

**PUNJABI UNIVERSITY, PATIALA**

**SYLLABI  
OUTLINES OF TESTS,  
AND COURSES OF READINGS**

**FOR**

**M. TECH. (COMPUTER SCIENCE AND ENGINEERING)**

**FIRST YEAR**

**(SEMESTER FIRST and SEMESTER SECOND)**

**Sessions 2018-19 and 2019-20**

**CHOICE-BASED CREDIT SYSTEM**

**(As per RUSA Guidelines)**

**PUNJABI UNIVERSITY,  
PATIALA 147002**

**SYLLABI  
OUTLINES OF PAPERS AND TESTS**

**M. TECH. (COMPUTER SCIENCE AND ENGINEERING)**

**FIRST YEAR- FIRST SEMESTER  
SESSIONS 2018-19 & 2019-2020**

Paper Code	Title of Paper	L	T	P	C	Internal Marks		External Marks	
						Max	Pass	Max	Pass
CS-611	Object Oriented Programming Using C++	5	0	0	5	50	20	50	20
CS-612	Operating Systems	5	0	0	5	50	20	50	20
CS-613	Computer Architecture	5	0	0	5	50	20	50	20
CS-614	Data Structures & Algorithms	5	0	0	5	50	20	50	20
CS-615	*Elective	5	0	0	5	50	20	50	20
CS-616	Software Lab – I (C++ and Data Structures)	0	0	6	3	60	24	40	16
	Total	25	0	6	28	310		290	

**\*List of Electives:** Any one of the following papers:

Paper Code	Title of Paper
CS-615 E1	Relational Database Management System
CS-615 E2	Business Intelligence
CS-615 E3	Statistical Computing
CS-615 E4	Communication Networks
CS-615 E5	Data Mining and Data Warehousing
CS-615 E6	Virtualization and Cloud Computing

**\*Note:** The electives will be offered to the students depending upon the availability of the teachers. The decision of the Head of the Department in this respect will be final. Student can also opt for any MOOC as an elective in place of the above offered electives. The list of MOOCs must be passed by the ACD.

**CONTINUOUS ASSESSMENT (THEORY PAPERS)**

1.	Two tests will be conducted during the Semester. Both the tests will be considered for assessment.	:	60% of the marks allotted for Continuous Assessment
2.	Assignment/Quizzes	:	20% of the marks allotted for Continuous Assessment
3.	Attendance	:	10% of the marks allotted for Continuous Assessment.
4.	Class Participation and behaviour	:	10% of the marks allotted for Continuous Assessment.

**CONTINUOUS ASSESSMENT (PRACTICAL LAB)**

1.	Two tests will be conducted during the Semester. Both the tests will be considered for assessment.	:	60% of the marks allotted for Continuous Assessment
2.	Lab Assignment	:	30% of the marks allotted for Continuous Assessment
3.	Attendance	:	10% of the marks allotted for Continuous Assessment.

**SYLLABI  
OUTLINES OF PAPERS AND TESTS**

**M. TECH. (COMPUTER SCIENCE AND ENGINEERING)**

**FIRST YEAR - SECOND SEMESTER  
SESSIONS 2018-19 & 2019-2020**

Paper Code	Title of Paper	L	T	P	C	Internal Marks		External Marks	
						Max	Pass	Max	Pass
CS-621	Distributed Systems	5	0	0	5	50	20	50	20
CS-622	Research Methodology	5	0	0	5	50	20	50	20
CS-623	Artificial Intelligence	5	0	0	5	50	20	50	20
CS-624	Computer Graphics	5	0	0	5	50	20	50	20
CS-625	*Elective	5	0	0	5	50	20	50	20
CS-626	Software Lab – II (Computer Graphics)	0	0	6	3	60	24	40	16
	Total	25	0	6	28	310		290	

**\*List of Electives:** Any one of the following papers:

Paper Code	Title of Paper
CS-625 E1	Digital Signal Processing
CS-625 E2	Parallel Computing
CS-625 E3	Theory of Computation
CS-625 E4	Communication Protocols
CS-625 E5	Data Science
CS-625 E6	Multimedia Information Systems

**\*Note:** The electives will be offered to the students depending upon the availability of the teachers. The decision of the Head of the Department in this respect will be final. Student can also opt for any MOOC as an elective in place of the above offered electives. The list of MOOCs must be passed by the ACD.

**CONTINUOUS ASSESSMENT (THEORY PAPERS)**

1.	Two tests will be conducted during the Semester. Both the tests will be considered for assessment.	:	60% of the marks allotted for Continuous Assessment
2.	Assignment/Quizzes	:	20% of the marks allotted for Continuous Assessment
3.	Attendance	:	10% of the marks allotted for Continuous Assessment.
4.	Class Participation and behaviour	:	10% of the marks allotted for Continuous Assessment.

**CONTINUOUS ASSESSMENT (PRACTICAL LAB)**

1.	Two tests will be conducted during the Semester. Both the tests will be considered for assessment.	:	60% of the marks allotted for Continuous Assessment
2.	Lab Assignment	:	30% of the marks allotted for Continuous Assessment
3.	Attendance	:	10% of the marks allotted for Continuous Assessment.

**CS-611 : OBJECT ORIENTED PROGRAMMING USING C++****Maximum Marks: 50****Maximum Time: 3 Hrs.****Minimum Pass Marks: 40%****Lectures to be delivered: 50-60**

**Course Objective:** This course is designed to explore computing and to show students the art of computer programming. Students will be able to learn Understand object oriented programming and advanced C++ concepts for writing good programs. On completion of this course, the students will be able to

- Write, compile and debug programs in C++ language.
- Use different data types, operators and console I/O function in a computer program.
- Design programs involving decision control statements, loop control statements and case control structures.
- Understand the implementation of arrays, pointers and functions and apply the dynamics of memory by the use of pointers.
- Comprehend the concepts of structures and classes: declaration, initialization and implementation.
- Apply basics of object oriented programming, polymorphism and inheritance.
- Use the file operations, character I/O, string I/O, file pointers, pre-processor directives and create/update basic data files.

**Course Content****SECTION A**

Evolution of OOP: Procedure Oriented Programming, OOP Paradigm, Advantages and disadvantages of OOP over its predecessor paradigms. Characteristics of Object Oriented Programming: Abstraction, Encapsulation, Data hiding, Inheritance, Polymorphism, Code Extensibility and Reusability, User defined Data Types.

Introduction to C++: Identifier, Keywords, data types, Modifiers, Reference variables, Constants. Operators: Arithmetic, relational, logical, conditional and assignment, size of operator, operator precedence and associativity.

Type conversion, variable declaration, expressions, statements and manipulators. Input and output statements, stream I/O, Conditional and Iterative statements, breaking control statements.

Storage Classes: Automatic, Static, Extern, Register.

Arrays, Arrays as Character Strings, Structures, Unions, Bit fields, Enumerations and User defined types. Pointers: Pointer Operations, Pointer Arithmetic, Pointers and Arrays, Multiple indirections, Generic pointers

Functions: Prototyping, Definition and Call, Scope Rules. Parameter Passing: by value, by address and by reference, Functions returning references, recursion, function overloading, Default Arguments, Const arguments, Pointer to functions, Inline functions.

Command line arguments.

Pre-processor: #define, #error, #include, #if, #else, #elif, #endif, #ifndef, #ifnndef, #undef. Type casting: static\_cast, const\_cast, dynamic\_cast, reinterpret\_cast.

Classes and Objects: Class Declaration and Class Definition, Defining member functions, making functions inline, nesting of member functions, Members access control, const data members, Const member functions, this pointer, union as space saving classes. Objects: Object as function arguments, array of objects, functions returning objects.

Static data members and static member functions. Friend functions and Friend classes: Global functions as friends of class, member functions as friends of another class, class as friend of another class. Constructors: properties, types of constructors (Default, parameterized and copy), Dynamic constructors, multiple constructors in classes.

Destructors: Properties. Destroying objects. Rules for constructors and destructors.

Array of objects. Dynamic memory allocation using new and delete operators. Nested and container classes

Scopes: Local, Global, Namespace and Class,

**SECTION B**

Inheritance: Defining derived classes, inheriting private members, single inheritance, types of derivation, function redefining, constructors in derived class. Types of inheritance: Single, Multiple, Multilevel and Hybrid. Types of base classes: Direct, Indirect, Virtual, Abstract, Code reusability. Polymorphism: Methods of achieving polymorphic behaviour.

Operator overloading: overloading binary operator, overloading unary operators, rules for operator overloading, operator overloading using friend function. Function overloading: early binding,

Polymorphism with pointers, virtual functions, late binding, pure virtual functions and abstract base class, Virtual destructors. Difference between function overloading, redefining, and overriding.

Templates: Generic Functions and Generic Classes, Overloading of template functions. Exception Handling catching class types, handling derived class exceptions, catching exceptions, restricting exception, rethrowing exceptions, terminate and unexpected, uncaught exceptions. Files and streams: Classes for file stream operations, opening and closing of files, stream state member functions, binary file operations, structures and file operations, classes and file operations, I/O with multiple objects, error handling, sequential and random access file processing. STL: Containers, Algorithms, Iterators and RTTI.

### **Pedagogy:**

The Instructor is expected to use leading pedagogical approaches in the class room situation, research-based methodology, innovative instructional methods, extensive use of technology in the class room, online modules of MOOCS, and comprehensive assessment practices to strengthen teaching efforts and improve student learning outcomes.

The Instructor of class will engage in a combination of academic reading, analyzing case studies, preparing the weekly assigned readings and exercises, encouraging in class discussions, and live project based learning.

### **Case/Class Discussion Assignments:**

Students will work in groups of up to four to prepare a brief write-up due before the start of each class covering the case study or class material to be discussed in the next session. Questions may include a quantitative analysis of the problem facing the decision-maker in the case.

### **Class Participation:**

Attendance will be taken at each class. Class participation is scored for each student for each class.

**Text and Readings:** Students should focus on material presented in lectures. The text should be used to provide further explanation and examples of concepts and techniques discussed in the course:

- Herbert Schildt, “The Complete Reference C++”, Tata McGraw-Hill.
- Deitel and Deitel, “C++ How to Program”, Pearson Education.
- Robert Lafore, “Object Oriented Programming in C++”, Galgotia Publications.
- Bjarne Strastrup, “The C++ Programming Language”, Addison- Wesley Publication Co.
- Stanley B. Lippman, Josee Lajoie, “C++ Primer”, Pearson Education.
- E. Balagurusamy, “ Object Oriented Programming with C++”, Tata McGraw-Hill

### **Scheme of Examination**

- English will be the medium of instruction and examination.
- Written Examinations will be conducted at the end of each Semester as per the Academic Calendar notified in advance
- Each course will carry 100 marks of which 50 marks shall be reserved for internal assessment and the remaining 50 marks for written examination to be held at the end of each semester.
- The duration of written examination for each paper shall be three hours.
- The minimum marks for passing the examination for each semester shall be 40% in aggregate as well as a minimum of 40% marks in the semester-end examination in each paper.
- A minimum of 75% of classroom attendance is required in each subject.

### **Instructions to the External Paper Setter**

The external paper will carry 50 marks and would be of three hours duration. The question paper will consist of three sections A, B and C. Sections A and B will have four questions each from the respective sections of the syllabus and each question will carry 7.5 marks. Section C will consist of 10 short answer type questions of 2 marks each covering the entire syllabus uniformly and will carry 20 marks in all. Candidates will be required to attempt four questions in all from section A and B selecting not more than two questions from each of these groups. Section C shall be compulsory.

### **Instructions for candidates**

- Candidates are required to attempt five questions in all, selecting two questions each from section A and B and compulsory question of section C.

**CS-612: OPERATING SYSTEMS**

**Maximum Marks: 50**  
**Minimum Pass Marks: 40%**

**Maximum Time: 3 Hrs.**  
**Lectures to be delivered: 50-60**

**Course Objective:** This course is designed to make students familiar with role and purpose of the operating system, Functionality of a typical operating system and managing atomic access to operating systems objects. On completion of this course, the students will be able to

- Explain basic operating system concepts such as overall architecture, interrupts, APIs, user mode and kernel mode.
- Distinguish concepts related to concurrency including, synchronization primitives, race conditions, critical sections and multi-threading.
- Analyze and apply CPU scheduling algorithms, deadlock detection and prevention algorithms.
- Examine and categorize various memory management techniques like caching, paging, segmentation, virtual memory, and thrashing.
- Appraise high-level operating systems concepts such as file systems, security, protection, virtualization and device-management, disk-scheduling algorithms and various file systems.

