DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

Scheme of Instruction

and

Syllabi of

B.E. (Computer Science & Engineering)
V & VI SEMESTER

AICTE Model Curriculum
2020-2021

UNIVERSITY COLLEGE OF ENGINEERING

(AUTONOMOUS)
OSMANIA UNIVERSITY
HYDERABAD – 500 007, TELANGANA

UNIVERSITY COLLEGE OF ENGINEERING

Vision

The Vision of the Institute is to generate and disseminate knowledge through a harmonious blending of Science, Engineering and Technology. To serve the society by developing a modern technology in students' heightened intellectual, cultural, ethical and humane sensitivities, fostering a scientific temper and promoting professional and technological expertise.

Mission

- To achieve excellence in Teaching and Research
- To generate, disseminate and preserve knowledge
- To enable empowerment through knowledge and information
- Advancement of knowledge in Engineering, Science and Technology
- Promote learning in free thinking and innovative environment
- Cultivate skills, attitudes to promote knowledge creation
- Rendering socially relevant technical services for the community
- To impart new skills of technology development
- To inculcate entrepreneurial talents and technology appreciation programmes
- Technology transfer and incubation

DEPARTMENT OF COMPUTER SCIENCE AND **ENGINEERING**

Vision

To be a leading academic department in the area of Computer Science and Information Technology with learning and research processes of global standards that contribute to innovations in various scientific disciplines and societal needs and also motivate young engineers to face future technological challenges.

Mission

- To achieve excellence in Teaching in the field of Computer Science and Engineering
- To promote learning in free thinking and innovative environment with the state-of-art- technologies.
- To cultivate skills to promote Information and Communication Technology.
- Advancement of knowledge in Various Specializations of Computer Science and Engineering.
- To impart skills to develop technical solutions for societal needs and inculcate
- Entrepreneurial talents.

Program Educational Objectives (PEOs) for B.E. (CSE) Programme

PEO1	To provide the necessary background in Basic Sciences and Humanities to build creative Engineering solutions.
PEO2	To train students to acquire problem solving skills in the three major areas of Computer Science and Engineering, namely, Systems, Theory and Applications; in order to pursue higher studies and to be successful in their career.
PEO3	To expose the students to industry practices for building practical applications using software tools and programming languages.
PEO4	To provide students with soft skills, managerial skills, high standards of ethics, and life-long learning capabilities.

Program Outcomes (POs) for B.E. (CSE) Programme

Engineering Graduates will be able to:

PO1	**Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2	**Problem analysis**: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3	**Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO4	**Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO5	**Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
PO6	**The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO7	**Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO8	**Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO9	**Individual and team work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO10	**Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO11	**Project management and finance**: Demonstrate knowledge and understanding of the **engineering and management principles and apply these to one's own work, as a member and** leader in a team, to manage projects and in multidisciplinary environments.
PO12	**Life-long learning**: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

SCHEME OF INSTRUCTION

BE (COMPUTER SCIENCE & ENGINEERING)

V-SEMESTER

S. No.	Course Code	Course Title	Scheme of Instruction			Contact Hours / Week	Scheme of Examination		Credits
			L	T	P		CIE	SEE	
THEORY									
1.	HS 901 AS	Positive Psychology	3	0	0	3	30	70	3
2.	MC 902 AS	Essence of Indian Traditional Knowledge	3	0	0	3	30	70	0
3.	ES 501 EC	Signals and Systems	3	0	0	3	30	70	3
4.	PC 501 CS	Database Management Systems	3	0	0	3	30	70	3
5.	PC 502 CS	Automata Languages and Computation	3	0	0	3	30	70	3
6.	PC 503 CS	Operating Systems	3	0	0	3	30	70	3
7.	**Professional Elective-I**		3	0	0	3	30	70	3
	PE 511 CS	Web Programming							
	PE 512 CS	Software Engineering							
Practicals									
1.	PC 551 CS	Database Management Systems Lab	0	0	4	4	25	50	2
2.	PC 552 CS	Operating Systems Lab	0	0	4	4	25	50	2
Total			**21**	**0**	**8**	**29**	**260**	**590**	**22**

L : Lectures

T : Tutorials

p : Practicals

CIE : Continuous Internal Evaluation

SEE : Semester End Examination

Program Electives For V, VI , VII and VII SEM

5th SEM	6th SEM		7th SEM			8th SEM
Elective I	II	III	IV	V	VI	VII
Web Prog	Distributed Systems	Cloud Computing	Multiplatform Mobile application development And Application development – Full Stack	Application development using Kubernetes	Application development using Micro services & service mesh	Architecture of Large application –Serverless and Cloud Functions
Software Engineering		Cloud Computing	Scalable architectures for Large Applications			
		Fundamentals of Internet of Things (IOT)	Management of Urban Infrastructures-Smart Cities	Industrial IOT : Markets & Security	Sustainability by architecting smart IOT	Enterprise IoT: Strategies and Best Practices for Connected Products and Services
	Artificial Intelligence	Machine Learning	Data Mining	Machine Vision	Neural Networks & Deep Learning	Natural Language Processing
	Graph Theory	Advanced Algorithms	Computational Complexity	Distributed Algorithms	Graph Analytics	Quantum Computing
	Distributed Databases	Data Engineering & Advanced DB	Scalable architectures for Large Applications	Programming with Elastic MR	Analytics using BD	Architecture of Large application –Serverless and Cloud Functions and Large DB

HS 901 AS

POSITIVE PSYCHOLOGY

Instruction: (3L) hrs per week *Duration of SEE: 3 Hours*

CIE: 30 Marks *SEE: 70 Marks*

Credits: 3

Course Objective:

- Understanding psychology can improve your well-being and success both at work and in your personal life. Positive psychology is the growing branch of psychology that focuses on strengths, positive states and happiness. This Positive Psychology course will have a particular emphasis on applying positive psychology in your personal and working life.

Course Outcomes:

1. Positive Psychology: An Introduction
2. Happiness
3. Flow
4. Subjective Well-being
5. Hope
6. Optimism
7. Positive Illusions and Playfulness
8. Creativity, Giftedness & Industry
9. Judgment, Wisdom & Fairness
10. Emotional Intelligence & Prudence
11. Spirituality
12. Love & Kindness
13. Gratitude & Zest
14. Modesty & Forgiveness
15. Altruism & Empathy & Social Intelligence
16. Positive Psychology at Work – Leadership, & Teamwork
17. Curiosity, Self-Regulation & Positive Youth Development

MC902AS

ESSENCE OF INDIAN TRADITIONAL KNOWLEDGE

Instructions: (2P) hrs per week *Duration of SEE: 3hours*

CIE: 30 Marks *SEE: 70 Marks*

Credits: NIL

Course Objectives:

The course aims at imparting inferencing. Sustainability is at connecting society and nature.

- Basic principles of thought process, reasoning and the core of Indian Traditional Knowledge Systems
- Holistic life style of Yogic-science and wisdom capsules in Sanskrit literature are also important in modern society with rapid technological advancements and societal disruptions.
- The course focuses on introduction to Indian Knowledge System, Indian perspective of modern scientific world-view and basic principles of Yoga and holistic health care system.

Course Outcomes:

1. Ability to understand, connect up and explain basics of Indian Traditional knowledge modern scientific perspective.

Course Content

1. Basic Structure of Indian Knowledge System (i) वेद, (ii) उऩवेद (आयवुदे, धनवुदे, गन्धवदे, स्थाऩत्य आदद) (iii) वेदाांग (शिक्षा, कल्ऩ, ननरुत, व्याकरण, ज्योनतष छांद), (iv) उऩाइग (धर्म िास्र, र्ीर्ाांस , ऩराणु, तकमिास्र)
2. Modern Science and Indian Knowledge System
3. Yoga and Holistic Health care
4. Case Studies.

Suggested Text/Reference Books:

1. V. Sivaramakrishna (Ed.), Cultural Heritage of India-Course Material, Bharatiya Vidya Bhavan, Mumbai, 5th Edition, 2014
2. Swami Jitatmanand, Modern Physics and Vedant, Bharatiya Vidya Bhavan
3. Fritzof Capra, Tao of Physics
4. Fritzof Capra, The wave of Life
5. V N Jha (Eng. Trans,), Tarkasangraha of Annam Bhatta, Inernational Chinmay Foundation, Velliarnad, Amakuam
6. Yoga Sutra of Patanjali, Ramakrishna Mission, Kolkatta
7. GN Jha (Eng. Trans.) Ed. R N Jha, Yoga-darshanam with Vyasa Bhashya, Vidyanidhi Prakasham, Delhi, 2016
8. RN Jha, Science of Consciousness Psychotherapy and Yoga Practices, Vidyanidhi Prakasham, Delhi, 2016
   P R Sharma (English translation), Shodashang Hridayam

ES 501 EC

SIGNALS AND SYSTEMS

Instruction 3 hrs per week *Duration of SEE: 3 hours*

CIE: 30 Marks *SEE: 70 Marks*

Credits: 3

Course Objectives:

- To explain signals and systems representations/classifications and also describe the time and frequency domain analysis of continuous time signals with Fourier series, Fourier transforms and Laplace transforms.
- To understand Sampling theorem, with time and frequency domain analysis of discrete time signals with DTFS, DTFT and Z-Transform.
- To present the concepts of convolution and correlation integrals and also understand the properties in the context of signals/systems and lay down the foundation for advanced courses.

Course Outcomes: Students will be able to:

1. Apply the knowledge of linear algebra topics like vector space, basis, dimension, inner product, norm and orthogonal basis to signals.
2. Analyse the spectral characteristics of continuous-time periodic and a periodic signals using Fourier analysis.
3. Understand the process of sampling and the effects of under sampling. Classify systems based on their properties and determine the response of LSI system using convolution.
4. Analyze system properties based on impulse response and Fourier analysis.
5. Apply the Laplace transform and Z- transform for analyze of continuous-time and discrete-time signals and systems.

UNIT-I

Some useful operations on signals: Time shifting, Time scaling, Time inversion. Signal models: Impulse function, Unit step function, Exponential function, Even and odd signals. Systems: Linear and Non-linear systems, Constant parameter and time varying parameter systems, Static and dynamic systems, Causal and Non-causal systems, Lumped Parameter and distributed parameter systems, Continuous-time and discrete-time systems, Analog and digital systems.

UNIT-II

Fourier Series: Signals and Vectors, Signal Comparison: correlation, Signal representation by orthogonal signal set, Trigonometric Fourier Series, Exponential Fourier Series, LTI system response to periodic inputs.

UNIT-III

Continuous-Time Signal Analysis: Fourier Transform: Aperiodic signal representation by Fourier integral, Fourier Transform of some useful functions, Properties of Fourier Transform, Signal transmission through LTI Systems, ideal and practical filters, Signal energy. Laplace transform: Definition, some properties of Laplace transform, solution of differential equations using laplace transform.

UNIT-IV

Discrete-time Signals and Systems : Introduction, some useful discrete-time signal models, Sampling continuous-time sinusoids and aliasing, Useful signal operations, examples of discrete-time systems. Fourier Analysis of discrete-time signals, periodic signal representation of discrete-time Fourier Series, aperiodic signal representation by Fourier integral.

