and except.
	24	**Functions:** Function calls, Built-in functions, Type conversion functions, Random numbers, Math functions, Adding new functions, Parameters and arguments.

9	25	**Iteration:** Updating variables, The while statement, Infinite loops, “Infinite loops” and break, Definite loops using for, Finishing iterations with continue
	26	**Strings:** len method, Traversal through a string with a loop, string slice, Strings are immutable, Looping and counting, The in operator, String comparison, string methods, Parsing strings, Format operator.
	27	**Files:** Opening files, Text files and lines, Reading files, Searching through a file, Letting the user choose the file name, Using try, except, and open, Writing files.
10	28	**Lists:** Lists are mutable, Traversing a list, List operations, List slices, List methods, Deleting elements, Lists and functions, Lists and string, Parsing lines, List arguments.
	29	**Dictionaries:** Dictionaries and files, Looping and dictionaries, Advanced text parsing.
	30	**Tuples:** Tuples are immutable, Comparing tuples, Tuple assignment, Dictionaries and tuples, Multiple assignment with dictionaries, Sequences: strings, lists, and tuples.