**Course content****SECTION A**

Overview of Operating Systems: Goals of an OS, Types of Operating Systems, Operating system Components and Services.

Process Management: Process Concept, Process Scheduling, Operations, Co-operating Processes, Inter-Process Communication,

Threads: Thread Structure, Types of Threads: User Level, Kernel level and Hybrid Threads.

CPU Scheduling: Basic Concepts, Scheduling Criteria, Scheduling Algorithms, Algorithm Evaluation

Process Synchronization: The Critical Section Problem, Synchronization Hardware, Semaphores, Classical Problems of Synchronization, Critical Regions and Monitors.

Deadlocks: Deadlock Characterization, Deadlock Prevention, Deadlock Avoidance, Deadlock Detection and Recovery.

**SECTION B**

Memory Management: Swapping, Contiguous Memory Allocation Schemes, Paging, Segmentation, Segmentation with Paging.

Virtual Memory: Demand Paging, Page Replacement, Page Replacement Algorithms, Allocation of Frames, Thrashing.

File System Implementation: File System Structure, Allocation Methods, Free Space Management, Directory Implementation

Secondary Storage Structure: Disk Structure, Disk Scheduling, Disk Management.

Protection & Security: Goals, Domain of Protection, Access Matrix, The Security Problem, User Authentication, Program Threats, System Threats

Distributed File System: Naming and Transparency, Remote File Access, Stateful Versus Stateless Service

Distributed Coordination: Event Ordering, Mutual Exclusion, Atomicity, Concurrency Control, Deadlock Handling, Election Algorithm, Reaching Agreement.

**Pedagogy:**

The Instructor is expected to use leading pedagogical approaches in the class room situation, research-based methodology, innovative instructional methods, extensive use of technology in the class room, online modules of MOOCS, and comprehensive assessment practices to strengthen teaching efforts and improve student learning outcomes.

The Instructor of class will engage in a combination of academic reading, analyzing case studies, preparing the weekly assigned readings and exercises, encouraging in class discussions, and live project based learning.

**Case/Class Discussion Assignments:**

Students will work in groups of up to four to prepare a brief write-up due before the start of each class covering the case study or class material to be discussed in the next session. Questions may include a quantitative analysis of the problem facing the decision-maker in the case.

**Class Participation:**

Attendance will be taken at each class. Class participation is scored for each student for each class.

Text and Readings: Students should focus on material presented in lectures. The text should be used to provide further explanation and examples of concepts and techniques discussed in the course:

- Silberschatz and Galvin, "Operating System Concepts", Addison-Wesley publishing Co.
- D. M. Dhamdhere, "Operating Systems – A Concept Based Approach", Tata McGraw Hill.
- William Stallings, "Operating Systems", Pearson Education

**Scheme of Examination**

- English will be the medium of instruction and examination.
- Written Examinations will be conducted at the end of each Semester as per the Academic Calendar notified in advance
- Each course will carry 100 marks of which 50 marks shall be reserved for internal assessment and the remaining 50 marks for written examination to be held at the end of each semester.
- The duration of written examination for each paper shall be three hours.
- The minimum marks for passing the examination for each semester shall be 40% in aggregate as well as a minimum of 40% marks in the semester-end examination in each paper.
- A minimum of 75% of classroom attendance is required in each subject.

**Instructions to the External Paper Setter**

The external paper will carry 50 marks and would be of three hours duration. The question paper will consist of three sections A, B and C. Sections A and B will have four questions each from the respective sections of the syllabus and each question will carry 7.5 marks. Section C will consist of 10 short answer type questions of 2 marks each covering the entire syllabus uniformly and will carry 20 marks in all. Candidates will be required to attempt four questions in all from section A and B selecting not more than two questions from each of these groups. Section C shall be compulsory.

**Instructions for candidates**

- Candidates are required to attempt five questions in all, selecting two questions each from section A and B and compulsory question of section C.
- Use of non-programmable scientific calculator is allowed.

## CS-613: COMPUTER ARCHITECTURE

**Maximum Marks: 50**  
**Minimum Pass Marks: 40%**

**Maximum Time: 3 Hrs.**  
**Lectures to be delivered: 50-60**

**Course Objective:** This course is designed to make students familiar with the architecture and organization of the basic computer modules viz controls unit, central processing unit, input-output organization and memory unit. On completion of this course, the students will be able to

- To conceptualize the basics of organizational and architectural issues of digital computer
- To analyze performance issues in processor and memory design of digital computer
- To understand various data transfer techniques in digital computers.
- To analyze processor performance improvement using instruction level parallelism

### Course content

#### SECTION A

Introduction to Computer Systems: CPU: Register and bus organized computers, stacks, ALU, instruction execution, control unit organization. Hardwired and Microprogrammed control. Instruction types, formats and addressing modes. Data representation, Error detection and Correction.

Design of Controller: Structure of Control unit, Hardwired Control, Design examples, Microprogrammed Control, Parallelism, Horizontal Vs Vertical, Addressing, timing cycles and clock generation. Organization of Microprogram based control unit. Concepts of RISC & comparison with CISC processing.

#### SECTION B

Memory Organization: Types of memories: Random access, serial access and semi random access. Core semiconductor and bubble memories, Multi-level memory systems, address translation and memory allocation: non-preemptive allocation, preemptive allocation, replacement policies, Caches: organization, address mapping, levels, structure vs. performance : cache types, performance and design process.

Parallel Processing: types of parallelism, performance considerations. Pipelined Control: Instruction pipeline, principles of linear programming, general pipelines and reservation tables, interleaved memory organization, instruction & arithmetic pipelines, design examples, multi-function and array pipelines, Pipeline processor design principles: pre -fetch and branch handling, data buffering, busing structure, register tagging, hazard detection, job sequencing and collision prevention. Vector Processing: requirements, characteristics. Multiprocessors: types, MINs: Fault tolerance, reliability, performance.

#### **Pedagogy:**

The Instructor is expected to use leading pedagogical approaches in the class room situation, research-based methodology, innovative instructional methods, extensive use of technology in the class room, online modules of MOOCS, and comprehensive assessment practices to strengthen teaching efforts and improve student learning outcomes.

The Instructor of class will engage in a combination of academic reading, analyzing case studies, preparing the weekly assigned readings and exercises, encouraging in class discussions, and live project based learning.

#### **Case/Class Discussion Assignments:**

Students will work in groups of up to four to prepare a brief write-up due before the start of each class covering the case study or class material to be discussed in the next session. Questions may include a quantitative analysis of the problem facing the decision-maker in the case.

#### **Class Participation:**

Attendance will be taken at each class. Class participation is scored for each student for each class.

**Text and Readings:** Students should focus on material presented in lectures. The text should be used to provide further explanation and examples of concepts and techniques discussed in the course:

- John P. Hayes: “Computer Architecture and Organization”, McGraw-Hill International Edition.
- Kai Hwang and F.A. Briggs: “Computer Architecture and Parallel Processing”, McGraw Hill International Edition.
- John P. Hayes: “Computer Architecture and Organization”, McGraw-Hill International Edition.
- Stallings: “Computer Organization and Architecture”, Pearson Education, Asia.
- A.S. Tanenbaum: “Structured Computer Organization”, PHI.
- Jyotsna Sengupta, “Fundamentals of Computer Organization and Architecture”, Deep & Deep Publications
- Jyotsna Sengupta, "Interconnection Networks for Parallel Processing", Deep & Deep Publications.

#### **Scheme of Examination**

- English will be the medium of instruction and examination.
- Written Examinations will be conducted at the end of each Semester as per the Academic Calendar notified in advance
- Each course will carry 100 marks of which 50 marks shall be reserved for internal assessment and the remaining 50 marks for written examination to be held at the end of each semester.
- The duration of written examination for each paper shall be three hours.
- The minimum marks for passing the examination for each semester shall be 40% in aggregate as well as a minimum of 40% marks in the semester-end examination in each paper.
- A minimum of 75% of classroom attendance is required in each subject.

#### **Instructions to the External Paper Setter**

The external paper will carry 50 marks and would be of three hours duration. The question paper will consist of three sections A, B and C. Sections A and B will have four questions each from the respective sections of the syllabus and each question will carry 7.5 marks. Section C will consist of 10 short answer type questions of 2 marks each covering the entire syllabus uniformly and will carry 20 marks in all. Candidates will be required to attempt four questions in all from section A and B selecting not more than two questions from each of these groups. Section C shall be compulsory.

#### **Instructions for candidates**

- Candidates are required to attempt five questions in all, selecting two questions each from section A and B and compulsory question of section C.
- Use of non-programmable scientific calculator is allowed

**CS-614: DATA STRUCTURES & ALGORITHMS**

**Maximum Marks: 50**  
**Minimum Pass Marks: 40%**

**Maximum Time: 3 Hrs.**  
**Lectures to be delivered: 50-60**

**Course Objective:** This course is designed to make students familiar with the advanced concepts of data structure and algorithms and its implementation. The course has the main ingredients required for a computer science graduate and has all the necessary topics for assessment of data structure and algorithms. On completion of this course, the students will be able to

- Impart the basic concepts of data structure and algorithms.
- Understand the concepts about searching and sorting techniques.
- Understood the basic concepts about stacks, queues, linked lists, trees and graphs.
- Understand about writing algorithms and step by step approach in solving problems with the help of fundamental data structure.

**Course content****SECTION A**

Data Structure: Introduction to data structure and algorithm.

Algorithm analysis: Time space trade off algorithms and Big O notation, efficiency of algorithms, Worst case and average case analysis.

Arrays: Introduction, one dimensional and multidimensional arrays, memory representation of arrays, operations on arrays, sparse arrays and sparse matrices and their implementation, Advantages and limitation of arrays.

Stacks: Introduction; Operation on stacks; Implementation of stacks.

Application of stacks: matching parenthesis, evaluation of arithmetic expressions, conversion from infix to postfix, recursion.

Queues: introduction, operation on queues, circular queue, memory representation of queues, priority queues, application of queues.

Linked List: Introduction; operation on linked list, circular linked list, doubly linked list, header linked list, implementation of linked list, application of linked lists.

Trees: Introduction; Binary Tree; Threaded Binary Trees; Binary Search Tree; AVL Trees, Balanced Trees; B-Trees, Heap.

**SECTION B**

Graphs: Introduction, Graph terminology. Memory Representation of Graphs: adjacency matrix representation of graphs, adjacency list or linked representation of graphs.

Operations performed on graphs: Breadth-first and Depth-first search, Dijkstra Shortest Path algorithm, Minimum Spanning Tree, Kruskal Algorithm, Prims Algorithms, Application of graphs.

Hashing: Hashing techniques; Collision resolution; open addressing, chaining; Application of hashing.

Sorting: Selection Sort, Insertion Sort, Merge Sort, Bucket Sort, Radix Sort, Quick Sort and Heap Sort, External Sorting techniques. Lower bound for sorting, Decision Trees.

Algorithm Design Techniques: Divide and Conquer Algorithms, Greedy Algorithms, Dynamic

Programming, Back Tracking Algorithms.

**Pedagogy:**

The Instructor is expected to use leading pedagogical approaches in the class room situation, research-based methodology, innovative instructional methods, extensive use of technology in the class room, online modules of MOOCs, and comprehensive assessment practices to strengthen teaching efforts and improve student learning outcomes.

The Instructor of class will engage in a combination of academic reading, analyzing case studies, preparing the weekly assigned readings and exercises, encouraging in class discussions, and live project based learning.

**Case/Class Discussion Assignments:**

Students will work in groups of up to four to prepare a brief write-up due before the start of each class covering the case study or class material to be discussed in the next session. Questions may include a quantitative analysis of the problem facing the decision-maker in the case.

**Class Participation:**

Attendance will be taken at each class. Class participation is scored for each student for each class.