UNIT-V

Discrete-time Signal Analysis : Z-Transform, some properties of Z-Transform, Solution to Linear difference equations using Ztransform, System realization. Relation between Laplace transform and Ztransform. DTFT: Definition, Properties of DTFT, comparison of continuous-time signal analysis with discrete-time signal analysis.

Suggested Reading:

1. B. P. Lathi, Linear Systems and Signals, Oxford University Press, 2nd Edition, 2009
2. Alan V O P Penheim, A. S. Wlisky , Signals and Systems, 2nd Edition, Prentice Hall
3. Rodger E. Ziemer, William H Trenter, D. Ronald Fannin, Signals and Systems, 4th Edition, Pearson 1998.
4. Douglas K. Linder, Introduction to Signals and Systems, McGraw Hill, 1999
5. P. Ramakrishna Rao, Signals and Systems, TMH.

PC 501 CS

DATABASE MANAGEMENT SYSTEMS

Instruction: 3L hrs per week *Duration of SEE: 3 hours*

CIE: 30 Marks *SEE: 70 Marks*

Credits: 3

Course Objectives:

- To introduce three schema architecture and DBMS functional components
- To learn formal and commercial query languages of RDBMS
- To understand the principles of ER modeling and theory of normalization
- To study different file organization and indexing techniques
- To familiarize theory of serializablity and implementation of concurrency control, and recovery

Course Outcomes:

Student will be able to:

1. Understand the mathematical foundations on which RDBMS are built
2. Model a set of requirements using the Extended Entity Relationship Model (EER), transform an EER model into a relational model ,and refine the relational model using theory of Normalization
3. Develop Database application using SQL and Embedded SQL
4. Use the knowledge of file organization and indexing to improve database application performance
5. Understand the working of concurrency control and recovery mechanisms in RDBMS

UNIT – I

Introduction: Database System Applications, Purpose of Database Systems, View of
Values, Nested Sub-queries, Complex Queries, Views, Modification of the Database, Joined Relations

Data, Database Languages, Relational Databases, Database Design, Object–based and Semi-structured Databases, Data Storage and Querying, Transaction Management, Data Mining and Analysis, Database Architecture, Database Users and Administrators.

Database Design and the E-R Model: Overview of the Design Process, The Entity- Relationship Model, Constraints, Entity-Relationship Diagrams, Entity – Relationship Design Issues, Weak Entity Sets, Extended E-R Features, Database Design for Banking Enterprise, Reduction to Relational Schemas, Other Aspects of Database Design

UNIT – II

Relational Model: Structure of Relational Databases, Fundamental Relational-Algebra Operations, Additional Relational – Algebra Operations, Extended Relational - Algebra Operations, Null Values, Modification of the Databases.

Structured Query Language: Data Definition, Basic Structure of SQL Queries, Set Operations, Aggregate Functions, Null.

UNIT – III

Advanced SQL: SQL Data Types and Schemas, Integrity Constraints, Authorization, Embedded SQL, Dynamic SQL, Functions and Procedural Constructs, Recursive Queries, Advanced SQL Features. Relational Database Design: Features of Good Relational Design, Atomic Domains and First Normal Form, Functional-Dependency Theory, Decomposition using Functional Dependencies.

UNIT – IV

Indexing and Hashing: Basic Concepts, Ordered Indices, B+-tree Index Files, B-tree Index Files, Multiple-Key Access, Static Hashing, Dynamic Hashing, Comparison of Ordered Indexing and Hashing, Bitmap Indices.
Index Definition in SQL Transactions: Transaction Concepts, Transaction State, Implementation of Atomicity and Durability, Concurrent Executions, Serializability, Recoverability, Implementation of Isolation, Testing for Serializability

UNIT – V

Concurrency Control: Lock-based Protocols, Timestamp-based Protocols, Validation-based Protocols, Multiple Granularity, Multi-version Schemes, Deadlock Handling, Insert and Delete Operations, Weak Levels of Consistency, Concurrency of Index Structures.

Recovery System: Failure Classification, Storage Structure, Recovery and Atomicity, Log-Based Recovery, Recovery with Concurrent Transactions, Buffer Management, Failure with Loss of Nonvolatile Storage, Advanced Recovery Techniques, Remote Backup Systems

Suggested Readings:

1. Abraham Silberschatz, Henry F Korth, S Sudarshan, Database System Concepts, McGraw-Hill International Edition, 6th Edition, 2010
2. Ramakrishnan, Gehrke, Database Management Systems, McGraw-Hill International Edition, 3rd Edition, 2003
3. Elmasri, Navathe, Somayajulu, Fundamentals of Database Systems, Pearson Education, 4th Edition, 2004

PC 502 CS

AUTOMATA LANGUAGES & COMPUTATION

Instruction: 3L hrs per week *Duration of SEE: 3 hours*

CIE: 30 Marks *SEE: 70 Marks*

Credits: 3

Course Objectives:

- Introduce the concept of formal specification of languages and different classes of formal languages
- Discuss automata models corresponding to different levels of Chomsky hierarchy.
- Understand the concept of computability and decidability

Course Outcomes :

Student will be able to

1. Design Finite State Machine, Pushdown Automata, and Turing Machine
2. Determine a language's place in the Chomsky hierarchy (regular, context-free, recursively enumerable)
3. Convert among equivalently powerful notations for a language, including among DFAs, NFAs, and regular expressions, and between PDAs and CFGs
4. Explain why the halting problem has no algorithmic solution

UNIT – I

Introduction, Finite state automata, Non-deterministic finite state automata, FA with **ε**-transitions, Regular expressions, FA with outputs, Applications of FA. Properties of regular sets-Pumping Lemma, Closure properties, Myhill-Nerode Theorem, Minimisation of FA, Decision Algorithms.

UNIT – II

Context Free Grammars and Languages–Derivations, Parse-trees, Ambiguity in Grammars and Languages. Pushdown Automata–Definitions, The languages of PDA, Equivalence of PDAs and CFGs, Deterministic Pushdown Automata (DPDA).

UNIT – III

Properties of CFLs–Normal forms for CFGs, Pumping Lemma, Closure properties, Decision algorithms, Deterministic Context Free Languages, Predicting machines, Decision properties, LR(0) grammars, LR(0) and DPDA, LR(k) grammars

UNIT – IV

Turing Machines–Introduction, Computational Languages and Functions, Techniques for construction of Turing machines. Modifications of TM, TM as enumerator, Restricted TM.

UNIT – V

Undecidability: Recursive and Recursively enumerable languages, UTM and undecidable problem, Rice Theorem, Post's correspondence problem. Chomsky's Hierarchy – Regular grammars, Unrestricted grammar, CSL, Relationship between classes of languages.

Suggested Readings:

1. John E. Hopcroft, Jeffrey D. Ullman, Introduction to Automata Theory, Languages and Computation, Narosa, 1979
2. Zvi Kohavi, Switching and Finite Automata Theory, TMH, 1976

PC 503 CS

OPERATING SYSTEMS

Instruction: 3L hrs per week *Duration of SEE: 3 hours*

CIE: 30 Marks *SEE: 70 Marks*

Credits: 3

Course Objectives:

- To introduce the concepts of OS structure and process synchronization
- To study different memory management strategies
- To familiarize the implementation of file system
- To understand the principles of system security and protection
- To discuss the design principles and structure of Windows 7 and Linux

Course Outcomes: Student will be able to

1. Evaluate different process scheduling algorithms
2. Describe the steps in address translation and different page replacement strategies
3. Compare different file allocation methods and decide appropriate allocation strategy for given type of file
4. Explain the mechanisms available in an OS to control access to resource

UNIT-I

Introduction to Operating Systems: OS structure and strategies, Process concepts, Multithreaded Programming, Process scheduling, Process synchronization, Deadlocks.

UNIT-II

Memory management strategies with example architectures: Swapping, Contiguous allocation, Paging, Segmentation, Segmentation with paging , Virtual memory management : Demand paging, Page replacement, Thrashing.

UNIT-III

File system interface: File concepts, Access methods and protection. File system implementation: File system structure, Allocation methods, Directory implementation of file systems, Mass storage structures, I/O systems

UNIT-IV

System Protection: Principles and Domain, Access Matrix and implementation, Access control and access rights, Capability based systems, Language based Protection.

System Security: Problem, Program threats, cryptography, user authentication, implementing security defenses, Firewalling, Computer security Classification

UNIT-V

Case Studies: The Linux System–Design principles, Kernel modules, Process management, Scheduling, Memory management, File systems, Input and Output, Inter process communication. Windows 7 –Design principles, System components, Terminal services and fast user switching File systems, Networking, Programmer interface.

Suggested Reading:

1. Abraham Silberschatz, Peter B Galvin, Operating System Concepts, 9th edition, Wiley, 2016
2. William Stallings, Operating Systems-Internals and Design Principles, 8th edition, Pearson, 2014
3. Andrew S Tanenbaum, Modern Operating Systems, 4th edition, Pearson, 2016.

PE 511 CS

WEB PROGRAMMING
(Professional Elective-I)

Instruction: 3L hrs per week *Duration of SEE: 3 hours*

CIE: 30 Marks *SEE: 70 Marks*

Credits: 3

Course Objectives:

- To learn HTML5 and JavaScript
- To familiarize the tools and technologies to process XML documents
- To learn various server-side and database connectivity technologies

Course Outcomes: Student will be able to

1. Design a website with static and dynamic web pages
2. Develop a web application with session tracking and client side data validations
3. Develop web content publishing application that accesses back-end data base and publishes data in XML format

UNIT-I

Introduction to World Wide Web, Web Browsers, Web Servers, Uniform Resource Locators, HTTP. HTML5: Introduction, Links, Images, Multimedia, Lists, Tables, Creating Forms, Styling Forms.

UNIT-II

Introduction to XML, XML document structure, Document Type Definition, Namespaces, XML Schemas, Displaying raw XML documents, Displaying XML documents with CSS, XPath Basics, XSLT, XML Processors.

UNIT-III

Introduction to Java script, Java Script and Forms Variables, Functions, Operators, Conditional Statements and Loops, Arrays DOM, Strings, Event and Event Handling, Java Script Closures. Introduction to Ajax, Pre-Ajax Java Script Communication Techniques, XML HTTP Request Object, Data Formats, Security Concerns, User Interface Design for Ajax. Introduction to Python, Objects and Methods, Flow of Control, Dynamic Web Pages.

UNIT-IV

Java Servlets: Java Servlets and CGI Programming, Benefits of Java Servlet, Life Cycle of Java Servlet, Reading data from client, HTTP Request Header, HTTP Response Header, working with Cookies, Tracking Sessions. Java Server Pages: Introduction to JSP, JSP Tags, Variables and Objects, Methods, Control Statements, Loops, Request String, User Sessions, Session Object, Cookies.

UNIT-V

Introduction to PHP: Overview of PHP, General Syntactic Characteristics, Primitives, Operations, Expressions, Control Statements, Arrays, Functions, Pattern matching, Form handling, Files, Cookies, Session Tracking. Database access through Web: Architectures for Database Access-Database access with Perl - Database access with PHP-Database access with JDBC.