**Text and Readings:** Students should focus on material presented in lectures. The text should be used to provide further explanation and examples of concepts and techniques discussed in the course:

- M. A. Weiss, "Data Structures and Algorithm Analysis in C++, Pearson Education.
- Tanenbaum, Y. Lanhgsam and A. J. Augenstein, "Data Structures Using C", Prentice Hall of India.
- CORMAN, Introduction to Algorithms
- S. Sahni, "Data Structures, Algorithms and Application in C++, McGraw-Hill.
- Donald Knuth : Fundamental Algorithms. Vol-1
- Donald Knuth : Sorting & Searching. Vol-3

**Scheme of Examination**

- English will be the medium of instruction and examination.
- Written Examinations will be conducted at the end of each Semester as per the Academic Calendar notified in advance
- Each course will carry 100 marks of which 50 marks shall be reserved for internal assessment and the remaining 50 marks for written examination to be held at the end of each semester.
- The duration of written examination for each paper shall be three hours.
- The minimum marks for passing the examination for each semester shall be 40% in aggregate as well as a minimum of 40% marks in the semester-end examination in each paper.
- A minimum of 75% of classroom attendance is required in each subject.

**Instructions to the External Paper Setter**

The external paper will carry 50 marks and would be of three hours duration. The question paper will consist of three sections A, B and C. Sections A and B will have four questions each from the respective sections of the syllabus and each question will carry 7.5 marks. Section C will consist of 10 short answer type questions of 2 marks each covering the entire syllabus uniformly and will carry 20 marks in all. Candidates will be required to attempt four questions in all from section A and B selecting not more than two questions from each of these groups. Section C shall be compulsory.

**Instructions for candidates**

- Candidates are required to attempt five questions in all, selecting two questions each from section A and B and compulsory question of section C.
- Use of non-programmable scientific calculator is allowed

**CS-615 : SOFTWARE LAB-I (C++ and Data Structures)**

**Maximum Marks: 100\***

**Maximum Time: 3 Hrs.**

**Minimum Pass Marks: 40%**

**Practical Sessions to be conducted: 55-65**

The Laboratory assignments for this lab will include the assignments from the Papers CS-611 (Object Oriented Programming Using C++) and CS-614 (Data Structures & Algorithms).

\*The splitting of marks is as under:

Maximum Marks for Continuous Assessment: 60

Maximum Marks for University Examination: 40

Continuous Assessment (Practical Labs) *Maximum Marks for Continuous Assessment: 60
1. Two tests will be conducted during the semester. Both the tests will be considered for assessment: 60% of the marks allotted for continuous assessment. 2. Lab Assignments: 30% of the marks allotted for continuous assessment. 3. Attendance: 10% of the marks allotted for continuous assessment.
University Examination (Practical Labs) *Maximum Marks for University Examination: 40
The evaluation will be done jointly by the team of internal and external examiner.  The examiners will give due weight age to Logic development/Program execution, Lab records and viva -voce of the student while awarding marks to the student during end-semester final practical examination.

**CS-615 E1: RELATIONAL DATABASE MANAGEMENT SYSTEM****Maximum Marks: 50**  
**Minimum Pass Marks: 40%****Maximum Time: 3 Hrs.**  
**Lectures to be delivered: 50-60**

**Course Objective:** This course is intended to provide students an understanding of the current theory and practice of database management systems. The course will help students by providing a solid technical overview of database management systems, using a current database product as a case study. In addition to technical concerns, more general issues are also emphasized which include data independence, integrity, security, recovery, performance, database design principles and database administration. On completion of this course, the students will be able to

- Analyze the Information Systems as socio-technical systems, its need and advantages as compared to traditional file based systems.
- Comprehend architecture of DBMS, Conceptual data modelling, logical database design and physical database design.
- Analyze Database design using E-R data model by identifying entities, attributes, relationships, generalization and specialization along with relational algebra.
- Apply and create Relational Database Design process with Normalization and De-normalization of data.
- Demonstrate use of SQL and PL/SQL to implementation database applications with usage of DDL aspect of SQL, DML aspect of SQL, aggregate functions, group by clause, sub query, joins, co-related sub query and indexes, cursor, stored function and procedure, triggers etc.

**Course content****SECTION A**

Database and Database management Systems: Introduction-History of Database Management Systems, Characteristics of DBMS, Meaning and Definition of Database objectives of database, advantages of database and disadvantages of traditional file environment systems, meaning and definition of Database Management Systems[DBMS] Database trends: Distributed Databases-data warehousing- and data mining- Object-oriented hypermedia Databases.

Introduction to ER Model, mapping cardinalities, generalization, specialization, aggregation Relational Database [RDBMS]: The Relational Database Model, Techniques Components of Relational Model, Definition of Relational Terms, Features of RDBMS, CODD's 12 rules for a fully RDBMS. Keys in relational model, Integrity in Relational model, Integrity rules, user-defined Integrity rules.

Normalisation: Benefits of normalization, Functional Dependency, Determinants, Decomposition, Normal forms up to 5NF.Introduction to NoSQL.

**SECTION B**

Oracle: Overview: Personal Databases, Client/Server Databases, Oracle an introduction SQL \*Plus Environment: SQL, Logging into SQL \*Plus, SQL \*Plus Commands, Errors & Help, Alternate Text Editors, SQL \*Plus Worksheet, iSQL \*Plus.

Oracle Tables: Naming Rules and conventions, Data Types, Constraints, Creating Oracle Table, Displaying Table Information, Altering an Existing Table, Dropping, Renaming, Truncating Table, Table Types, Spooling, Error codes.

Working with Table: Data Management and Retrieval, DML, adding a new Row/Record, Customized Prompts, Updating and Deleting an Existing Rows/Records, retrieving Data from Table, Arithmetic Operations, restricting Data with WHERE clause, Sorting, Revisiting Substitution Variables, DEFINE command, CASE structure.

Functions and Grouping: Built-in functions, Grouping Data.

Multiple Tables: Joins and Set operations.

PL/SQL: A Programming Language, Fundamentals, Block Structure, Comments, Data Types, Other Data Types, Declaration, Assignment operation, Bind variables, Substitution Variables, Printing, Arithmetic Operators.

Control Structures and Embedded SQL: Control Structures, Nested Blocks, SQL in PL/SQL, Data Manipulation, Transaction Control statements.

PL/SQL Cursors and Exceptions: Cursors, Implicit & Explicit Cursors and Attributes, Cursor FOR loops, SELECT...FOR, UPDATE – WHERE CURRENT OF clause, Cursor with Parameters, Cursor Variables, Exceptions, Types of Exceptions.

PL/SQL Composite Data Types: Records, Tables, arrays.

Named Blocks: Procedures, Functions, Packages, Triggers, Data Dictionary Views.

### **Pedagogy:**

The Instructor is expected to use leading pedagogical approaches in the class room situation, research-based methodology, innovative instructional methods, extensive use of technology in the class room, online modules of MOOCS, and comprehensive assessment practices to strengthen teaching efforts and improve student learning outcomes.

The Instructor of class will engage in a combination of academic reading, analyzing case studies, preparing the weekly assigned readings and exercises, encouraging in class discussions, and live project based learning.

### **Case/Class Discussion Assignments:**

Students will work in groups of up to four to prepare a brief write-up due before the start of each class covering the case study or class material to be discussed in the next session. Questions may include a quantitative analysis of the problem facing the decision-maker in the case.

### **Class Participation:**

Attendance will be taken at each class. Class participation is scored for each student for each class.

**Text and Readings:** Students should focus on material presented in lectures. The text should be used to provide further explanation and examples of concepts and techniques discussed in the course:

- Elmasri & Navathe, Fundamentals of Database Systems, Addison-Wesley.
- Connolly & Begg, Database Systems, Pearson Education.
- Ivan Bayross, SQL,PL/SQL The programming language of Oracle, BPB Publications.
- H. F. Korth & Silverschatz, A., Database System Concepts, Tata McGraw Hill.
- Hoffer, Prescott, Mcfadden, Modern Database Management, Paperback International.
- Martin Gruber, Understanding SQL, BPB Publication.
- Joel Murach, Oracle SQL and PL/SQL, Shroff Publishers and Distributors.

### **Scheme of Examination**

- English will be the medium of instruction and examination.
- Written Examinations will be conducted at the end of each Semester as per the Academic Calendar notified in advance
- Each course will carry 100 marks of which 50 marks shall be reserved for internal assessment and the remaining 50 marks for written examination to be held at the end of each semester.
- The duration of written examination for each paper shall be three hours.
- The minimum marks for passing the examination for each semester shall be 40% in aggregate as well as a minimum of 40% marks in the semester-end examination in each paper.
- A minimum of 75% of classroom attendance is required in each subject.

### **Instructions to the External Paper Setter**

The external paper will carry 50 marks and would be of three hours duration. The question paper will consist of three sections A, B and C. Sections A and B will have four questions each from the respective sections of the syllabus and each question will carry 7.5 marks. Section C will consist of 10 short answer type questions of 2 marks each covering the entire syllabus uniformly and will carry 20 marks in all. Candidates will be required to attempt four questions in all from section A and B selecting not more than two questions from each of these groups. Section C shall be compulsory.

### **Instructions for candidates**

- Candidates are required to attempt five questions in all, selecting two questions each from section A and B and compulsory question of section C.
- Use of non-programmable scientific calculator is allowed

**CS-615 E2 : Business Intelligence****Maximum Marks: 50****Maximum Time: 3 Hrs.****Minimum Pass Marks: 40%****Lectures to be delivered: 50-60**

Course Objective: The objectives of this course are to provide students comprehensive and in-depth knowledge of Business Intelligence (BI) principles and techniques by introducing the relationship between managerial and technological perspectives. This course is also designed to expose students to the frontiers of information systems, while providing a sufficiently strong foundation to encourage further research. On completion of this course, the students will be able to

- Identify the major frameworks of computerized decision support: decision support systems (DSS), data analytics and business intelligence (BI).
- Explain the foundations, definitions, and capabilities of DSS, data analytics and BI.
- List the definitions, concepts, and architectures of data warehousing.
- Demonstrate the impact of business reporting, information visualization, and dashboards.
- Explain data mining, neural networks, support vector machines, text analytics, text mining, sentiment analysis, web mining, web analytics, social analytics, social network analysis.
- Outline the definitions, concepts, and enabling technologies of big data analytics.
- Identify the major ethical and legal issues of analytics.
- Describe how analytics are powering consumer applications and creating a new opportunity for entrepreneurship for analytics.

**Course content****SECTION A**

Introduction to Business Intelligence, Digital data and its types – structured, semi-structured and unstructured, Introduction to Online Transaction Processing (OLTP), Online Analytical Processing (OLAP), Different OLAP architectures: MOLAP, ROLAP, HOLAP, Comparison of OLTP and OLAP. BI Definitions and need, BI Component Framework, Business Applications of BI

Data Warehouse: definition, reasons and goals of a data warehouse. What constitutes a data warehouse. Introduction to Extraction-Transformation-Loading (ETL), Data integration, needs and advantages of using data integration, introduction to common data integration approaches, Introduction to Data Quality, Data Profiling concepts and applications

**SECTION B**

Multi-Dimensional Data Modeling, Introduction to data and dimension modeling, Multi-dimensional data model, ER Modeling vs. Multi-dimensional modeling, Concepts of dimensions, facts, cubes, attribute, hierarchies, Typical Dimensional models - star and snowflake schema

Basics of Enterprise Reporting: Features of good reporting, Common report layout types, Report delivery formats, Report standardization and presentation practices, Brief introduction to Balanced scorecard, and Enterprise dashboards, Balanced scorecards vs. Enterprise dashboards.

**Pedagogy:**

The Instructor is expected to use leading pedagogical approaches in the class room situation, research-based methodology, innovative instructional methods, extensive use of technology in the class room, online modules of MOOCS, and comprehensive assessment practices to strengthen teaching efforts and improve student learning outcomes.

The Instructor of class will engage in a combination of academic reading, analyzing case studies, preparing the weekly assigned readings and exercises, encouraging in class discussions, and live project based learning.

**Case/Class Discussion Assignments:**

Students will work in groups of up to four to prepare a brief write-up due before the start of each class covering the case study or class material to be discussed in the next session. Questions may include a quantitative analysis of the problem facing the decision-maker in the case.

**Class Participation:**

Attendance will be taken at each class. Class participation is scored for each student for each class.

**Text and Readings:** Students should focus on material presented in lectures. The text should be used to provide further explanation and examples of concepts and techniques discussed in the course:

- R N Prasad, Seema Acharya: Fundamentals of Business Analytics, Wiley India Ltd.
- Mike Biere, Business Intelligence for the Enterprise, Prentice Hall Professional.
- David Taniar, Progressive methods in Data Warehousing and Business Intelligence: Concepts and competitive analytics, Idea Group Inc.

**Scheme of Examination**

- English will be the medium of instruction and examination.
- Written Examinations will be conducted at the end of each Semester as per the Academic Calendar notified in advance
- Each course will carry 100 marks of which 50 marks shall be reserved for internal assessment and the remaining 50 marks for written examination to be held at the end of each semester.
- The duration of written examination for each paper shall be three hours.
- The minimum marks for passing the examination for each semester shall be 40% in aggregate as well as a minimum of 40% marks in the semester-end examination in each paper.
- A minimum of 75% of classroom attendance is required in each subject.

**Instructions to the External Paper Setter**

The external paper will carry 50 marks and would be of three hours duration. The question paper will consist of three sections A, B and C. Sections A and B will have four questions each from the respective sections of the syllabus and each question will carry 7.5 marks. Section C will consist of 10 short answer type questions of 2 marks each covering the entire syllabus uniformly and will carry 20 marks in all. Candidates will be required to attempt four questions in all from section A and B selecting not more than two questions from each of these groups. Section C shall be compulsory.

**Instructions for candidates**

- Candidates are required to attempt five questions in all, selecting two questions each from section A and B and compulsory question of section C.
- Use of non-programmable scientific calculator is allowed

## CS-615 E3: STATISTICAL COMPUTING

**Maximum Marks: 50**  
**Minimum Pass Marks: 40%**

**Maximum Time: 3 Hrs.**  
**Lectures to be delivered: 50-60**

**Course Objective:** This course is designed to help students select the right package for data analysis tasks they will carry out in other courses in the program and in their working life. They will be able to transfer data easily between applications. They will also be able to communicate information in the data to colleagues in simple but meaningful ways. On completion of this course, the students will be able to

- Construct and interpret visual presentations of data;
- Apply and interpret computational procedures for inference from univariate data;
- Apply and interpret computation procedures for inference from bivariate data including the fitting of generalised linear models; and
- Apply and interpret multivariate statistical procedures.

Course content**SECTION A**

Statistical Analysis of Data: Measures of central tendency and variation. Mean, Median, Mode, Range, Mean Deviation and Standard Deviation and their properties. Skewness and Kurtosis: Karl Pearson's and Bowley's coefficient of skewness, Karl Pearson's Beta and Gamma coefficients of Skewness and Kurtosis based on moments.

Analysis of Bivariate Data: Correlation and linear Regression involving two variables, their properties and interrelations. Probability: classical and axiomatic definitions of probability; simple properties of probability function. Addition and Multiplication theorems of probability; Independence of events; Bayes' theorem.

**SECTION B**

Random Variable & Probability Distribution of a random variable: Definitions, discrete and continuous random variables; Moment of a random variable. Binomial, Poisson, Hyper geometric, Negative Binomial, Uniform and Normal Distributions.

Tests of Hypotheses: Basic ideas of testing of hypotheses; tests of significance based on normal, chi-square T and F-distributions. Hands on experience on Statistical Package

**Pedagogy:**

The Instructor is expected to use leading pedagogical approaches in the class room situation, research-based methodology, innovative instructional methods, extensive use of technology in the class room, online modules of MOOCS, and comprehensive assessment practices to strengthen teaching efforts and improve student learning outcomes.

The Instructor of class will engage in a combination of academic reading, analyzing case studies, preparing the weekly assigned readings and exercises, encouraging in class discussions, and live project based learning.

**Case/Class Discussion Assignments:**

Students will work in groups of up to four to prepare a brief write-up due before the start of each class covering the case study or class material to be discussed in the next session. Questions may include a quantitative analysis of the problem facing the decision-maker in the case.

**Class Participation:**

Attendance will be taken at each class. Class participation is scored for each student for each class.

**Text and Readings:** Students should focus on material presented in lectures. The text should be used to provide further explanation and examples of concepts and techniques discussed in the course:

- Goon, A. M, Gupta, M. K Dasgupta, B, "Fundamentals of Statistics" Vol I, World Press, Calcutta.

- Gupta, S. C., "Fundamentals of Statistics", Himalaya Publishing House.
- Meyer, P. L, "Introductory Probability & Statistical Applications", Oxford & IBH Publishing Company, New Delhi.
- Hogg, R. V. & Craig, I. T, "Introduction to Mathematical Statistics", MacMillan.

#### **Scheme of Examination**

- English will be the medium of instruction and examination.
- Written Examinations will be conducted at the end of each Semester as per the Academic Calendar notified in advance
- Each course will carry 100 marks of which 50 marks shall be reserved for internal assessment and the remaining 50 marks for written examination to be held at the end of each semester.
- The duration of written examination for each paper shall be three hours.
- The minimum marks for passing the examination for each semester shall be 40% in aggregate as well as a minimum of 40% marks in the semester-end examination in each paper.
- A minimum of 75% of classroom attendance is required in each subject.

#### **Instructions to the External Paper Setter**

The external paper will carry 50 marks and would be of three hours duration. The question paper will consist of three sections A, B and C. Sections A and B will have four questions each from the respective sections of the syllabus and each question will carry 7.5 marks. Section C will consist of 10 short answer type questions of 2 marks each covering the entire syllabus uniformly and will carry 20 marks in all. Candidates will be required to attempt four questions in all from section A and B selecting not more than two questions from each of these groups. Section C shall be compulsory.

#### **Instructions for candidates**

- Candidates are required to attempt five questions in all, selecting two questions each from section A and B and compulsory question of section C.
- Use of non-programmable scientific calculator is allowed.

**CS-615 E4 : COMMUNICATION NETWORKS**

**Maximum Marks: 50**  
**Minimum Pass Marks: 40%**

**Maximum Time: 3 Hrs.**  
**Lectures to be delivered: 50-60**

**Course Objective:** The main objective of this course is to provide students with an overview of the concepts and fundamentals of data communication and computer networks. Upon completion of this course students will be able to:

- Build an understanding of the fundamental concepts of computer networking.
- Familiarize the student with the basic taxonomy and terminology of the computer networking area.
- Introduce the student to advanced networking concepts, preparing the student for entry Advanced courses in computer networking.
- Allow the student to gain expertise in some specific areas of networking such as the design and maintenance of individual networks.

**Course content****SECTION A**

History of Communication Networks: Telephone Networks, Computer networks, Cable Television Networks.

Network Principles: Digitization, Economies of Scale, Network Externalities, Service Integration. Future Networks: The Internet, Pure ATM Network, Video Dial Tone.

Network Applications, Connection-Oriented and Connectionless Network Services, High performance Networks, Network elements, Service Characteristics, Multiplexing, switching, Error Control, Flow Control, Resource Allocation, Layered Architecture, Open Data Network Model.

Packet-Switched Networks: OSI Reference Model, Ethernet, Token Ring, FDDI, DQDB, Frame Relays, SMDS, Internet Protocol.

Circuit-Switched Networks: Performance of Circuit-Switched Networks, SONET, Fiber to Home, ISDN, Intelligent Networks, Video Dial Tone.

**SECTION B**

Asynchronous Transfer Mode: Features of ATM, ATM Header Structure, ATM Adaptation Layer, Management and Control, BISDN, Internetworking with ATM.

Control of Networks: Objectives and Methods of Control, Circuit-Switched Networks, Datagram Networks, ATM Networks.

Mathematical Background of Networks: Markov Chains, Circuit-Switched Networks, Datagram Networks, ATM Networks.

Economics: Network Charges, A Billing System for Internet Connections, Internet Traffic measurements, Pricing a Single Resource, Pricing for ATM Services.

**Pedagogy:**

The Instructor is expected to use leading pedagogical approaches in the class room situation, research-based methodology, innovative instructional methods, extensive use of technology in the class room, online modules of MOOCS, and comprehensive assessment practices to strengthen teaching efforts and improve student learning outcomes.

The Instructor of class will engage in a combination of academic reading, analyzing case studies, preparing the weekly assigned readings and exercises, encouraging in class discussions, and live project based learning.

**Case/Class Discussion Assignments:**

Students will work in groups of up to four to prepare a brief write-up due before the start of each class covering the case study or class material to be discussed in the next session. Questions may include a quantitative analysis of the problem facing the decision-maker in the case.

**Class Participation:**

Attendance will be taken at each class. Class participation is scored for each student for each class.

**Text and Readings:** Students should focus on material presented in lectures. The text should be used to provide further explanation and examples of concepts and techniques discussed in the course:

- J. Walrand, P. Varaiya, Morgan Kaufmann "High-Performance Communication Networks", Publishers.
- Shanmugam, S. Rajeev "Computer Communication Networks".
- Alberto, Leon-Garcia and Indra Widjaja "Communication Networks" McGraw-Hill.

#### **Scheme of Examination**

- English will be the medium of instruction and examination.
- Written Examinations will be conducted at the end of each Semester as per the Academic Calendar notified in advance
- Each course will carry 100 marks of which 50 marks shall be reserved for internal assessment and the remaining 50 marks for written examination to be held at the end of each semester.
- The duration of written examination for each paper shall be three hours.
- The minimum marks for passing the examination for each semester shall be 40% in aggregate as well as a minimum of 40% marks in the semester-end examination in each paper.
- A minimum of 75% of classroom attendance is required in each subject.

#### **Instructions to the External Paper Setter**

The external paper will carry 50 marks and would be of three hours duration. The question paper will consist of three sections A, B and C. Sections A and B will have four questions each from the respective sections of the syllabus and each question will carry 7.5 marks. Section C will consist of 10 short answer type questions of 2 marks each covering the entire syllabus uniformly and will carry 20 marks in all. Candidates will be required to attempt four questions in all from section A and B selecting not more than two questions from each of these groups. Section C shall be compulsory.

#### **Instructions for candidates**

- Candidates are required to attempt five questions in all, selecting two questions each from section A and B and compulsory question of section C.
- Use of non programmable scientific calculator is allowed.

## CS-615 E5: DATA MINING AND DATA WAREHOUSING

**Maximum Marks: 50**  
**Minimum Pass Marks: 40%**

**Maximum Time: 3 Hrs.**  
**Lectures to be delivered: 50-60**

**Course Objective :** The objective of this course is to introduce the students with basic concepts of Data Warehouse and Data Mining techniques. Examine the types of the data to be mined and apply preprocessing methods on raw data. Discover interesting patterns, analyze supervised and unsupervised models and estimate the accuracy of the algorithms. On completion of this course students will be able to

- Process raw data to make it suitable for various data mining algorithms.
- Discover and measure interesting patterns from different kinds of databases.
- Apply the techniques of clustering, classification, association finding, feature selection and visualization to real world data.

### Course Content

#### SECTION A

Data Warehousing and Business Analysis: Data warehousing Components – Building a Data warehouse – Mapping the Data Warehouse to a Multiprocessor Architecture – DBMS Schemas for Decision Support – Data Extraction, Cleanup, and Transformation Tools – Metadata – reporting – Query tools and Applications – Online Analytical Processing (OLAP) – OLAP and Multidimensional Data Analysis.

Data Mining: Data Mining Functionalities – Data Preprocessing – Data Cleaning – Data Integration and Transformation – Data Reduction – Data Discretization and Concept Hierarchy Generation. Association Rule Mining: Efficient and Scalable Frequent Item set Mining Methods – Mining Various Kinds of Association Rules – Association Mining to Correlation Analysis – Constraint-Based Association Mining.