Suggested Reading:

1. Robert W.Sebesta, Programming the World Wide Web, 3rd Edition, Pearson Education, 2006
2. Wendy Willard, HTML5, McGraw Hill Education (India) Edition, 2013
3. Thomas Powell, The Complete Reference: Ajax, Tata-McGraw-Hill, 2011
4. John Pollock, Java Script, 4th Edition, McGraw Hill Education (India) Edition, 2013
5. Jim Keogh, J2EE : The Complete Reference, Tata-McGraw-Hill, 2002

PE 512 CS

SOFTWARE ENGINEERING
(Professional Elective-I)

Instruction: 3L hrs per week *Duration of SEE: 3 hours*

CIE: 30 Marks *SEE: 70 Marks*

Credits: 3

Course Objectives:

- To introduce the basic concepts of software development- processes from defining a product to shipping and maintaining that product
- To impart knowledge on various phases , methodologies and practices of software development
- To understand the importance of testing in software development and study various testing strategies and software quality metrics

Course Outcomes

Student will be able to

1. Acquire working knowledge of alternative approaches and techniques for each phase of software development
2. Acquire skills necessary for independently developing a complete software project
3. Understand the practical challenges associated with the development of a significant software system

UNIT-I

Introduction to Software Engineering:

A generic view of Process: Software Engineering, Process Framework, CMM Process Patterns, Process Assessment.

Process Models: Prescriptive Models, Waterfall Model, Incremental Process Models, Evolutionary Process Models, Specialized Process Models, The Unified Models, Personal and Team Process Models, Process Technology, Product and Process.

An Agile view of Process: Introduction to Agility and Agile Process, Agile Process Models.

UNIT-II

Software Engineering Principles: SE Principles, Communication Principles, Planning Principles, Modeling Principles, Construction Principles, Deployment.

System Engineering: Computer-based Systems, The System Engineering Hierarchy, Business Process Engineering, Product Engineering, System Modeling.

Requirements Engineering: A Bridge to Design and Construction, Requirements Engineering Tasks, Initiating Requirements Engineering Process, Eliciting Requirements, Developing Use-Cases, Building the Analysis Model, Negotiating Requirements, Validating Requirements.

UNIT-III

Building the Analysis Model: Requirements Analysis Modeling Approaches, Data Modeling Concepts, Object-Oriented Analysis, Scenario-based Modeling, Flow-oriented Modeling, Class-based Modeling, Creating a Behavioral Model.

Design Engineering: Design within the context of SE, Design Process and Design Quality, Design Concepts, The Design Model, Pattern-based Software Design.

UNIT-IV

Creating an Architectural Design: Software Architecture, Data Design, Architectural Styles and Patterns, Architectural Design, Assessing Alternative Architectural Designs, Mapping Data Flow into a Software Architecture.

Modeling Component-Level Design: Definition of Component, Designing Class-based Components, Conducting Component-level Design, Object Constraint Language, Designing Conventional Components.

Performing User Interface Design: The Golden Rules, User Interface Analysis and Design, Interface Analysis, Interface Design Steps, Design Evaluation.

UNIT-V

Software Quality Assurance: Basic Elements, Tasks, Goals and Metrics, Formal Approaches, Statistical Software Quality Assurance, Software Reliability, ISO 9000 Quality Standards, SQA Plan.

Testing Strategies: A Strategic Approach to Software Testing, Strategic Issues, Test Strategies for O-O Software, Validation Testing, System Testing, The Art of Debugging.

Testing Tactics: Software Testing Fundamentals, Black-box and White-box Testing, Basis Path Testing, Control Structure Testing, O-O Testing Methods, Testing Methods applicable on the Class Level, Inter Class Test Case Design, Testing for Specialized Environments, Architectures and Applications, Testing Patterns.

Product Metrics: Software Quality, A Framework for Product Metrics, Metrics for the Analysis Model, Metrics for the Design Model, Metrics for Source Code, Metrics for Testing, Metrics for Maintenance.

Suggested Reading:

1. Roger S.Pressman, Software Enigneering: A Practitioner's Approach, 7th Edition, McGraw Hill, 2009.
2. Ali Behforooz and Frederick J.Hudson, Software Engineering Fundamentals, Oxford University Press, 1996.
3. Pankaj Jalote , An Integrated Approach to Software Engineering, 3rd Edition, Narosa Publishing House, 2008.

PC 551CS

DATABASE MANAGEMENT SYSTEMS LABORATORY

Instruction: 4 periods per week *Duration of SEE: 3hours*

CIE: 25 marks *SEE: 50 marks*

Credits: 2

Course Objectives:

- To practice various DDL commands in SQL
- To write simple and Complex queries in SQL
- To familiarize PL/SQL

Course Outcomes:

Student will be able to:

1. Design and implement a database schema for a given problem
2. Populate and query a database using SQL and PL/SQL
3. Develop multi-user database application using locks

The list of programs suggested :

Creation of database (exercising the commands for creation).

1. Simple to Complex condition query creation using SQL Plus.
2. Usage of Triggers and Stored Procedures.
3. Creation of Forms for Student information, Library information, Pay roll etc.
4. Writing PL/SQL procedures for data validation.
5. Report generation using SQL reports.
6. Creating password and security features for applications.
7. Usage of File locking, Table locking facilities in applications.
8. Creation of small full- fledged database application spreading over3 sessions.

Note:-The creation of sample database for the purpose of the experiments is expected to be pre- decided by the instructor.

PC 552 CS

OPERATING SYSTEMS LABORATORY

Instruction: 4 periods per week *Duration of SEE: 3hours*

CIE: 25 marks *SEE: 50 marks*

Credits: 2

Course Objectives:

- To learn shell programming and the use of filters in the LINUX environment
- To practice multithreaded programming
- To implement CPU Scheduling Algorithms and memory management algorithms

Course Outcomes:

Student will be able to:

1. Write shell scripts for simple system administration tasks
2. Write concurrent programs with synchronization constricts
3. Compare the performance of various CPU Scheduling Algorithm
4. Critically analyze the performance of the various Memory management algorithms

List of programs Suggested:

1-3. Memory Management Algorithms

4-5. Examples of Multithreading

6. Producer & Consumer problem using Semaphores and shared memory

7-8.Processor Scheduling algorithms

9. Dining Philosophers problem using Semaphores

10. Readers and Writers problem using Semaphores

11. Shell-programming exercises

SCHEME OF INSTRUCTION
B.E. (COMPUTER SCIENCE & ENGINEERING)
VI - SEMESTER

S. No.	Course Code	Course Title	Scheme of Instruction			Contact Hours / Week	Scheme of Examination		Credits
			L	T	P		CIE	SEE	
THEORY									
1.	PC 601 CS	Compiler Design	3	1	0	4	30	70	4
2.	PC 602 CS	Computer Networks	3	1	0	4	30	70	4
3.	**Professional Elective-II**		3	0	0	3	30	70	3
	PE 621 CS	Distributed Systems							
	PE 622 CS	Artificial Intelligence							
	PE 623 CS	Graph Theory							
	PE 624 CS	Distributed Databases							
4.	**Professional Elective-III**		3	0	0	3	30	70	3
	PE 631 CS	Cloud Computing							
	PE 632 CS	An Introduction to Programming the Internet of Things							
	PE 633 CS	Machine Learning							
	PE 634 CS	Advanced Algorithms							
	PE 635 CS	Data Engineering and Advanced Database							
5.	**Open Elective-I**		3	0	0	3	30	70	3
Practicals									
6.	PC 651 CS	Compiler Design Lab	0	0	2	2	25	50	1
7.	PC 652 CS	Computer Networks Lab	0	0	2	4	25	50	1
8.	PC653CS	Mini Project	0	0	3	6	50		3
9.	PW 961 CS	Summer Internship	Six Weeks during summer vacation Evaluation will be done in VII-Semester						
Total			**15**	**2**	**7**	**29**	**250**	**450**	**22**

L	:	Lectures
T	:	Tutorials
p	:	Practicals
CIE	:	Continuous Internal Evaluation
SEE	:	Semester End Examination

Open Elective – I:

OE 601 BM : Engineering Application in Medicine

OE 602 CE : Disaster Management

OE 603 EC : Electronic Instrumentation

OE 604 EC : Principles of Electronic Communication Systems

OE 605 ME : 3D Printing Technology

OE 606 ME : Finite Element Methods

Program Electives For V, VI , VII and VII SEM

5th SEM	6th SEM		7th SEM			8th SEM
Elective I	II	III	IV	V	VI	VII
Web Prog	Distributed Systems	Cloud Computing	Multiplatform Mobile application development And Application development – Full Stack	Application development using Kubernetes	Application development using Micro services & service mesh	Architecture of Large application –Serverless and Cloud Functions
Software Engineering		Cloud Computing	Scalable architectures for Large Applications			
		Fundamentals of Internet of Things (IOT)	Management of Urban Infrastructures-Smart Cities	Industrial IOT : Markets & Security	Sustainability by architecting smart IOT	Enterprise IoT: Strategies and Best Practices for Connected Products and Services
	Artificial Intelligence	Machine Learning	Data Mining	Machine Vision	Neural Networks & Deep Learning	Natural Language Processing
	Graph Theory	Advanced Algorithms	Computational Complexity	Distributed Algorithms	Graph Analytics	Quantum Computing
	Distributed Databases	Data Engineering & Advanced DB	Scalable architectures for Large Applications	Programming with Elastic MR	Analytics using BD	Architecture of Large application –Serverless and Cloud Functions and Large DB

****Students has to undergo summer internship of 6 Weeks duration at the end of semester VI and credits will be awarded after evaluation.

PC 601CS

COMPILER DESIGN

Instruction: 4 hrs per week *Duration of SEE: 3 hours*

CIE: 30 Marks *SEE: 70 Marks*

Credits: 4

Course Objectives:

- To introduce the steps in language translation pipeline and runtime data structures used in translation
- To learn about Scanning (lexical analysis) process using regular expressions and use of LEX to generate scanner
- To introduce different Parsing strategies including top-down (e.g., recursive descent, Earley parsing, or LL) and bottom-up (e.g., backtracking or LR) techniques
- Describe semantic analyses using an attribute grammar
- To learn how to build symbol tables and generate intermediate code.
- To introduce techniques of program analysis and code optimization

Course Outcomes:

Student will be able to :

1. Create lexical rules and grammars for a given language
2. Generate scanners and parsers from declarative specifications.
3. Describe an abstract syntax tree for a small language.
4. Use program analysis techniques for code optimization
5. Develop the compiler for a subset of a given language

UNIT – I

Introduction: Compilers, The translation process, Data structures and issues in compiler structure, Bootstrapping and Porting.

Scanning: The scanning process, Regular expressions, Finite Automata, Regular expressions to DFA‘s, use of LEX to generate scanner.

UNIT – II

Context Free Grammars & Parsing: The parsing process, Context free grammars, Parse tree & Abstract syntax trees, EBNF and syntax diagrams, and Properties of CFLs.

Top Down Parsing: Recursive descent parsing, LL (1) parsing, First and follow sets, Recursive descent parser, and Error recovery in top down parsers.

UNIT – III

Bottom-up Parsing: Overview, LR (0) items and LR (0) Parsing, SLR (1) Parsing, general LR(1) and LALR(1) parsing, YACC, and Error recovery in bottom-up parsers.