#### SECTION B

Classification and Prediction: Issues Regarding Classification and Prediction – Classification by Decision Tree Introduction – Bayesian Classification – Rule Based Classification – Classification by Back propagation – Support Vector Machines – Associative Classification – Lazy Learners – Other Classification Methods – Prediction – Accuracy and Error Measures – Evaluating the Accuracy of a Classifier or Predictor – Ensemble Methods – Model Selection.

Cluster Analysis: Types of Data in Cluster Analysis – A Categorization of Major Clustering Methods – Partitioning Methods – Hierarchical methods – Density-Based Methods – Grid-Based Methods – Model-Based Clustering Methods – Clustering High Dimensional Data – Constraint-Based Cluster Analysis – Outlier Analysis.

#### **Pedagogy:**

The Instructor is expected to use leading pedagogical approaches in the class room situation, research-based methodology, innovative instructional methods, extensive use of technology in the class room, online modules of MOOCs, and comprehensive assessment practices to strengthen teaching efforts and improve student learning outcomes.

The Instructor of class will engage in a combination of academic reading, analyzing case studies, preparing the weekly assigned readings and exercises, encouraging in class discussions, and live project based learning.

#### **Case/Class Discussion Assignments:**

Students will work in groups of up to four to prepare a brief write-up due before the start of each class covering the case study or class material to be discussed in the next session. Questions may include a quantitative analysis of the problem facing the decision-maker in the case.

#### **Class Participation:**

Attendance will be taken at each class. Class participation is scored for each student for each class.

**Text and Readings:** Students should focus on material presented in lectures. The text should be used to provide further explanation and examples of concepts and techniques discussed in the course:

- Jiawei Han, MichelineKamber and Jian Pei, Data Mining Concepts and Techniques, Elsevier.
- Alex Berson and Stephen J. Smith, Data Warehousing, Data Mining & OLAP, Tata McGraw – Hill Edition.
- K.P. Soman, ShyamDiwakar and V. Ajay, Insight into Data mining: Theory and Practice, Prentice Hall of India.
- G. K. Gupta, Introduction to Data Mining with Case Studies, Prentice Hall of India.
- Pang-Ning Tan, Michael Steinbach and Vipin Kumar, Introduction to Data Mining, Pearson Education.

#### **Scheme of Examination**

- English will be the medium of instruction and examination.
- Written Examinations will be conducted at the end of each Semester as per the Academic Calendar notified in advance
- Each course will carry 100 marks of which 50 marks shall be reserved for internal assessment and the remaining 50 marks for written examination to be held at the end of each semester.
- The duration of written examination for each paper shall be three hours.
- The minimum marks for passing the examination for each semester shall be 40% in aggregate as well as a minimum of 40% marks in the semester-end examination in each paper.
- A minimum of 75% of classroom attendance is required in each subject.

#### **Instructions to the External Paper Setter**

The external paper will carry 50 marks and would be of three hours duration. The question paper will consist of three sections A, B and C. Sections A and B will have four questions each from the respective sections of the syllabus and each question will carry 7.5 marks. Section C will consist of 10 short answer type questions of 2 marks each covering the entire syllabus uniformly and will carry 20 marks in all. Candidates will be required to attempt four questions in all from section A and B selecting not more than two questions from each of these groups. Section C shall be compulsory.

#### **Instructions for candidates**

- Candidates are required to attempt five questions in all, selecting two questions each from section A and B and compulsory question of section C.
- Use of non programmable scientific calculator is allowed.

## CS-615 E6: VIRTUALIZATION AND CLOUD COMPUTING

**Maximum Marks: 50**  
**Minimum Pass Marks: 40%**

**Maximum Time: 3 Hrs.**  
**Lectures to be delivered: 50-60**

**Course objective:** The basic objective of this course is to give students the skills and knowledge to understand how Cloud Computing can enable transformation, business development and agility in an organization. This course deals with management of complex virtual environments, analysis of key Performance factors of virtualized systems, principal issues in troubleshooting virtual environments, evaluation of small scale virtual environment developed in the lab. On completion of this course students will be able to

- Understanding the key dimensions of the challenge of Cloud Computing
- Assessment of the economics, financial, and technological implications for selecting cloud computing for own organization
- Assessing the financial, technological, and organizational capacity of employer's for actively initiating and installing cloud-based applications.
- Assessment of own organizations' needs for capacity building and training in cloud computing related IT areas

### Course Content

#### SECTION A

Virtualization Basics: What is Virtualization, Virtualization theory, VMDK File Structure, CPU Virtualization, Memory Virtualization, Storage Virtualization, Network Virtualization, Virtual machine

Cloud Computing Basics: Overview, Applications, Intranet and the Cloud, First Movers on the cloud, the need for Cloud Computing, Benefits of cloud Computing, Limitations of Cloud Computing, security concerns and regulatory issues, over view of different cloud computing applications

Introduction to Cloud Computing: What and what is not cloud computing, Moving from collaboration to cloud, Cloud Architectures, cloud storage, cloud Services, reasons for cloud computing, pros and cons of cloud computing, benefits of cloud computing, users of cloud computing

Cloud Computing Technologies: Hardware and Infrastructure: Clients, Security, Network, services

Local Clouds: server solutions, Thin Clients

#### SECTION B

Accessing the Clouds: Platforms, WEB applications, WEB APIS, WB Browsers

Cloud Storage: Overview, Storage provides,

Cloud Standards: Applications, Client, Infrastructure, Services

Cloud Computing Mechanisms: Software as a service: Overview, Driving Forces

Issues in cloud computing: Implementing real time application over cloud Platform, Issues in Inter-cloud environments, QoS Issues in Cloud, Dependability, data migration, streaming in Cloud, Application development in Clouds

Development Platforms: Google, Sales Force, Azure,

Migrating to the clouds: Cloud services for individuals, Mid-market, and Enterprise wide, Migration, best practices, analyzing the service

#### **Pedagogy:**

The Instructor is expected to use leading pedagogical approaches in the class room situation, research-based methodology, innovative instructional methods, extensive use of technology in the class room, online modules of MOOCS, and comprehensive assessment practices to strengthen teaching efforts and improve student learning outcomes.

The Instructor of class will engage in a combination of academic reading, analyzing case studies, preparing the weekly assigned readings and exercises, encouraging in class discussions, and live project based learning.

#### **Case/Class Discussion Assignments:**

Students will work in groups of up to four to prepare a brief write-up due before the start of each class covering the case study or class material to be discussed in the next session. Questions may include a quantitative analysis of the problem facing the decision-maker in the case.

**Class Participation:**

Attendance will be taken at each class. Class participation is scored for each student for each class.

**Text and Readings:** Students should focus on material presented in lectures. The text should be used to provide further explanation and examples of concepts and techniques discussed in the course:

- Cloud Computing a Practical approach, Anthony T Velte, Toby J Velte, Robert Elsenpeter, Tata McGraw-Hill.
- Cloud Computing-Web Based applications that change the way you work and collaborate online, Michael Miller, Pearson Education,
- Virtualization for Dummies: Wiley-India
- Cloud Computing, Antonopoulos, Nick; Gillam, Lee, Springer.
- Cloud Computing for Dummies by Judith Hurwitz, R.Bloor, M.Kanfman, F.Halper, Wiley-India.
- Enterprise Cloud Computing by GautamShroff, Cambridge.
- Cloud Security by Ronald Krutz and Russell Dean Vines, Wiley-India.

**Scheme of Examination**

- English will be the medium of instruction and examination.
- Written Examinations will be conducted at the end of each Semester as per the Academic Calendar notified in advance
- Each course will carry 100 marks of which 50 marks shall be reserved for internal assessment and the remaining 50 marks for written examination to be held at the end of each semester.
- The duration of written examination for each paper shall be three hours.
- The minimum marks for passing the examination for each semester shall be 40% in aggregate as well as a minimum of 40% marks in the semester-end examination in each paper.
- A minimum of 75% of classroom attendance is required in each subject.

**Instructions to the External Paper Setter**

The external paper will carry 50 marks and would be of three hours duration. The question paper will consist of three sections A, B and C. Sections A and B will have four questions each from the respective sections of the syllabus and each question will carry 7.5 marks. Section C will consist of 10 short answer type questions of 2 marks each covering the entire syllabus uniformly and will carry 20 marks in all. Candidates will be required to attempt four questions in all from section A and B selecting not more than two questions from each of these groups. Section C shall be compulsory.

**Instructions for candidates**

- Candidates are required to attempt five questions in all, selecting two questions each from section A and B and compulsory question of section C.
- Use of non programmable scientific calculator is allowed.

**CS-616 : SOFTWARE LAB – I (C++ and Data Structures)**

**Maximum Marks: 100\***

**Minimum Pass Marks: 40%**

**Maximum Time: 3 Hrs.**

**Practical Sessions to be conducted: 55-65**

The Laboratory assignments for this lab will include the assignments from the Papers CS-611 (Object Oriented Programming Using C++) and CS-614(Data Structures & Algorithms).

\*The splitting of marks is as under:

Maximum Marks for Continuous Assessment: 60

Maximum Marks for University Examination: 40

<p><b>Continuous Assessment (Practical Labs)</b> *Maximum Marks for Continuous Assessment : 60</p>
<p>1. Two tests will be conducted during the semester. Both the tests will be considered for assessment: 60% of the marks allotted for continuous assessment. 2. Lab Assignments: 30% of the marks allotted for continuous assessment. 3. Attendance: 10% of the marks allotted for continuous assessment.</p>
<p><b>University Examination (Practical Labs)</b> *Maximum Marks for University Examination : 40</p>
<p>The evaluation will be done jointly by the team of internal and external examiner. The examiners will give due weightage to Logic development/Program execution, Lab records and viva-voce of the student while awarding marks to the student during end-semester final practical examination.</p>

**CS-621: DISTRIBUTED SYSTEMS****Maximum Marks: 50**  
**Minimum Pass Marks: 40%****Maximum Times: 3 Hrs.**  
**Lectures to be delivered: 50-60**

**Course Objective:** The major objective of this course is to provide advanced background on relevant computer networking topics to have a comprehensive and deep knowledge in computer networks, distributed systems and cloud computing. This course will help students to be familiar with basics of computer networks, distributed systems and cloud computing through a study of layered models of computer networks and applications. The sole aim of this course is to provide advanced background on relevant computer networks, distributed systems and cloud computing topics and to have a comprehensive and deep knowledge in relevant areas. Upon completion of this course, students will:

- Be familiar with basic networking concepts
- Be familiar with computer networks, distributed systems and cloud computing concepts
- Have better understanding about cloud computing and network security aspects
- Be well known about the fundamentals of wireless communication technology

**Course content****SECTION A**

Characterization of Distributed Systems, Examples, Resource Sharing and Web Challenges. System Models: Architectural models, Fundamental Models.

Networking and Internetworking: Network issues, types, principles: packet transmission, Data streaming, Switching schemes, protocols, Routing, Congestion Control, Internetworking, Internet Protocols: IP Addressing, IP protocol, IP routing, Mobile IP, TCP and UDP, Domain names, Firewalls.

Reference Models : OSI model, TCP/IP model, Network case studies: Ethernet, wireless LAN, Ad hoc Network, ATM, Bluetooth, Wi-Fi, Wi-Max, Wireless sensor networks

Inter process communication: external data representation, client server communication, group communication.

Operating system support: operating system layers, protection, process and threads, O.S. Architecture.

**SECTION B**

Distributed file systems: file service architecture, Sun network file system, Andrew file system. Distributed Shared memory: Design and implementation, sequential consistency, ivy Security – Security models, Applications.

Cloud Computing Basics: Overview, Intranet and the Cloud, the need for Cloud Computing, Benefits, Limitations of Cloud Computing, security concerns and regulatory issues, over view of different cloud computing applications. Cloud Architectures, cloud storage, cloud Services, reasons for cloud computing, pros and cons of cloud computing users of cloud computing.

Wireless Communications Wireless system design and components: Frequency reuse and Planning, distance to reuse ratio, call handoff, hexagon grid and Cellular system components.

Cell base station: cell sites, COWs, wireless system towers: Monopole, free standing, guyed, design options, tower loading, safety, leasing, Maintenance. Wireless interconnection to the public switched telephone network: Structure, types of inter connection. Cellular call processor: mobile telephone calls. Roaming and inter carrier networking: roaming systems, international roaming, WIN.

**Pedagogy:**

The Instructor is expected to use leading pedagogical approaches in the class room situation, research-based methodology, innovative instructional methods, extensive use of technology in the class room, online modules of MOOCS, and comprehensive assessment practices to strengthen teaching efforts and improve student learning outcomes.

The Instructor of class will engage in a combination of academic reading, analyzing case studies, preparing the weekly assigned readings and exercises, encouraging in class discussions, and live project based learning.

**Case/Class Discussion Assignments:**

Students will work in groups of up to four to prepare a brief write-up due before the start of each class covering the case study or class material to be discussed in the next session. Questions may include a quantitative analysis of the problem facing the decision-maker in the case.

**Class Participation:**

Attendance will be taken at each class. Class participation is scored for each student for each class.

**Text and Readings:** Students should focus on material presented in lectures. The text should be used to provide further explanation and examples of concepts and techniques discussed in the course:

- G. Couloris, J. Dollimore, T. Kindberg, "Distributed systems: Concepts and Design" Pearsons Education Asia.
- Paul Bedell "Wireless crash course", Tata McGraw Hill.
- Computer Networks, Tanenbaum, PHI.
- Stallings W., Wireless Communications and Networks, Pearson Education
  
- Stojmenic Ivan, Handbook of Wireless Networks and Mobile Computing, John Wiley and Sons Inc.
  
- Schiller J., Mobile Communications, Addison Wesley.
  
- Cloud Computing a Practical approach, Anthony T Velte, Toby J Velte, Robert Elsenpeter, Tata McGraw-HILL.

**Scheme of Examination**

- English will be the medium of instruction and examination.
- Written Examinations will be conducted at the end of each Semester as per the Academic Calendar notified in advance
- Each course will carry 100 marks of which 50 marks shall be reserved for internal assessment and the remaining 50 marks for written examination to be held at the end of each semester.
- The duration of written examination for each paper shall be three hours.
- The minimum marks for passing the examination for each semester shall be 40% in aggregate as well as a minimum of 40% marks in the semester-end examination in each paper.
- A minimum of 75% of classroom attendance is required in each subject.

**Instructions to the External Paper Setter**

The external paper will carry 50 marks and would be of three hours duration. The question paper will consist of three sections A, B and C. Sections A and B will have four questions each from the respective sections of the syllabus and each question will carry 7.5 marks. Section C will consist of 10 short answer type questions of 2 marks each covering the entire syllabus uniformly and will carry 20 marks in all. Candidates will be required to attempt four questions in all from section A and B selecting not more than two questions from each of these groups. Section C shall be compulsory.

**Instructions for candidates**

- Candidates are required to attempt five questions in all, selecting two questions each from section A and B and compulsory question of section C.
- Use of non-programmable scientific calculator is allowed.

**CS-622 : Research Methodology****Maximum Marks: 50****Maximum Time: 3 Hrs.****Minimum Pass Marks: 40%****Lectures to be delivered: 50-60**

**Course Objective:** The objective of this course is to have a good understanding of inferential Statistics Methods and Research Methodology as applicable in computer science applications. The main objective of the course is to develop a set of skills among the students to use the statistical tools at the workplace to solve computer related and general decision problems. At the end of the course, the students should be able to:

- Understand basic aspects of research, its types and its scope and formulation
- Have better understanding towards statistical methods used for research
- Develop the skills to identify the appropriate statistical techniques for the analysis of data
- Analyse the data using appropriate statistical tool
- Learn how to collect, analyze, present and interpret research data.

**Course content****SECTION A**

Scientific Research: Nature and Objectives of research; Methods of research: historical, descriptive and experimental. Study and formulation of research problem

Scope of research and formulation of hypothesis; Feasibility, preparation and presentation of research proposal

Statistical Analysis: Introduction to statistical analysis: Measures of central tendency and dispersion; mean, median, mode, range, mean deviation and standard deviation.

Regression and Correlation Analysis

Random Variables and Probability Distribution: Probability and probability distributions; Binomial, Poisson, Geometric, Negative binomial, Uniform, Exponential, Normal and Log-normal distribution.

**SECTION B**

Test of Hypothesis: Basic ideas of testing of hypothesis; Tests of significance based on normal, t and Chi-square distributions. Analysis of variance technique

Design of Experiments: basic principles, study of completely randomized and randomized block designs.

Introduction to Thesis report writing

Presentation: Edition and tabulation of results, presentation of results using figures, tables and text, quoting of references and preparing bibliography.

Software's: Introduction of common software's viz. SPSS, Mini Tab and/or MAT LAB for statistical analysis.

**Pedagogy:**

The Instructor is expected to use leading pedagogical approaches in the class room situation, research-based methodology, innovative instructional methods, extensive use of technology in the class room, online modules of MOOCS, and comprehensive assessment practices to strengthen teaching efforts and improve student learning outcomes.

The Instructor of class will engage in a combination of academic reading, analyzing case studies, preparing the weekly assigned readings and exercises, encouraging in class discussions, and live project based learning.

**Case/Class Discussion Assignments:**

Students will work in groups of up to four to prepare a brief write-up due before the start of each class covering the case study or class material to be discussed in the next session. Questions may include a quantitative analysis of the problem facing the decision-maker in the case.

**Class Participation:**

Attendance will be taken at each class. Class participation is scored for each student for each class.

**Text and Readings:** Students should focus on material presented in lectures. The text should be used to provide further explanation and examples of concepts and techniques discussed in the course:

- Borth, Wayne C, et. Al. The Craft of Research Chicago Guides to Writing Edition and Publishing.

- Johnson, R.A., Probability and Statistics, PHI, New Delhi.
- Meyer, P. L.: Introduction to Probability & Statistical Applications, Oxford, IBH.
- Hogg, R.V. & Craig, A. T: Introduction to Mathematical Statistics: MacMillan.
- Goon, A. M., Gupta, M. K. Dasgupta: Fundamentals of Statistics, Vol. I, World Press.
- Gupta, S.C. Kapoor, V. K.: Fundamentals of Mathematical Statistics, Sultan Chand & Sons.

#### **Scheme of Examination**

- English will be the medium of instruction and examination.
- Written Examinations will be conducted at the end of each Semester as per the Academic Calendar notified in advance
- Each course will carry 100 marks of which 50 marks shall be reserved for internal assessment and the remaining 50 marks for written examination to be held at the end of each semester.
- The duration of written examination for each paper shall be three hours.
- The minimum marks for passing the examination for each semester shall be 40% in aggregate as well as a minimum of 40% marks in the semester-end examination in each paper.
- A minimum of 75% of classroom attendance is required in each subject.

#### **Instructions to the External Paper Setter**

The external paper will carry 50 marks and would be of three hours duration. The question paper will consist of three sections A, B and C. Sections A and B will have four questions each from the respective sections of the syllabus and each question will carry 7.5 marks. Section C will consist of 10 short answer type questions of 2 marks each covering the entire syllabus uniformly and will carry 20 marks in all. Candidates will be required to attempt four questions in all from section A and B selecting not more than two questions from each of these groups. Section C shall be compulsory.

#### **Instructions for candidates**

- Candidates are required to attempt five questions in all, selecting two questions each from section A and B and compulsory question of section C.
- Use of scientific calculator is allowed.

**CS-623: ARTIFICIAL INTELLIGENCE****Maximum Marks: 50****Maximum Time: 3 Hrs.****Minimum Pass Marks: 40%****Lectures to be delivered: 50-60**

**Course Objective:** The objective of the course is to present an overview of artificial intelligence (AI) principles and approaches. Develop a basic understanding of the building blocks of AI as presented in terms of intelligent agents: Search, Knowledge representation, inference, logic, and learning. Students will implement a small AI system in a team environment. The knowledge of artificial intelligence plays a considerable role in some applications students develop for courses in the program. At the end of the course, the students should be able to:

- design a knowledge based system
- familiar with terminology used in this topical area
- Read and analyze important historical and current trends addressing artificial intelligence.

**Course content****SECTION A**

**Introduction to AI:** Definitions, Importance of AI, Early works in AI, AI and related fields.

**Knowledge base Systems:** General concepts, LISP as AI Programming Language: Syntax, functions, predicates, conditionals, variables, iterations and recursions, lists and arrays.

**Formalized Symbolic Logic:** Propositional Logic, First order Predicate Logic, Well-formed Formulae, Clausal form, Resolution Principle, Deductive and non-deductive Inference.

**Dealing with uncertainties:** Truth Maintenance system, Closed World Assumption, Circumscription, Modal and Temporal Logic, Fuzzy Logics.

**Probabilistic reasoning:** Bayesian Inference, Dempster-Shafer Theory, Heuristic reasoning methods.

**Structured Knowledge Representation:** Weak vs strong slot-and-filler structures, Semantic nets, Frames, Conceptual dependencies and Scripts.

**Object Oriented Representation:** Overview, objects, classes, messages, and methods.

**SECTION B**

**Search and Control Strategies:** Search Problem, Uninformed search, Heuristic search techniques such as Generate-and-Test, Hill Climbing, Best-First Search (A\* Algorithm), Problem reduction (AO\* Algorithm).

**Matching Techniques:** Structures used for matching, Measures for Matching, Pattern matching, partial matching, Fuzzy matching, RETE algorithm.

**Knowledge Organization and Management:** Indexing and retrieval Techniques, Knowledge integration, memory organization.

**Knowledge Acquisition:** Types of learning, General Learning Model, Perceptrons, Learning Automata, Genetic Learning, Intelligent Editor, Learning by Induction.

**Applications of AI:** Natural Language Processing – Challenges, Steps in Language processing, Natural language generation. Pattern Recognitions – basic process, learning classification patterns. Expert System architectures.

**Pedagogy:**

The Instructor is expected to use leading pedagogical approaches in the class room situation, research-based methodology, innovative instructional methods, extensive use of technology in the class room, online modules of MOOCS, and comprehensive assessment practices to strengthen teaching efforts and improve student learning outcomes.

The Instructor of class will engage in a combination of academic reading, analyzing case studies, preparing the weekly assigned readings and exercises, encouraging in class discussions, and live project based learning.

**Case/Class Discussion Assignments:**

Students will work in groups of up to four to prepare a brief write-up due before the start of each class covering the case study or class material to be discussed in the next session. Questions may include a quantitative analysis of the problem facing the decision-maker in the case.

**Class Participation:**

Attendance will be taken at each class. Class participation is scored for each student for each class.

**Text and Readings:** Students should focus on material presented in lectures. The text should be used to provide further explanation and examples of concepts and techniques discussed in the course:

- Elaine Rich, Kevin Knight, B. Nair, Artificial Intelligence, McGraw Hill Education.
- Dan W. Patterson, Introduction to Artificial Intelligence and Expert Systems, Pearson Education.
- E. Charnaik and D. McDermott, Introduction to artificial Intelligence, Addison-Wesley Publishing.
- Nils J. Nilsson, Principles of Artificial Intelligence, Springer-Verlag.
- Patrick Henry Winston, Artificial Intelligence, Pearson Education.
- N.P. Padhy, Artificial Intelligence and Intelligent Systems, Oxford University Press.

#### **Scheme of Examination**

- English will be the medium of instruction and examination.
- Written Examinations will be conducted at the end of each Semester as per the Academic Calendar notified in advance
- Each course will carry 100 marks of which 50 marks shall be reserved for internal assessment and the remaining 50 marks for written examination to be held at the end of each semester.
- The duration of written examination for each paper shall be three hours.
- The minimum marks for passing the examination for each semester shall be 40% in aggregate as well as a minimum of 40% marks in the semester-end examination in each paper.
- A minimum of 75% of classroom attendance is required in each subject.

#### **Instructions to the External Paper Setter**

The external paper will carry 50 marks and would be of three hours duration. The question paper will consist of three sections A, B and C. Sections A and B will have four questions each from the respective sections of the syllabus and each question will carry 7.5 marks. Section C will consist of 10 short answer type questions of 2 marks each covering the entire syllabus uniformly and will carry 20 marks in all. Candidates will be required to attempt four questions in all from section A and B selecting not more than two questions from each of these groups. Section C shall be compulsory.