UNIT – IV

Semantic Analysis: Attributes and attribute grammars, Algorithms for attribute computation, Symbol table, Data types and Type checking.

Runtime Environments: Memory organization during program execution, Fully static runtime environments, Stack-based runtime environments, Dynamic memory, and Parameter parsing mechanisms.

UNIT – V

Code Generation: Intermediate code and data structures for code generation, Basic code generation techniques, Code generation of data structure references, Code generation of control statements and logical expressions, Code generation of procedure and function calls, Code generation in commercial compilers, Code optimization techniques, and Data flow equation.

Suggested Readings:

1. Kenneth C. Louden, ―*Compiler Construction: Principles and Practice*‖, Thomson Learning Inc., 1997.

2. Ravi Sethi, Aho & Ullman JP, ―*Compilers: Principles, Techniques and Tools*‖, Addison Wesley publishing co., 1986.

3. J.P. Tremblay and P.S. Sorenson, ―*The Theory and Practice of Compiler Writing*‖, TMH-1985.

PC 602CS

COMPUTER NETWORKS

Instruction: (3L + 1T) hrs per week *Duration of SEE: 3 hours*
CIE: 30 Marks *SEE: 70 Marks*
Credits: 4

Course Objectives:

- To study the design issues in network layer and various routing algorithms
- To introduce internet routing architecture and protocols
- To learn the flow control and congestion control algorithms in Transport Layer
- To introduce the TCP/IP suite of protocols and the networked applications supported by it
- To learn basic and advanced socket system calls

Course Outcomes

Student will be able to

1. Explain the function of each layer of OSI and trace the flow of information from one node to another node in the network
2. Understand the principles of IP addressing and internet routing
3. Describe the working of various networked applications such as DNS, mail, file transfer and www
4. Implement client-server socket-based networked applications.

UNIT I
DATA COMMUNICATIONS: Components, analog and digital signals and Encoders, Modems, RS232 Interfacing
Switching: Circuit Switching, Message Switching and Packet Switching.
Topologies – Concept of layering.-Protocols and Standards – ISO / OSI model, TCP/IP

UNIT II
DATA LINK LAYER: Error Control: Error detection and correction (CRC and Hamming code for single bit correction)
Flow Control: stop and wait – - sliding window protocols-go back-N ARQ – selective repeat ARQ

MAC LAYER: Ethernet IEEE 802.3LAN, Manchester encoding, Binary exponential algorithm, Efficiency calculation, ARP and RARP.

UNIT III

NETWORK LAYER : Internetworks – virtual circuit and Datagram approach Routing – Distance Vector Routing ,Link State Routing , OSPF and BGP IPv4 , addressing, Subnetting, IPv6, CIDR, ICMP and IGMP protocols

UNIT IV

TRANSPORT LAYER : Services of transport layer, Multiplexing and crash recovery
Transmission Control Protocol (TCP) – TCP window management Congestion Control, timer management and User Datagram Protocol (UDP)

UNIT V

Socket Programming : Primitive and advanced system calls, client/server iterative and concurrent programs
IO multiplexing, Asynchronous IO and select system call.
APPLICATION LAYER : Domain Name Space (DNS) – SMTP – FTP – HTTP

References:

1) Computer Networks (5th Edition), Authors: Andrew S. Tanenbaum , David J. Wetherall , Pearson
2) Computer Networks: A Systems Approach, Authors: Larry Peterson and Bruce Davie, Elsevier
3) Computer Networking: A Top-Down Approach (6th Edition), Authors: James F. Kurose , Keith W. Ross , Pearson

PE 621CS

DISTRIBUTED SYSTEMS
(Professional Elective-II)

Instruction: 3 hrs per week *Duration of SEE: 3 hours*

CIE: 30 Marks *SEE: 70 Marks*

Credits: 3

Course Objectives:

- To acquire an understanding of the issues in distributed systems
- To study architectures and working of distributed file systems
- To expose the students to distributed transaction management, security issues and replication

Course Outcomes:

Student will be able to:

1. Describe the problems and challenges associated with distributed systems.
2. Implement small scale distributed systems.
3. Understand design tradeoffs in large-scale distributed systems

UNIT-I

Introduction: Goals and Types of Distributed Systems

Architectures: Architectural Styles, System Architectures, Architectures versus Middleware, and Self-Management in Distributed Systems.

Processes: Threads, Virtualization, Clients, Servers, and Code Migration.

Communication: Fundamentals, Remote Procedure Call, Message-Oriented Communication, Stream-Oriented Communication, and Multicast Communication.

UNIT-II

Naming: Names, Identifiers and Addresses, Flat Naming, Structured Naming, and Attribute-Based Naming.

Synchronization: Clock Synchronization, Logical Clocks, Mutual Exclusion, Global Positioning of Nodes, and Election Algorithms.

Consistency and Replication: Introduction, Data-Centric Consistency Models, Client-Centric Consistency Models, Replica Management, and Consistency Protocols.

UNIT-III

Fault Tolerance: Introduction to Fault Tolerance, Process Resilience, Reliable Client-Server Communication, Reliable Group Communication, Distributed Commit, and Recovery.

Distributed Object-Based Systems: Architecture, Processes, Communication, Naming, Synchronization, Consistency and Replication, Fault Tolerance, and Security.

UNIT-IV

Distributed File Systems: Architecture, Processes, Communication, Naming, Synchronization, Consistency and Replication, Fault Tolerance, and Security.

Distributed Web-Based Systems: Architecture, Processes, Communication, Naming, Synchronization, Consistency and Replication, Fault Tolerance, and Security.

UNIT-V

Distributed Coordination-Based Systems: Introduction to Coordination Models, Architecture, Processes, Communication, Naming, Synchronization, Consistency and Replication, Fault Tolerance, and Security.

Map-Reduce: Example, Scaling, programming model, Apache Hadoop, Amazon Elastic Map Reduce, Mapreduce.net, Pig and Hive.

Suggested Readings:

1. Andrew S. Tanenbaum and Maarten Van Steen, ―*Distributed Systems*‖, PHI 2nd Edition, 2009.
2. R.Hill, L.Hirsch, P.Lake, S.Moshiri, ―*Guide to Cloud Computing*, Principles and Practice‖, Springer, 2013.
3. R.Buyya, J.Borberg, A.Goscinski,‖*Cloud Computing-Principles and Paradigms*‖, Wiley 2013.

PE 622CS

ARTIFICIAL INTELLIGENCE
(Professional Elective-II)

Instruction: (3L) hrs per week *Duration of SEE: 3 hours*
CIE: 30 Marks *SEE: 70 Marks*
Credits: 3

Course Objectives:

- Gain a historical perspective of AI and its foundations.
- Become familiar with basic principles of AI toward problem solving, inference, perception, knowledge representation, and learning.
- Investigate applications of AI techniques in intelligent agents, expert systems, artificial neural networks and other machine learning models.
- Experience AI development tools such as an 'AI language', expert system shell, and/or data mining tool.
- Experiment with a machine learning model for simulation and analysis.
- Explore the current scope, potential, limitations, and implications of intelligent systems

Course Outcomes:

Upon successful completion of this course, student will be able to

1. Compare AI with human intelligence and traditional information processing and discuss its strengths and limitations as well as its application to complex and human-centred problems.
2. discuss the core concepts and algorithms of advanced AI, including informed searching, CSP, logic, uncertain knowledge and reasoning, dynamic Bayesian networks, graphical models, decision making, multiagent, inductive learning, statistical learning, reinforcement learning, deep learning, natural language processing, robotics, and so on.
3. Apply the basic principles, models, and algorithms of AI to recognize, model, and solve problems in the analysis and design of information systems.
4. Analyze the structures and algorithms of a selection of techniques related to searching, reasoning, machine learning, and language processing.
5. Design AI functions and components involved in intelligent systems such as computer games, expert systems, semantic web, information retrieval, machine translation, mobile robots, decision support systems, and intelligent tutoring systems.
6. Review research articles from well-known AI journals and conference proceedings regarding the theories and applications of AI.
7. Carry out a research project and write a research proposal, report and paper.

UNIT -I

Introduction: History Intelligent Systems, Foundations of Artificial Intelligence, Sub areas of Al, Applications.

Problem Solving - State - Space Search and Control Strategies: Introduction, General Problem Solving Characteristics of problem, Exhaustive Searches, Heuristic Search Techniques, Iterative - Deepening A*, Constraint Satisfaction.

Game Playing, Bounded Look - ahead Strategy and use of Evaluation Functions, Alpha Beta Pruning.

UNIT – II

Logic Concepts and Logic Programming: Introduction, Propositional Calculus Propositional Logic, Natural Deduction System, Axiomatic System, Semantic Table, A System in Propositional Logic, Resolution, Refutation in Propositional Logic, Predicate Logic, Logic Programming.

Knowledge Representation: Introduction, Approaches to knowledge Representation, Knowledge Representation using Semantic Network, Extended Semantic Networks for KR, Knowledge Representation using Frames.

UNIT - III

Expert System and Applications: Introduction, Phases in Building Expert Systems Expert System Architecture, Expert Systems Vs Traditional Systems, Truth Maintenance Systems, Application of Expert Systems, List of Shells and tools.

Uncertainity Measure - Probability Theory: Introduction, Probability Theory, Bayesian Belief Networks, Certainity Factor Theory, Dempster - Shafer Theory.

UNIT - IV

Machine - Learning Paradigms: Introduction, Machine learning System, Supervised and Unsupervised Learning, Inductive Learning, Learning Decision Trees, Deductive Learning, Clustering, Support Vector Machines.

Artificial Neural Networks: Introduction Artificial Neural Networks, Single - Layer Feed Forward Networks, Multi - Layer Feed Forward Networks, Radial - Basis Function Networks, Design Issues of Artificial Neural Networks, Recurrent Networks

UNIT - V

Reinforcement Learning: Overview of reinforcement learning: the agent environment framework, successes of reinforcement learning, Bandit problems and online learning, Markov decision processes, Returns, and value functions, Solution methods: dynamic programming, Solution methods: Monte Carlo learning, Solution methods: Temporal difference learning learning, Eligibility traces, Value function approximation (function approximation), Models and planning (table lookup case), Case studies: successful examples of RL systems, Frontiers of RL research

Suggested Reading:

1. Saroj Kaushik, *Artificial Intelligence*, Cengage Learning India, First Edition, 2011.
2. Russell, Norvig, *Artificial Intelligence: A Modern Approach*, Pearson Education, 2nd Edition, 2004.
3. Rich, Knight, Nair , *Artificial Intelligence*, Tata McGraw Hill, 3rd Edition 2009.