#### **Instructions for candidates**

- Candidates are required to attempt five questions in all, selecting two questions each from section A and B and compulsory question of section C.
- Use of non programmable scientific calculator is allowed.

**CS-624 : Computer Graphics****Maximum Marks: 50****Maximum Time: 3 Hrs.****Minimum Pass Marks: 40%****Lectures to be delivered: 50-60**

**Course Objective:** The main objective of this course is to introduce students with concepts and implementation of computer graphics. As one of the important subject areas of the study of computer science and information systems, this course will focus on the theoretical aspects and implementation of computer graphics using OpenGL. After completing this course students will be able to :

- Identify and explain the core concepts of computer graphics.
- Apply graphics programming techniques to design, and create computer graphics scenes.
- Create effective OpenGL programs to solve graphics programming issues, including 3D transformation, objects modeling, color modeling, lighting, textures, and ray tracing

**Course content****SECTION A**

Scan Conversion: Scan-converting a point, Scan-converting a Line: DDA Algorithm, Bresenham's Line Algorithm, Scan-converting a Circle: Bresenham's Circle Algorithm, Mid-Point Circle Algorithm, Scan-converting an Ellipse: Mid-Point Ellipse Algorithm, Region Filling: Boundary-Fill Algorithm, Flood-Fill Algorithm, Scan-Line Algorithm, Aliasing Effects, Anti Aliasing

Two-Dimensional Transformations: Geometric Transformations: Translation, Rotation, Scaling, Shearing, Coordinate Transformations, Homogeneous Coordinates, Composite Transformations Two-Dimensional Viewing and Clipping: Window-to-Viewport Mapping, Point Clipping, Line Clipping: The Cohen Sutherland Algorithm, Mid-Point Subdivision, The Liang Barsky Algorithm, Polygon Clipping

Three-Dimensional Transformations: Geometric Transformation: Translation, Rotation, Scaling, Coordinate Transformations, Composite Transformations, Shearing Transformations

Projections: Taxonomy of Projection, Perspective Projection: Mathematical Description of a Perspective Projection, Perspective Anomalies, Parallel Projection: Mathematical Description of a Parallel Projection.

**SECTION B**

Three- Dimensional Viewing and Clipping: Three-Dimensional Viewing: View Plane Coordinates, Specifying the View Volume, Clipping and Viewing Transformation

Curve and Surface Design: Simple Geometric Forms, Wire frame Models, Curved Surfaces and Polynomial Basis Functions, The problem of Approximation, Curved-Surface Design, Transforming Curves and Surfaces, Quadric Surfaces

Hidden Surfaces: Depth Comparisons, Z-Buffer Algorithm, Back-face Removal, The Painter's Algorithm, Scan-Line Algorithm, Subdivision Algorithm, Hidden-Line Elimination, Rendering of Mathematical Surfaces, Warnock's Algorithm, Weiler-Atherton Algorithm

Color and Shading Models: Light and Color, The Phong Model, Interpolative Shading Methods: Constant Shading, Gouraud Shading, Phong Shading.

Ray Tracing: The Pinhole Camera, A Recursive Ray-Tracer, Parametric Vector Representation of a Ray, Ray-Surface Intersection

**Pedagogy:**

The Instructor is expected to use leading pedagogical approaches in the class room situation, research-based methodology, innovative instructional methods, extensive use of technology in the class room, online modules of MOOCS, and comprehensive assessment practices to strengthen teaching efforts and improve student learning outcomes.

The Instructor of class will engage in a combination of academic reading, analyzing case studies, preparing the weekly assigned readings and exercises, encouraging in class discussions, and live project based learning.

**Case/Class Discussion Assignments:**

Students will work in groups of up to four to prepare a brief write-up due before the start of each class covering the case study or class material to be discussed in the next session. Questions may include a quantitative analysis of the problem facing the decision-maker in the case.

**Class Participation:**

Attendance will be taken at each class. Class participation is scored for each student for each class.

**Text and Readings:** Students should focus on material presented in lectures. The text should be used to provide further explanation and examples of concepts and techniques discussed in the course:

- Zhigang Xiang and Roy A Plastock, Computer Graphics, Tata Mc-Graw Hill Company
- 2 D. Hearn and M. Pauline Baker, Computer Graphics with OpenGL, Pearson Education,
- J.D. Foley, A.V. Dam, S.K. Feiner, J.F. Hughes, R.L Philips, "Introduction to Computer Graphics Addison-Wesley Publishing Company, N.Y.

#### **Scheme of Examination**

- English will be the medium of instruction and examination.
- Written Examinations will be conducted at the end of each Semester as per the Academic Calendar notified in advance
- Each course will carry 100 marks of which 50 marks shall be reserved for internal assessment and the remaining 50 marks for written examination to be held at the end of each semester.
- The duration of written examination for each paper shall be three hours.
- The minimum marks for passing the examination for each semester shall be 40% in aggregate as well as a minimum of 40% marks in the semester-end examination in each paper.
- A minimum of 75% of classroom attendance is required in each subject.

#### **Instructions to the External Paper Setter**

The external paper will carry 50 marks and would be of three hours duration. The question paper will consist of three sections A, B and C. Sections A and B will have four questions each from the respective sections of the syllabus and each question will carry 7.5 marks. Section C will consist of 10 short answer type questions of 2 marks each covering the entire syllabus uniformly and will carry 20 marks in all. Candidates will be required to attempt four questions in all from section A and B selecting not more than two questions from each of these groups. Section C shall be compulsory.

#### **Instructions for candidates**

- Candidates are required to attempt five questions in all, selecting two questions each from section A and B and compulsory question of section C.
- Use of non programmable scientific calculator is allowed.

**CS-625 E1 : DIGITAL SIGNAL PROCESSING**

**Maximum Marks: 50**  
**Minimum Pass Marks: 40%**

**Maximum Time: 3 Hrs.**  
**Lectures to be delivered: 50-60**

**Course Objective:** The objective of this course is to provide appropriate knowledge about Digital Signal Processing and how it can be used widely in applications that include telecommunication equipment, multimedia systems, electronic and biomedical instrumentation, automotive systems and many military and weapon systems. The students will be able to learn about DSP chips, general processors or dedicated ASIC chips which are now able to process wide bandwidth signal of all sorts in real-time. Upon completion of this course, students will be able:

- To understand the key theoretical principles underpinning DSP in a design procedure through design examples and case studies.
- To understand the architecture of a digital signal processor and some programming issues in fixed-point digital signal processor in real-time implementation.
- To learn to design a real-time signal processing algorithms using the latest fixed-point processor.

**Course content****SECTION A**

Introduction: Basic elements of a digital signal processing system, classification of signals. Discrete-Time signals and systems: Discrete-Time signal, Discrete-Time systems, Analysis of Discrete-Time Linear Time-Invariant (LTI) Systems: Techniques for the analysis of Linear Systems, Response of LTI systems to arbitrary inputs, Properties of convolution and the Interconnection of LTI systems, casual LTI systems, Discrete-Time systems described by difference equations, Implementation of Discrete-Time systems.

Frequency Analysis of signals and systems: Frequency analysis of continuous-time signals, Frequency analysis of discrete-time signals, Properties of the Fourier Transform for Discrete-Time signals, Frequency-Domain characteristics of Linear Time-invariant systems.

Z-Transforms: Z-Transform and its properties, Rational Z-Transform, Inverse Z-transform using contour integration, power series and partial fraction expansion methods, applications of z-transform in signal processing, Analysis of LTI systems in the Z-Domain.

Sampling of Signals in the time & frequency domain: Analog-to-digital and digital-to-analog conversions, Discrete Fourier transform

**SECTION B**

Design of digital filters: introduction to filter design, types of digital filters, choosing between, fir and IIR filters, filter design steps for both IIR and FIR filters, effect of finite register length in filter design. Realization of IIR digital filters and fir digital filter, design of IIR filters from continuous time filters, coefficient calculation methods for IIR filters(pole-zero placement and impulse invariant methods of coefficient calculation), design of FIR filters by windowing and only introduction to optimal and frequency sampling methods of fir filter design.

Digital signal processors: general and special purpose digital signal processors, computer architecture for signal processing, selecting digital signal processors, architecture and programming of ADSP 2181 processor.

DSP applications in wireless communications

**Pedagogy:**

The Instructor is expected to use leading pedagogical approaches in the class room situation, research-based methodology, innovative instructional methods, extensive use of technology in the class room, online modules of MOOCS, and comprehensive assessment practices to strengthen teaching efforts and improve student learning outcomes.

The Instructor of class will engage in a combination of academic reading, analyzing case studies, preparing the weekly assigned readings and exercises, encouraging in class discussions, and live project based learning.

**Case/Class Discussion Assignments:**

Students will work in groups of up to four to prepare a brief write-up due before the start of each class covering the case study or class material to be discussed in the next session. Questions may include a quantitative analysis of the problem facing the decision-maker in the case.

**Class Participation:**

Attendance will be taken at each class. Class participation is scored for each student for each class.

**Text and Readings:** Students should focus on material presented in lectures. The text should be used to provide further explanation and examples of concepts and techniques discussed in the course:

- Emmanuel C.Ifeachor, Barrie W.Jervis, “Digital Signal Processing”, Pearson Education Asia
- J. G. Proakes, D. G. Manolakis,” Digital Signal Processing principles, algorithms, and applications”, Prentice Hall, India.
- ADSP 2181 manuals

**Scheme of Examination**

- English will be the medium of instruction and examination.
- Written Examinations will be conducted at the end of each Semester as per the Academic Calendar notified in advance
- Each course will carry 100 marks of which 50 marks shall be reserved for internal assessment and the remaining 50 marks for written examination to be held at the end of each semester.
- The duration of written examination for each paper shall be three hours.
- The minimum marks for passing the examination for each semester shall be 40% in aggregate as well as a minimum of 40% marks in the semester-end examination in each paper.
- A minimum of 75% of classroom attendance is required in each subject.

**Instructions to the External Paper Setter**

The external paper will carry 50 marks and would be of three hours duration. The question paper will consist of three sections A, B and C. Sections A and B will have four questions each from the respective sections of the syllabus and each question will carry 7.5 marks. Section C will consist of 10 short answer type questions of 2 marks each covering the entire syllabus uniformly and will carry 20 marks in all. Candidates will be required to attempt four questions in all from section A and B selecting not more than two questions from each of these groups. Section C shall be compulsory.

**Instructions for candidates**

- Candidates are required to attempt five questions in all, selecting two questions each from section A and B and compulsory question of section C.
- Use of non programmable scientific calculator is allowed.

**CS-625 E2: PARALLEL COMPUTING**

**Maximum Marks: 50**  
**Minimum Pass Marks: 40%**

**Maximum Time: 3 Hrs.**  
**Lectures to be delivered: 50-60**

**Course Objective:** The objective of this course is to introduce students with the fundamentals of parallel computing and application development in different parallel programming environments. The aim of this course is to teach basic models of parallel machines and further how to use machine tools to program them. Upon completion of these course students will be able to:

- Define terminology commonly used in parallel computing, such as efficiency and speedup.
- Describe different parallel architectures; inter-connect networks, programming models, and algorithms for common operations such as matrix-vector multiplication.
- Develop an efficient parallel algorithm to solve a specific problem.
- Analyze the time complexity as a function with respect to the problem size and number of processors.
- Analyze performance of a parallel code and to determine its computational bottlenecks and to optimize the performance of the code.
- Implement an efficient and correct code, analyze its performance, and give convincing written and oral presentations.

**Course content****SECTION A**

Parallel Computers: Computational speed, Computer Structures, Types of parallel computers, shared and distributed memory machines and models, networked computers as a multi compiler platform, symmetric multiprocessing. Discussion of threads and multiprocessing, Synchronization and election, fundamental notions of performance in parallel systems

Message passing Computing: Basics of message passing, programming, using workstation clusters, evaluation parallel programs, debugging and evaluating parallel programs. Pipeline technique: Computing platforms for pipelined applications, pipelined program examples; synchronization computations; synchronization, synchronized computations, examples.

**SECTION B**

Performance: Load Balancing, dynamic centralized, decentralized, load balancing using a line structure, distributed termination detection algorithms, examples.