PE 623CS

GRAPH THEORY
(Professional Elective-II)

Instruction: (3L) hrs per week *Duration of SEE: 3 hours*
CIE: 30 Marks *SEE: 70 Marks*
Credits: 3

Course Objectives:

- To familiarize a variety of different problems in Graph Theory
- To learn various techniques to prove theorems
- To understand and analyze various graph algorithms

Course Outcomes:
Student will be able to
1. Write precise and accurate mathematical definitions of objects in graph theory
2. Validate and critically assess a mathematical proof
3. Develop algorithms based on diverse applications of Graphs in different domains

UNIT-I
Preliminaries: Graphs, isomorphism, subgraphs, matrix representations, degree, operations on graphs, degree sequences

Connected graphs and shortest paths: Walks, trails, paths, connected graphs, distance, cut-vertices, cut-edges, blocks, connectivity, weighted graphs, shortest path algorithms T**rees:** Characterizations, number of trees, minimum spanning trees

UNIT- II
Special classes of graphs: Bipartite graphs, line graphs, chordal graphs
Eulerian graphs: Characterization, Fleury's algorithm, chinese-postman-problem

UNIT -III
Hamilton graphs: Necessary conditions and sufficient conditions

Independent sets, coverings, matchings: Basic equations, matchings in bipartite graphs, perfect matchings, greedy and approximation algorithms

UNIT- IV
Vertex colorings: Chromatic number and cliques, greedy coloring algorithm, coloring of chordal graphs, Brook's theorem
Edge colorings: Gupta-Vizing theorem, Class-1 graphs and class-2 graphs, equitable edge-coloring

UNIT- V
Planar graphs: Basic concepts, Eulers formula, polyhedrons and planar graphs, characterizations, planarity testing, 5-color-theorem

Directed graphs: Out-degree, in-degree, connectivity, orientation, Eulerian directed graphs, Hamilton directed graphs, tournaments

Suggested Reading:

1. F.Harry, Graph theory, Narosa Publications, 1988.
2. C.Berge: Graphs and Hypergraphs, North Holland/Elsevier, 1973
3. J A Bondy and U.S. R Murthy, Graph Theory with Applications, Elsevier Science Ltd, 1976.
4. Douglas B West, Introduction to Graph Theory, Prentice Hall, 2004

PE 624CS

DISTRIBUTED DATABASES
(Professional Elective-II)

Instruction: 3L hrs per week *Duration of SEE: 3 hours*
CIE: 30 Marks *SEE: 70 Marks*
Credits: 3

Course Objectives:

The aim of the course is to

- Enhance the previous knowledge of database systems by deepening the understanding of the theoretical and practical aspects of the database technologies, and showing the need for distributed database technology to tackle deficiencies of the centralized database systems;
- Introduce basic principles and implementation techniques of distributed database systems,
- Expose active and emerging research issues in distributed database systems and application development,
- Apply theory to practice by building and delivering a distributed database query engine, subject to remote Web service calls.

Course Outcomes:

After the completion of the course, the students are expected to

1. Get familiar with the currently available models, technologies for and approaches to building distributed database systems and services;
2. Have developed practical skills in the use of these models and approaches to be able to select and apply the appropriate methods for a particular case;
3. Be aware of the current research directions in the field and their possible outcomes;
4. Be able to carry out research on a relevant topic, identify primary references, analyze them, and come up with meaningful conclusions
5. Be able to apply learned skills to solving practical database related tasks.

UNIT- I

Introduction: Database-System Applications, Purpose of Database Systems, View of Data, Database Languages, Relational Databases, Database Design, Object-Based and Semistructured Databases, Data Storage and Querying, Transaction Management, Data Mining and Analysis, Database Architecture, Database Users and Administrators, History of Database Systems.
Relational Model: Structure of Relational Databases, Fundamental Relational-Algebra Operations, Additional Relational-Algebra Operations, Extended Relational-Algebra Operations, Null Values, Modification of the Database.

UNIT-II

Query Processing: Overview, Measures of query cost, Selection operation, sorting, Join operation, other operations, Evaluation of Expressions.
Query Optimization: Overview, Transformation of Relational expressions, Estimating statistics of expression results, Choice of evaluation plans, Materialized views.

UNIT-III

Parallel Systems: Speedup and Scaleup, Interconnection Networks, Parallel Database Architectures.
Parallel Databases: Introduction, I/O Parallelism, Interquery Parallelism, Intraquery Parallelism, Interoperation Parallelism, Intraoperation Parallelism, Design of Parallel Systems.

UNIT-IV

Distributed Databases: Reference architecture for DDB, Types of Data Fragmentation, Distribution Transparency for Read-only applications, Distribution Transparency for Update applications, Distributed
Database Access Primitives, Integrity Constraints in DDB.

Distributed Database Design: A frame work for Distributed Database Design, The design of Database fragmentation, The allocation of fragmentation.

UNIT-V

Translation of Global Queries to Fragment Queries: Equivalence transformations for queries, Transforming global queries into fragment queries, Distributed grouping and aggregate function evaluation, Parametric queries.

Optimization of Access Strategies: Access Control Models, Database Security, A framework for query optimization, Join queries, General queries.

Suggested Reading:

1. Silberschatz A, Korth HF, Sudarshan S, *Database System Concepts*, McGraw-Hill International Edition, 5th Edition, 2006.
2. Ceri S, Pelagatti G, *Distributed Databases: Principles and Systems*, McGraw-Hill International Edition, 1984.

PE 631CS

CLOUD COMPUTING
(Professional Elective-III)

Instruction: 3 hrs per week *Duration of SEE: 3 hours*
CIE: 30 Marks *SEE: 70 Marks*
Credits: 3

Course Objectives:

- To introduce basic concepts cloud computing and enabling technologies
- To learn about Auto-Scaling, capacity planning and load balancing in cloud
- To introduce security, privacy and compliance issues in clouds
- To introduce cloud management standards and programming models

.

Course Outcomes:

\Student will be able to:

1. Understand the architecture and concept of different cloud models: IaaS, PaaS, SaaS
2. Create virtual machine images and deploy them on cloud
3. Identify security and compliance issues in clouds.

UNIT- I

Introduction, Benefits and challenges, Cloud computing services, Resource Virtualization, Resource pooling sharing and provisioning

UNIT -II

Scaling in the Cloud, Capacity Planning , Load Balancing, File System and Storage,

UNIT-III

Multi-tenant Software, Data in Cloud , Database Technology, Content Delivery Network, Security Reference Model , Security Issues, Privacy and Compliance Issues

UNIT-IV

Portability and Interoperability Issues, Cloud Management and a Programming Model Case Study, Popular Cloud Services

UNIT- V

Enterprise architecture and SOA, Enterprise Software , Enterprise Custom Applications, Workflow and Business Processes, Enterprise Analytics and Search, Enterprise Cloud Computing Ecosystem.

Suggested Readings:

1. Cloud Computing - Sandeep Bhowmik, Cambridge University Press, 2017.
2. Enterprise Cloud Computing - Technology, Architecture, Applications by Gautam Shroff, Cambridge University Press, 2016.
3. Kai Hwang, Geoffrey C.Fox, Jack J.Dongarra, ―*Distributed and Cloud Computing From Parallel Processing to the Internet of Things*‖, Elsevier, 2012.

PE 632CS

AN INTRODUCTION TO PROGRAMMING THE INTERNET OF THINGS (IOT)
(Professional Elective-III)

Instruction: 3 hrs per week *Duration of SEE: 3 hours*
CIE: 30 Marks *SEE: 70 Marks*
Credits: 3

Course Objectives:

- Discuss fundamentals of IoT and its applications and requisite infrastructure
- Describe Internet principles and communication technologies relevant to IoT
- Discuss hardware and software aspects of designing an IoT system
- Describe concepts of cloud computing and Data Analytics
- Discuss business models and manufacturing strategies of IoT products

Course Outcomes:

Student will be able to

1. Understand the various applications of IoT and other enabling technologies.
2. Comprehend various protocols and communication technologies used in IoT
3. Design simple IoT systems with requisite hardware and C programming software
4. Understand the relevance of cloud computing and data analytics to IoT
5. Comprehend the business model of IoT from developing a prototype to launching a product.

UNIT- I

Introduction to Internet of Things

IOT vision, Strategic research and innovation directions, Iot Applications, Related future technologies, Infrastructure, Networks and communications, Processes, Data Management, Security, Device level energy issues.

UNIT- II

Internet Principles and communication technology

Internet Communications: An Overview – IP, TCP, IP protocol Suite, UDP. IP addresses – DNS, Static and Dynamic IP addresses, MAC Addressess, TCP and UDP Ports, Application Layer Protocols –
HTTP,HTTPS, Cost Vs Ease of Production, Prototypes and Production, Open Source Vs Closed Source.

UNIT- III

Prototyping and programming for IoT

Prototyping Embedded Devices – Sensors, Actuators, Microcontrollers, SoC, Choosing a platform, Prototyping, Hardware platforms – Arduino, Raspberry Pi. Prototyping the physical design – Laser Cutting, 3D printing, CNC Milling.

Techniques for writing embedded C code: Integer data types in C, Manipulating bits - AND,OR,XOR,NOT, Reading and writing from I/ O ports. Simple Embedded C programs for LED Blinking, Control of motor using switch and temperature sensor for arduino board.

UNIT- IV

Cloud computing and Data analytics

Introduction to Cloud storage models -SAAS, PAAS, IAAS. Communication APIs, Amazon webservices for IoT, Skynet IoT Messaging Platform.

Introduction to Data Analytics for IoT - Apache hadoop- Map reduce job execution workflow.

UNIT- V

IoT Product Manufacturing - From prototype to reality

Business model for IoT product manufacturing, Business models canvas, Funding an IoT Startup,

Mass manufacturing - designing kits, designing PCB,3D printing, certification, Scaling up software, Ethical issues in IoT- Privacy, Control, Environment, solutions to ethical issues.

Suggested Readings:

1. Internet of Things - Converging Technologies for smart environments and Integrated ecosystems, River Publishers.
2. Designing the Internet of Things , Adrian McEwen, Hakim Cassimally. Wiley India Publishers
3. Fundamentals of embedded software: where C meets assembly by Daneil W lewies, Pearson.
4. Internet of things -A hands on Approach, Arshdeep Bahga, Universities press.

PE 633 CS

MACHINE LEARNING
(Professional Elective-III)

Instruction: 3 hrs per week *Duration of SEE : 3 hours*
CIE: 30 Marks *SEE: 70 Marks*
Credits: 3

Course objectives:

- To introduce the basic concepts of machine learning and range of problems that can be handled by machine learning
- To introduce the concepts of instance based learning and decision tree induction
- To introduce the concepts of linear separability , Perceptron and SVM
- To learn the concepts of probabilistic inference, graphical models and evolutionary learning
- To learn the concepts of ensemble learning, dimensionality reduction and clustering

Course Outcomes:
Student will be able to:

1. Explain the strengths and weaknesses of many popular machine learing approaches
2. Recognize and implement various ways of selecting suitable model parameters for different machine learning techniques
3. Design and implement various machine learning algorithms in a range of real-world applications

UNIT-I

Introduction: Learning, Types of Machine Learning, Machine Learning Examples , Decision Tree Learning

Concept learning: Introduction, Version Spaces and the Candidate Elimination Algorithm.
Learning with Trees: Decision Tree Learning, The Big Picture

Linear Discriminants : Learning Linear Separators , The Perceptron Algorithm , Margins

UNIT-II

Estimating Probabilities from Data, Bayes Rule, MLE, MAP

Naive Bayes: Conditional Independence, Naive Bayes: Why and How, Bag of Words

Logistic Regression : Maximizing Conditional likelihood , Gradient Descent

Kernels: Kernalization Algorithm, Kernalizing Perceptoron,

Discriminants: The Perceptron, Linear Separability, Linear Regression

Multilayer Perceptron (MLP): Going Forwards, Backwards, MLP in practices, Deriving back Propagation.

UNIT-III

Support Vector Machines: Geometric margins, Primal and Dual Forms, Kernalizing SVM
Generalization & Overfitting : Sample Complexity, Finite Hypothesis classes, VC Dimension Based Bounds
Some Basic Statistics: Averages, Variance and Covariance, The Gaussian, The Bias-Variance Tradeoff Bayesian learning: Introduction, Bayes theorem. Bayes Optimal Classifier, Naive Bayes Classifier.
Graphical Models: Bayesian networks, Approximate Inference, Making Bayesian Networks, Hidden Markov Models, The Forward Algorithm.

UNIT-IV

Model Selection & Regularization: Structural Risk Minimization, Regularization, k-Fold Cross validation
Linear Regression: Linear regression, minimizing squared error and maximizing data Likelihood
Neural Networks: Back Propagation,
Deep Neural Networks: Convolution, Convolution Neural Networks, LeNet-5 architecture
Boosting : Boosting Accuracy, Ada Boosting, Bagging

UNIT-V

Clustering: Introduction, Similarity and Distance Measures, Outliers, Hierarchical Methods, Partitional Algorithms, Clustering Large Databases, Clustering with Categorical Attributes, Comparison
Dimensionality Reduction: Linear Discriminant Analysis, Principal Component Analysis

Interactive Learning: Active Learning, Active Learning , Common heuristics, Sampling bias , Safe Disagreement Based Active Learning Schemes

Semi-Supervised Learning : Semi-supervised Learning , Transductive SVM, Co-training

Reinforcement Learning : Markov Decision Processes , Value Iteration, Q-Learning

Suggested Reading:

1. Tom M. Mitchell, *Machine Learning*, Mc Graw Hill, 1997
2. Chistopher Bishop, Pattern recognition & Machine Learning, Springer 2006.
3. Stephen Marsland, *Machine Learning - An Algorithmic Perspective*, CRC Press, 2009
4. Margaret H Dunham, *Data Mining*, Pearson Edition., 2003.
5. Galit Shmueli, Nitin R Patel, Peter C Bruce, *Data Mining for Business Intelligence*, Wiley India Edition, 2007
6. Rajjan Shinghal, *Pattern Recognition*, Oxford University Press, 2006.
7. Jerry Zhu, *Encyclopedia of Machine Learning*,

PE 634 CS

ADVANCED ALGORITHMS
(Professional Elective-III)

Instruction: (3L) hrs per week *Duration of SEE: 3 hours*
CIE: 30 marks *SEE: 70 marks*
Credits: 3

Course Objective

- Introduce students to the advanced methods of designing and analyzing algorithms.
- The student should be able to choose appropriate algorithms and use it for a specific problem.
- To familiarize students with basic paradigms and data structures used to solve advanced algorithmic problems.
- Students should be able to understand different classes of problems concerning their computation difficulties.
- To introduce the students to recent developments in the area of algorithmic design.

Course Outcomes

1. After completion of course, students would be able to:
2. Analyze the complexity/performance of different algorithms.
3. Determine the appropriate data structure for solving a particular set of problems.
4. Categorize the different problems in various classes according to their complexity.
5. Students should have an insight of recent activities in the field of the advanced data structure.

UNIT 1

Sorting: Review of various sorting algorithms, topological sorting,
Graph: Definitions and Elementary Algorithms: Shortest path by BFS, shortest path in edge-weighted case (Dijkasra's), depth-first search and computation of strongly connected components, emphasis on correctness proof of the algorithm and time/space analysis, example of amortized analysis.

UNIT II

Matroids: Introduction to greedy paradigm, algorithm to compute a maximum weight maximal independent set. Application to MST.
Graph Matching: Algorithm to compute maximum matching. Characterization of maximum matching by augmenting paths, Edmond's Blossom algorithm to compute augmenting path.

UNIT III

Flow-Networks: Maxflow-mincut theorem, Ford-Fulkerson Method to compute maximum flow, Edmond-Karp maximum-flow algorithm.
Matrix Computations: Strassen's algorithm and introduction to divide and conquer paradigm, inverse of a triangular matrix, relation between the time complexities of basic matrix operations, LUP-decomposition.

UNIT IV

Shortest Path in Graphs: Floyd-Warshall algorithm and introduction to dynamic programming paradigm. More examples of dynamic programming.
Modulo Representation of integers/polynomials: Chinese Remainder Theorem, Conversion between base-representation and modulo-representation. Extension to polynomials. Application: Interpolation problem.
Discrete Fourier Transform (DFT): In complex field, DFT in modulo ring. Fast Fourier Transform algorithm. Schonhage-Strassen Integer Multiplication algorithm

UNIT V

Linear Programming: Geometry of the feasibility region and Simplex algorithm
NP-completeness: Examples, proof of NP-hardness and NP-completeness.
Approximation algorithms, Randomized Algorithms, Interior Point Method, Advanced Number Theoretic Algorithm. Recent Trends in problem solving paradigms using recent searching and sorting techniques by applying recently proposed data structures

Suggested Reading:

1. "Introduction to Algorithms" byCormen, Leiserson, Rivest, Stein, 4th edition, McGraw Hill,
2. "The Design and Analysis of Computer Algorithms" by Aho, Hopcroft, Ullman.
3. "Algorithm Design" by Kleinberg and Tardos.

PE 635 CS

DATA ENGINEERING & ADVANCED DATABASES
(Professional Elective-III)

Instruction: (3L) hrs per week *Duration of SEE: 3 hours*
CIE: 30 Marks *SEE: 70 Marks*
Credits: 3

Course Objectives:

- This field covers all aspects of computing and information access across multiple processing elements connected by any form of communication network, either local area, or wide area
- There has been a steady growth in the development of contemporary applications that demonstrate their efficacy by connecting millions of users/applications/machines across the globe without relying on a traditional client-server approach.
- The general computing trend is to leverage shared resources and massive amounts of data over the Internet. This course aims to provide an understanding of theory and systems aspects of distributed

Course Outcomes

Student will be able to

1. Describe the features added to modern database systems to distinguish them from standard relational systems.
2. Understand different algorithms used in the implementation of query evaluation engine
3. Understand the different concurrency control and commit protocols in distributed databases
4. Demonstrate an understanding of the role and the concepts involved in special purpose databases such as Temporal, Spatial, Mobile and other similar database types

UNIT-I

Distributed Data Storage Technology : Server-centric IT architecture and its limitations , Storage-centric IT architecture and its advantages , Architecture of intelligent disk subsystems, Hard disks and internal i/o channels and JBOD, Storage virtualization using RAID, Introduction to NAS, SAN and DAS

Distributed File Systems & Security : File Models & Accessing models , File sharing Semantics, File Caching, File Replication, Fault Tolerance, File System Security

UNIT - II

Distributed Databases: Distributed DBMS , Architectural Models for DDBS, Distributed DBMS Architecture , Distributed Data Sources

Distributed Database Design Issues & Integration : Framework of Distribution , Distributed Design Issues, Top-Down Design Process , Fragmentation, Allocation , Bottom-Up Design Methodology, Schema Matching , Schema Integration , Schema Mapping, Data Cleaning

UNIT –III

Data and Access Control : Database Security, Discretionary Access Control, Multilevel Access Control, Distributed Access Control, View Management, Views in Centralized DBMSs, Views in Distributed DBMSs , Maintenance of Materialized Views
Data Replication: Consistency of Replicated Databases, Update Management Strategies, Replication Protocols, Replication and failures, Replication Mediator Service.
Parallel Database Systems: Parallel Database System Architectures, Parallel Data Placement, Load Balancing, Database Clusters

UNIT – IV

Web Data Management : Web Graph Management, Web Search, Web Crawling , Indexing, Ranking and Link Analysis , Keyword Search, Web Querying, Semi-structured Data Approach, Web Query Language Approach, Question Answering, Searching and Querying the Hidden Web
Hadoop & Big Data : Introduction, Hadoop Architecture, HDFS Operations, HDFS Commands, Big Data Overview, Multi Node Cluster, Map Reduce

UNIT - V

Advanced Application Development: Performance Tuning, Performance Benchmarks Other Issues in Application Development, Standardization.

Spatial and Temporal Data and Mobility: Motivation, Time in Databases, Spatial and Geographic Data, Multimedia Databases, Mobility and Personal Databases.

Suggested Reading:

1. M. Tamer Özsu, Patrick Valduriez Principles of Distributed Database Systems Third Edition
2. Distributed Operating Systems: Concepts And Design By Pradeep K. Sinha
3. "Storage Networks Explained" – by Ulf Troppens, Wolfgang Muller-Freidt, Rainer Wolafka, IBM Storage Software Development, Germany. Publishers: Wiley
4. Abraham Silberschatz, Henry F Korth, S Sudarshan, Database System Concepts, McGrawHill International Edition, 6th Edition, 2010.
5. Elmasri Navathe, Somayajulu, Gupta, Fundamentals of Database Systems, Pearson Education, 4th Edition, 2006.
6. CJ Date, A Kannan, S Swamynathan, An Introduction to Database Systems, Pearson Education, 8th Edition, 2006.
7. Raghu Ramakrishnan, and Johannes Gehrke, Database Management Systems, McGraw-Hill International Edition, 3rd Edition, 2002.

OE 601BM

ENGINEERING APPLICATIONS IN MEDICINE
(Open Elective-I)

Instruction: 3 hrs per week | Duration of SEE: 3 hours
CIE: 30 Marks | SEE: 70 Marks
Credits: 3

COURSE OBJECTIVES:

- To make the students gain basic knowledge of Human Physiology.
- To make the students learn the applications of various branches of engineering in Medicine.

COURSE OUTCOMES: Upon the completion of the course, the students will be able to:

1. Describe the major organ systems of the human body
2. Understand the concepts of bioelectricity and medical instruments
3. Apply solid and fluid mechanics principles to joints and blood flow respectively
4. Learn the need and applications of BCI
5. Analyze and choose proper biomaterial for various applications

UNIT-I

Evolution of Modern healthcare, Major organ systems- Cardiovascular, Respiratory, Nervous, Skeletal, Muscular. Homeostasis. Physiological signals and their diagnostic importance.

UNIT-II

Bioelectricity-Excitable cells, Resting potential, Action potential, Accommodation, Strength-Duration Curve, Propagation of impulses in myelinated and unmyelinated nerves.
Medical Instrumentation System-Functions, Characteristics, Design Challenges.
Signal Processing-QRS detection.

UNIT-III

Solid mechanics-Analysis of muscle force and joint reaction force for the limb joints.
Fluid mechanics-Factors governing and opposing blood flow, Wind-Kessel model, Application of Hagen-Poiseuille flow to blood flow.

UNIT-IV

Brain-Computer Interface: Brain signals for BCIs, Generic setup for a BCI, Feature extraction and Feature translation involved in BCIs. Typical applications-Word forming, Device control.

UNIT-V

Materials and Tissue Replacements-Types of Biomaterials- Metals, Polymers, Ceramics and Composites and their applications in Soft and Hard tissue replacements. Implants- Manufacturing process, Design, fixation.

Suggested Reading:

1. John Enderle, Susan M. Blanchard and Joseph Bronzino, *Introduction to Biomedical Engineering*, Second Edition, Elsevier, 2005.
2. Ozkaya, Nordin. M, *Fundamentals of Biomechanics*, Springer International Publishing, 4th Edition, 2017.
3. Khandpur R.S., *Handbook of Biomedical Instrumentation*, Tata McGraw Hill, 2016.
4. John G.Webster, *Medical Instrumentation: Application and Design*, John Wiley and Sons Inc., 3rd Ed., 2003.

OE 602CE

DISASTER MANAGEMENT
(Open Elective-I)

Instruction: 2+1 periods per week *Duration of SEE : 3 hours*
CIE: 30 marks *SEE: 70 marks*
Credits: 3

Course Objectives:

- To introduce basic conceptual understanding of natural & man-made hazards and different contextual aspects.
- To develop the knowledge and understanding of the International and national strategy for disaster reduction (UN-ISDR)
- To ensure skills and abilities to analyze potential effects of disasters and of the strategies and methods to deliver public health response to avert these effects.
- To promote the use of science and technology for implementing the disaster risk reduction (DRR) plans and policies.

Course Outcomes:

1. Aptitude to link hazards, risk, vulnerability, differential impacts and capacity building to the life and property loss during disasters and its impacts on the society and sustainability.
2. Ability to understand various aspects of natural and man-made hazards and emerging trends
3. Acquaintance with different steps involved in disaster risk reduction (DRR) and international initiatives for prevention, mitigation and preparedness.
4. Knack to appreciate the national policy and role of individuals, communities, and government organizations in disaster management.
5. Capacity to identifying current technological constraints and hazard specific solutions, particularly construction codes etc.

UNIT I: INTRODUCTION TO DISASTER

- Understanding the Concepts, Definitions and Terminologies used in the field of Disaster Management (i.e. Hazard, Risk, Vulnerability, Resilience, and Capacity Building).
- Differential impacts of Disasters in terms of Gender, Age, Social Status, Location, Prosperity, Disabilities.
- Disaster- Development Nexus.

UNIT II: TYPES of HAZARDS AND EMRGING TRENDS

- Classification, Causes, Consequences and Controls of
  - I) Geophysical hazards-Earthquakes, Landslides, Tsunami
  - II) Weather related hazards- Meteorological (Cyclones, Storm-surge and Lighting)
    Hydrological (Floods, Droughts, Avalanches)
    Climatological (Wildfire, Cold & Heat Waves)
  - III) Biological hazards-Epidemic & Pandemics,
  - IV) Technological hazards-Chemical, Industrial, Nuclear
  - V) Man-made hazards-Structural Failure, Fire, Transportation accidents, Terrorism and Wars
- Emerging Disasters- Urban Areas, Climate Change.
- Regional and Global Trends-loss of life & Property in various hazards

UNIT III: DISASTER MANAGEMENT CYCLE AND INTERNATIONAL FRAMEWORK

- Disaster Management Cycle
  Pre-Disaster – Risk Assessment and Analysis, Risk Mapping, zonation and Microzonation, Prevention and Mitigation of Disasters, Early Warning System; Preparedness, Capacity Development; Awareness
  During Disaster – Evacuation – Disaster Communication – Search and Rescue– Emergency Operation Centre – Incident Command System – Relief and Rehabilitation –
  Post-disaster – Damage and Needs Assessment, Restoration of Critical Infrastructure – Early Recovery – Reconstruction and Redevelopment
- Paradigm Shift in Disaster Management: International Decade for Natural Disaster Reduction; Yokohama Strategy; Hyogo Framework of Action

UNIT IV: DISASTER RISK MANAGEMENT IN INDIA

- Disaster Profile of India – Mega Disasters of India and Lessons Learnt
- Disaster Management Act 2005 – Institutional and Financial Mechanism
- National Policy on Disaster Management,
- National Guidelines and Plans on Disaster Management;
- Role of Government (local, state and national),Non-Government and Inter-governmental Agencies

UNIT V: TECHNOLOGICAL APPROACHES TO DISASTER RISK REDUCTION

- Geo-informatics in Disaster Management (RS, GIS, GPS and RS)
- Disaster Communication System (Early Warning and Its Dissemination)
- Land Use Planning and Development Regulations
- Disaster Safe Designs and Constructions
- Structural and Non Structural Mitigation of Disasters
- Science &Technology Institutions for Disaster Management in India

Suggested Books/ Material/ References

1. Coppola D P, 2007. Introduction to International Disaster Management, Elsevier Science (B/H), London.
2. Manual on natural disaster management in India, M C Gupta, NIDM, New Delhi
3. An overview on natural & man-made disasters and their reduction, R K Bhandani, CSIR, New Delhi
4. World Disasters Report, 2009. International Federation of Red Cross and Red Crescent, Switzerland
5. Disasters in India Studies of grim reality, Anu Kapur & others, 2005, 283 pages, Rawat Publishers, Jaipur
6. 10 Disaster Management Act 2005, Publisher by Govt. of India
7. Publications of National Disaster Management Authority (NDMA) on Various Templates and Guidelines for Disaster Management
8. National Disaster Management Policy, 2009, GoI

OE 603EC

ELECTRONIC INSTRUMENTATION

(Open Elective-I)

Instruction: 3 periods per week *Duration of SEE: 3 hours*
CIE: 30 marks *SEE: 70 marks*
Credits: 3

Course Objectives:

- To familiarize with various measurement parameters and Standards of measurement.
- To learn the working principles of various types of Microphones and Hygrometers.
- To understand the operation and applications of CRO.
- To understand about the operation of various transducers.
- To understand the importance of biomedical instrumentation and Virtual instrumentation.

Course Outcomes:

1. Analyze the various characteristics of measurement parameters and Standards of measurement.
2. Evaluate the operation and application of microphones
3. Use the CROs for various applications and explore its features.
4. Explore various types of Transducers and their characteristics.
5. Analyze the operation of various biomedical instruments and the features of Virtual Instrumentation.

UNIT – I

Measurement parameters: History of instrumentation. Error in Measurement, Types ofErrors, Statistical analysis of errors, Limiting errors, Standards of measurement, IEEE and ISO standards.

UNIT – II

Microphones and Hygrometers: Microphones: Microphones and their types, Humidity measurement, resistive, capacitive, aluminium-oxide and crystal Hygrometer types – Operation and applications.

UNIT – III

CRO: Basic Principle of CRT, its features, Block diagram and operation of CRO, Oscilloscope Controls, Waveform display, Measurement of frequency and Phase using Lissajous method, Applications and Advantages of CRO.

UNIT –IV

Transducers: Introduction, Electrical Transducer, Factors for Selecting a Transducer, Active and Passive Transducers, Operation and applications of Resistive transducers, Strain gauges and Thermistors.

UNIT –V

Biomedical and Virtual Instrumentation: Biomedical instrumentation, Bio-potential electrodes, Principles of operation and applications of ECG, EEG, EMG, X-ray machines, CT scanners and Introduction to virtual instrumentation.

Suggested Reading:

1. Albert D.Helfrick and William D.Cooper, *"Modern Electronic Instrumentation and Measurement Techniques",* Prentice-Hall of India Private Limited, New Delhi, 1996.
2. H S Klasi, *"Electronic Instrumentation", Tata* McGraw-Hill Company Limited, New Delhi, 2004.
3. David A.Bell, *"Electronic Instrumentation and Measurements",* 2nd Edition, Prentice-Hall of India Private Limited, New Delhi, 1994.
4. R.S.Khandpur, *"Handbook of biomedical Instrumentation",* Tata McGraw- Hill publishing company Limited, New Delhi, 2000.

OE 604EC

PRINCIPLES OF ELECTRONIC COMMUNICATION SYSTEMS
(Open Elective-I)

Instruction: 3 periods per week *Duration of SEE: 3 hours*
CIE: 30 Marks *SEE: 70 Marks*
Credits: 3

Course Objectives:

- Provide an introduction to fundamental concepts in the understanding of communications systems.
- Provide an introduction to network model and some of the network layers including physical layer, data link layer, network layer and transport layer.
- Provide an introduction to the evolution of wireless systems and current wireless technologies.

Course Outcomes: Student will be able to

1. Understand the working of analog and digital communication systems
2. Understand the OSI network model and the working of data transmission
3. Understand the concepts of modulation and demodulations
4. Understand the evolution of communication technologies from traditional telephony systems to modern wireless communication systems.
5. Understand the principles of optical communications systems

UNIT- I

Introduction to communication systems: Electromagnetic Frequency Spectrum, Signal and its representation, Elements of Electronic Communications System, Types of Communication Channels, Signal Transmission Concepts-Baseband transmission and Broadband transmission, Communication parameters-Transmitted power, Channel bandwidth and Noise, Need for modulation Signal Radiation and Propagation-Principle of electromagnetic radiation, Types of Antennas, Antenna Parameters and Mechanisms of Propagation.

UNIT- II

Analog and Digital Communications: Amplitude modulation and demodulation, FM modulation and demodulation, Digital converters, Digital modulation schemes – ASK, FSK, PSK, QPSK, Digital demodulation.

UNIT- III

Data Communication and Networking: Network Models, OSI Model, Data Link Layer – Media Access control, Ethernet, Network Layer – Internet Protocol (IPv4/IPv6), Transport Layer – TCP, UDP.

UNIT- IV

Telecommunication Systems: Telephones, Telephone system, Paging systems, Internet Telephony. Optical Communications: Optical Principles, Optical Communication Systems, Fiber –Optic Cables, Optical Transmitters & Receivers, Wavelength Division Multiplexing.

UNIT- V

Wireless Communications: Evolution of Wireless Systems: AMPS, GSM, CDMA, WCDMA, And OFDM. Current Wireless Technologies: Wireless LAN, Bluetooth, PAN and ZigBee, Infrared wireless, RFID communication, UWB, Wireless mesh networks, Vehicular adhoc networks.

Suggested Readings:

1. Louis E. Frenzel, "*Principles of Electronic Communication Systems*", 3e, McGraw Hill publications, 2008.
2. Behrouz A. Forouzan,*"Data Communications and Networking",* 5e TMH, 2012.
3. Kennady, Davis, "*Electronic Communications systems*", 4e, TMH, 1999.

OE 605ME

3D PRINTING TECHNOLOGY
(Open Elective-I)

Instructions: (3L) hrs per week *Duration of SEE: 3hours*
CIE: 30 Marks *SEE: 70 Marks*
Credits: 3

Course Objectives:

- To understand the fundamental concepts of 3D Printing, its advantages and limitations.
- To know the working principle, advantages, disadvantages and applications of liquid, solid and Powder based 3D Printing Technologies.
- To know the various types of STL file errors and other data formats used in 3D Printing Technology.
- To know the features of various 3D Printing software's.
- To know diversified applications of 3D Printing Technologies.

Course Outcomes: At the end of the course the student will be able to:

1 Interpret the features of 3D Printing and compare it with conventional methods.
2 Illustrate the working principle of liquid, solid and powder based 3D Printing Technologies.
3 Identify various types of errors in STL file and other data formats used in 3D Printing Technology.
4 Select suitable software used in 3D Printing Technology.
5 Apply the knowledge of various 3D Printing technologies for developing innovative applications.

UNIT-I

Introduction: Prototyping fundamentals: Need for time compression in product development, Historical development, Fundamentals of 3D Printing, 3D Printing Process Chain, Advantages and Limitations of 3D Printing, 3D Printing wheel, Commonly used Terms, Classification of 3D printing processes, Fundamental Automated Processes: Distinction between 3D Printing and Conventional Machining Processes.

UNIT-II

Liquid-based 3D Printing Systems: Stereo Lithography Apparatus (SLA): Models and specifications, Process, working principle, photopolymers, photo polymerization, Layering technology, laser and laser scanning, Applications, Advantages and Disadvantages, Case studies. Polyjet: Models and specifications, Process, working principle, Applications, Advantages and Disadvantages, Case studies

Solid-based 3D Printing System: Laminated Object Manufacturing (LOM): Models and specifications, Process, working principle, Applications, Advantages and Disadvantages, Case studies. Fused Deposition Modeling (FDM): Models and specifications, Process, working principle, Applications, Advantages and Disadvantages, Case studies.

UNIT-III

Powder Based 3D Printing Systems: Working principle, Specifications, Materials used, Process, Applications, Advantages and Disadvantages, Case studies of the following 3D Printing Technologies like Selective laser sintering (SLS), Selective Laser Melting (SLM) and Direct Metal Laser Sintering (DMLS), Laser Engineered Net Shaping (LENS), Electron Beam Melting (EBM),

UNIT-IV

3D Printing Data Formats & Software: STL Format, STL File Problems, Consequence of Building Valid and Invalid Tessellated Models, STL file Repairs: Generic Solution, Other Translators, Newly Proposed Formats. 3D Printing Software's Features: Magics, Mimics, Solid View, View Expert, 3 D Rhino, 3 D doctor, Flash Print, Object Studio, Cura, ITK Snap, 3-matic, Simplant, 3-matic, Simplant, MeshLab, Ansys for Additive Manufacturing.

UNIT-V

Applications of 3D Printing : Application in Design, Application in Engineering, Analysis and Planning, Aerospace Industry, Automotive Industry, Electronic Industry, Jewellery Industry, Coin Industry, GIS application, Arts and Architecture. RP Medical and Bioengineering Applications: Planning and simulation of complex surgery, Customized Implants & Prosthesis, Design and Production of Medical Devices, Forensic Science and Anthropology, Visualization of Biomolecules. Biopolymers, Packaging, Disaster Management, Entertainment and Sports industry.

Suggested Readings:

1. Chee Kai Chua and Kah Fai Leong, "3D Printing and Additive Manufacturing Principles and Applications" Fifth Edition, World scientific
2. Additive Manufacturing Technologies: 3D Printing, Rapid Prototyping, and Direct Digital Manufacturing- Ian Gibson, David W Rosen, Brent Stucker, Springer, Second Edition, 2010.
3. Rapid Prototyping & Engineering Applications – Frank W.Liou, CRC Press, Taylor & Francis Group, 2011.
4. Rafiq Noorani, Rapid Prototyping: Principles and Applications in Manufacturing, John Wiley & Sons, 2006.
5. NPTEL Course on Rapid Manufacturing. https://nptel.ac.in/courses/112/104/112104265/

OE 606ME

FINITE ELEMENT METHOD
(Open Elective-I)

Instructions: (3L) hrs per week *Duration of SEE: 3hours*
CIE: 30 Marks *SEE: 70 Marks*
Credits: 3

Course Objectives:

- To understand the theory and application of the finite element method for analyzing structural systems.
- To learn Approximation theory for structural problems as the basis for finite element methods.
- To learn formulations for a variety of elements in one, two, and three dimensions. Implementations of element formulations will be examined using Matlab.
- To understand modeling and analysis of structures using planar, solid, and plate elements

Course Outcomes: Upon successful completion of this course, the student will be able to:

1 Demonstrate a basic understanding of the concepts, mathematical formulation and numerical implementation.
2 Demonstrate the ability to invoke appropriate assumptions, select proper elements and develop FEA models that adequately and efficiently represent physical systems.
3 Underlying the FEA as applied to solid mechanics.
4 Solve 2D vector variable problems and analyze higher order elements and its applications.
5 Create his/her own FEA computer programs using Matlab to solve simple engineering problems.

UNIT-I: INTRODUCTION

Historical Background – Mathematical Modeling of field problems in Engineering – Governing Equations – Discrete and continuous models – Boundary, Initial and Eigen Value problems– Weighted Residual Methods – Variational Formulation of Boundary Value Problems – Ritz Technique – Basic concepts of the Finite Element Method.

UNIT-II : ONE-DIMENSIONAL PROBLEMS

One Dimensional Second Order Equations – Discretization – Element types- Linear and Higher order Elements – Derivation of Shape functions and Stiffness matrices and force vectors- Assembly of Matrices – Solution of problems from solid mechanics and heat transfer. Longitudinal vibration frequencies and mode shapes.

UNIT-III TWO DIMENSIONAL SCALAR VARIABLE PROBLEMS

Second Order 2D Equations involving Scalar Variable Functions – Variational formulation –Finite Element formulation – Triangular elements – Shape functions and element matrices and vectors. Application to Field Problems – Thermal problems – Torsion of Non circular shafts –Quadrilateral elements – Higher Order Elements.

UNIT-IV TWO DIMENSIONAL VECTOR VARIABLE PROBLEMS

Equations of elasticity – Plane stress, plane strain and axisymmetric problems – Body forces and temperature effects – Stress calculations – Plate and shell elements.

UNIT-V ISOPARAMETRIC FORMULATION

Natural co-ordinate systems – Isoparametric elements – Shape functions for iso parametric elements – One and two dimensions – Serendipity elements – Numerical integration and application to plane stress problems – Matrix solution techniques – Solutions Techniques to Dynamic problems – Introduction to Analysis Software.

Suggested Reading:

1. Tirupathi R. Chandraputla and Ashok, D. Belgundu" Introduction to Finite Elements in Engineering", Pearson Education, 2002, 3rd Edition.
2. Rao S.S., "The Finite Element Methods in Engineering", pergamon Press, 1989.
3. Segerlind, L.J. "Applied Finite Element Analysis", Wiley Publication, 1984.
4. Reddy J.N., "An Introduction to Finite Element Method", McGraw-Hill Company, 1984.

PC 651 CS

COMPLIER DESIGN LABORATORY

Instruction: 2 periods per week *Duration of SEE: 3hours*
CIE: 25 marks *SEE: 50 marks*
Credits: 1

Course Objectives:

- To learn usage of tools LEX, YAAC
- To develop a code generator
- To implement different code optimization schemes

Course Outcomes:

Student will be able to:

1. To Generate scanner and parser from formal specification
2. To design a compiler for a subset of any High level language

List of programs suggested :

1. Construction of DFA from NFA
2. Scanner program using LEX
3. Construction of a Predictive parsing Table
4. SLR Parser table generation
5. Implement unification Algorithm
6. LR Parser table generation
7. Parser Generation using YACC
8. Write a program on code generation
9. Write a program on code optimization

PC 652 CS

COMPUTER NETWORKS LABORATORY

Instruction: 2 periods per week *Duration of SEE: 3hours*
CIE: 25 marks *SEE: 50 marks*
Credits: 1

Course Objectives:

- To familiarize POSIX: IPC
- To use socket interface to write client-server network applications
- To effectively use sockets to write simple network monitoring tools

Course Outcomes:

Student will be able to:

1. Write concurrent programs using message queues and semaphores
2. Use connection-oriented , connectionless and Asynchronous sockets
3. Implement networked applications in TCP/IP protocol Suite

1. Examples using IPC
2. Echo Server using TCP (Concurrent or Iterative) and UDP
3. Time of the day server
4. Talker and Listener
5. Ping routine
6. Trace route
7. Mini DNS

Note: The above experiments [2-7] have to be carried out using socket programming interface. Multi- threading has to be employed wherever it is required.

PC 653 CS

MINI PROJECT

Instruction: 6 Periods per week *CIE: 50 Marks*
Credits: 3

Course Objectives:

- To enhance practical and professional skills.
- To expose the students to industry practices and team work.
- To encourage students to work with innovative and entrepreneurial ideas

Course Outcomes:

Student will be able to:

1. Demonstrate the ability to synthesize and apply the knowledge and skills acquired in the academic program to real-world problems
2. Evaluate different solutions based on economic and technical feasibility
3. Effectively plan a project and confidently perform all aspects of project management
4. Demonstrate effective written and oral communication skills

The department can initiate the project allotment procedure at the end of V semester and finalize it in the first two weeks of VI semester.
The department will appoint a project coordinator who will coordinate the following:

Collection of project topics/ descriptions from faculty members (Problems can also be invited from the industries)
Grouping of students (max 3 in a group)
Allotment of project guides

The aim of mini project to develop solutions to realistic problems applying the knowledge and skills obtained in different courses, new technologies and current industry practices. This requires students to understand current problems in their domain and methodologies to solve these problems. To get awareness on current problems and solution techniques, the first 2 weeks of VI semester will be spent on special lectures by faculty members, research scholars, post graduate students of the department and invited lectures by engineers from industries and R&D institutions. After completion of these seminars each group has to formalize the project proposal based on their own ideas or as suggested by the project guide.
Seminar schedule will be prepared by the coordinator for all the students from the 5th week to the last week of the semester which should be strictly adhered to.

Each group will be required to:

1. Submit a one page synopsis before the seminar for display on notice board.
2. Give a 30 minutes presentation followed by 10 minutes discussion.
3. Submit a technical write-up on the talk.

At least two teachers will be associated with the Mini Project to evaluate students for the award of sessional marks which will be on the basis of performance in all the 3 items stated above.

The seminar presentation should include the following components of the project:
*Problem definition and specification
*Literature survey
*Broad knowledge of available techniques to solve a particular problem.
*Planning of the work, preparation of bar (activity) charts
*Presentation- oral and written.

PW 961 CS

SUMMER INTERNSHIP*

Instruction: 6 weeks *CIE: 50 marks*
Credit: 2

Course Objectives:

- To train and provide hands-on experience in analysis, design, and programming of information systems by means of case studies and projects.
- To expose the students to industry practices and team work.
- To provide training in soft skills and also train them in presenting seminars and technical report writing.

Course Outcomes:
Student will be able to :

1. Get Practical experience of software design and development, and coding practices within Industrial/R&D Environments.
2. Gain working practices within Industrial/R&D Environments.
3. Prepare reports and other relevant documentation.

Summer Internship is introduced as part of the curricula of encouraging students to work on problems of interest to industries. A batch of three students will be attached to a person from the Computer Industry/Software Companies/R&D Organization for a period of 8 weeks. This will be during the summer vacation following the completion of the III year Course. One faculty coordinator will also be attached to the group of 3 students to monitor the progress and to interact with the industry co-ordinate (person from industry).

After the completion of the project, student will submit a brief technical report on the project executed and present the work through a seminar talk to be organized by the Department. Award of sessionals are to be based on the performance of the students, to be judged by a committee constituted by the department. One faculty member will co-ordinate the overall activity of Industry Attachment Program.

***Students have to undergo summer internship of 6 Weeks duration at the end of semester VI and the credits will be awarded after evaluation in VII semester.**