Programming: Shared memory microprocessors, contracts for specifying parallelism, sharing data, examples. Algorithms and applications: sorting algorithms, numerical algorithms: Matrix addition, multiplication, Matrix vector multiplication, implementation

**Pedagogy:**

The Instructor is expected to use leading pedagogical approaches in the class room situation, research-based methodology, innovative instructional methods, extensive use of technology in the class room, online modules of MOOCS, and comprehensive assessment practices to strengthen teaching efforts and improve student learning outcomes.

The Instructor of class will engage in a combination of academic reading, analyzing case studies, preparing the weekly assigned readings and exercises, encouraging in class discussions, and live project based learning.

**Case/Class Discussion Assignments:**

Students will work in groups of up to four to prepare a brief write-up due before the start of each class covering the case study or class material to be discussed in the next session. Questions may include a quantitative analysis of the problem facing the decision-maker in the case.

**Class Participation:**

Attendance will be taken at each class. Class participation is scored for each student for each class.

**Text and Readings:** Students should focus on material presented in lectures. The text should be used to provide further explanation and examples of concepts and techniques discussed in the course:

- Barrey Wilkinson, Michael Allen "Parallel Programming" Pearson Education."
- MJ Quinn, "Parallel Computing: theory and practice", McGraw-Hill
- Hwang & Briggs F.A., "Computer Architecture and Parallel Processing."
- Peter Pacheco, Parallel Programming with MPI", Morgan Kaufman Publisher.
- William Gropp, et al, Using MPI: Portable Parallel Programming with the Message Passing Interface (Scientific and Engineering computation), MIT Press;
- Leighton, An Introduction to Parallel Algorithms and Architectures; Arrays, Trees, Hypercubes, Morgan Kaufmann, Indian Edition

**Scheme of Examination**

- English will be the medium of instruction and examination.
- Written Examinations will be conducted at the end of each Semester as per the Academic Calendar notified in advance
- Each course will carry 100 marks of which 50 marks shall be reserved for internal assessment and the remaining 50 marks for written examination to be held at the end of each semester.
- The duration of written examination for each paper shall be three hours.
- The minimum marks for passing the examination for each semester shall be 40% in aggregate as well as a minimum of 40% marks in the semester-end examination in each paper.
- A minimum of 75% of classroom attendance is required in each subject.

**Instructions to the External Paper Setter**

The external paper will carry 50 marks and would be of three hours duration. The question paper will consist of three sections A, B and C. Sections A and B will have four questions each from the respective sections of the syllabus and each question will carry 7.5 marks. Section C will consist of 10 short answer type questions of 2 marks each covering the entire syllabus uniformly and will carry 20 marks in all. Candidates will be required to attempt four questions in all from section A and B selecting not more than two questions from each of these groups. Section C shall be compulsory.

**Instructions for candidates**

- Candidates are required to attempt five questions in all, selecting two questions each from section A and B and compulsory question of section C.
- Use of non programmable scientific calculator is allowed.

**CS-625 E3 : Theory of Computation**

**Maximum Marks: 50**  
**Minimum Pass Marks: 40%**

**Maximum Time: 3 Hrs.**  
**Lectures to be delivered: 50-60**

**Course Objective:** The learning objective of this course is to introduce students with the mathematical foundations of computation including automata theory; the theory of formal languages and grammars; the notions of algorithm, decidability, complexity, and computability. To enhance and develop students ability for understanding and conducting mathematical proofs for computation and algorithms. After completing this course students will be able to:

- Analyze and design finite automata, pushdown automata, Turing machines, formal languages, and grammars.
- Demonstrate their understanding of key notions, such as algorithm, computability, decidability, and complexity through problem solving.
- Prove the basic results of the Theory of Computation.

**Course content****SECTION A**

Formal language, Need for formal computational models, Non computational models

Finite Automata: Deterministic finite Automata, Non deterministic finite Automata, Equivalence of NFA and DFA, Finite Automata with Epsilon-moves. 2-Way Finite Automata, Crossing sequences, Moore and Mealy Machine, Application of finite automata i.e. Lexical Analyzers, text editors

Regular Expression and Languages: Regular expression, Equivalence of finite Automata and Regular expressions, Conversion between regular expressions and finite automata: Application of Regular Expressions: Regular Expression in UNIX, Lexical analysis and finding pattern in text.

Regular Languages and Regular sets: Pumping lemma for regular sets, Applications of pumping lemma. Closure properties of regular language, The Myhill-Nerode Theorem, Minimization of finite Automata

**SECTION B**

Context free Grammar and Languages: Context free Grammars: Derivation Trees, Leftmost and rightmost derivations, Ambiguity, Parsing techniques for parsing of general CFG's-Early's, Cook-Kassami - Younger (CKY) and Tomitas's parsing. Properties of Context free Languages- Normal forms for context free grammars, The Pumping Lemma for context free Languages; Closure properties of context free languages.

Pushdown Automata: Pushdown Automata: Deterministic Push Down Automata; Equivalence of Push Down Automata and Context free grammar. Linear Bounded Automata (LBA): Power of LBA, Closure Properties.

Turning Machine (TM): One Tape, multitape, the notions of time and space complexity in terms of T.M. Construction of simple problems. Computational complexity

Chomsky Hierarchy of Languages: Recursive and recursively-enumerable languages.

**Pedagogy:**

The Instructor is expected to use leading pedagogical approaches in the class room situation, research-based methodology, innovative instructional methods, extensive use of technology in the class room, online modules of MOOCS, and comprehensive assessment practices to strengthen teaching efforts and improve student learning outcomes.

The Instructor of class will engage in a combination of academic reading, analyzing case studies, preparing the weekly assigned readings and exercises, encouraging in class discussions, and live project based learning.

**Case/Class Discussion Assignments:**

Students will work in groups of up to four to prepare a brief write-up due before the start of each class covering the case study or class material to be discussed in the next session. Questions may include a quantitative analysis of the problem facing the decision-maker in the case.

**Class Participation:**

Attendance will be taken at each class. Class participation is scored for each student for each class.

**Text and Readings:** Students should focus on material presented in lectures. The text should be used to provide further explanation and examples of concepts and techniques discussed in the course:

- J.E. Hopcroft, R. Motwani and J.D. Ullam, “Introduction to Automata Theory, Languages and Computation”, Pearson Education Asia.
- Daniel I.A. Cohen, "Introduction to Computer Theory", Wiley.
- B. M. Moret, “The Theory of Computation”, Pearson Education Asia.
- H.R. Lewis and C.H. Papa dimitriou, “Elements of the theory of Computation”, Pearson Education Asia.

#### **Scheme of Examination**

- English will be the medium of instruction and examination.
- Written Examinations will be conducted at the end of each Semester as per the Academic Calendar notified in advance
- Each course will carry 100 marks of which 50 marks shall be reserved for internal assessment and the remaining 50 marks for written examination to be held at the end of each semester.
- The duration of written examination for each paper shall be three hours.
- The minimum marks for passing the examination for each semester shall be 40% in aggregate as well as a minimum of 40% marks in the semester-end examination in each paper.
- A minimum of 75% of classroom attendance is required in each subject.

#### **Instructions to the External Paper Setter**

The external paper will carry 50 marks and would be of three hours duration. The question paper will consist of three sections A, B and C. Sections A and B will have four questions each from the respective sections of the syllabus and each question will carry 7.5 marks. Section C will consist of 10 short answer type questions of 2 marks each covering the entire syllabus uniformly and will carry 20 marks in all. Candidates will be required to attempt four questions in all from section A and B selecting not more than two questions from each of these groups. Section C shall be compulsory.

#### **Instructions for candidates**

- Candidates are required to attempt five questions in all, selecting two questions each from section A and B and compulsory question of section C.
- Use of non programmable scientific calculator is allowed.

## CS-625 E4: COMMUNICATION PROTOCOLS

**Maximum Marks: 50**  
**Minimum Pass Marks: 40%**

**Maximum Time: 3 Hrs.**  
**Lectures to be delivered: 50-60**

**Course Objective:** The learning objective of this course is to introduce students with basic concepts of communication protocols under TCP/IP protocol suite. The students will learn about the core aspects of communication protocols which are used in internet such as transmission control protocol, user datagram protocol and internet protocol. Upon completion of this course students will be able to:

- Understand and develop core aspects of networking protocols
- Familiar with TCP/IP protocol suite with detail study if each and every layered protocol architecture
- Able to create public and private networks with the use of communication protocols

**Course content****SECTION A**

TCP/IP Protocol Suite: Need, OSI, TCP/IP, Layers, TCP, UDP, IP, IPv6, Operations, Protocol Interfaces, Internetworking issues, example.

Protocols of physical layer: EIA-232D/RS-232C/V.24, RS-449, X.21, T-1, ISDN.

Data Link Layer Protocols: HDLC, LAP-B, DLC.

Circuit Switching, Packet Switching Principles, Virtual Circuits and Datagrams, X.25, Frame and Cell Relay, ATM

LAN Protocols: Architecture, Ethernet: topology, 802.2, IEEE 802.3; Gigabit Ethernet; Wireless LANs, 802.11; Broadband Wireless: 802.16; Bluetooth protocol stack; Bridges from 802.x to 802.y

**SECTION B**

Internet Network Layer protocol: IP Protocol, IP Address, Internet Control Protocols, OSPF, BGP, Internet Multicasting, and Mobile IP

Transport Protocols: Speed and Quality of Service needs, Performance requirements, Connection-Oriented Transport Protocol Mechanisms, TCP services, UDP, RPC, RSVP, and Real-Time Transport Protocol.

Application layer - Terminal Access: Telnet; File Transfer: FTP; Electronic Mail: SMTP, MIME; Web Access: HTTP; Internet Directory Service: DNS; Voice over IP: SIP; Sockets.

**Pedagogy:**

The Instructor is expected to use leading pedagogical approaches in the class room situation, research-based methodology, innovative instructional methods, extensive use of technology in the class room, online modules of MOOCS, and comprehensive assessment practices to strengthen teaching efforts and improve student learning outcomes.

The Instructor of class will engage in a combination of academic reading, analyzing case studies, preparing the weekly assigned readings and exercises, encouraging in class discussions, and live project based learning.

**Case/Class Discussion Assignments:**

Students will work in groups of up to four to prepare a brief write-up due before the start of each class covering the case study or class material to be discussed in the next session. Questions may include a quantitative analysis of the problem facing the decision-maker in the case.

**Class Participation:**

Attendance will be taken at each class. Class participation is scored for each student for each class.

**Text and Readings:** Students should focus on material presented in lectures. The text should be used to provide further explanation and examples of concepts and techniques discussed in the course:

- William Stallings "Computer Networking with Internet Protocols and Technology", Pearson Education.
- A.S. Tanenbaum, "Computer Networks", Pearson Education.
- Farrel, Morgan Kaufmann "The Internet and its Protocols: A Comparative Approach.

**Scheme of Examination**

- English will be the medium of instruction and examination.

- Written Examinations will be conducted at the end of each Semester as per the Academic Calendar notified in advance
- Each course will carry 100 marks of which 50 marks shall be reserved for internal assessment and the remaining 50 marks for written examination to be held at the end of each semester.
- The duration of written examination for each paper shall be three hours.
- The minimum marks for passing the examination for each semester shall be 40% in aggregate as well as a minimum of 40% marks in the semester-end examination in each paper.
- A minimum of 75% of classroom attendance is required in each subject.

#### **Instructions to the External Paper Setter**

The external paper will carry 50 marks and would be of three hours duration. The question paper will consist of three sections A, B and C. Sections A and B will have four questions each from the respective sections of the syllabus and each question will carry 7.5 marks. Section C will consist of 10 short answer type questions of 2 marks each covering the entire syllabus uniformly and will carry 20 marks in all. Candidates will be required to attempt four questions in all from section A and B selecting not more than two questions from each of these groups. Section C shall be compulsory.

#### **Instructions for candidates**

- Candidates are required to attempt five questions in all, selecting two questions each from section A and B and compulsory question of section C.
- Use of non programmable scientific calculator is allowed.

**CS-625 E5: DATA SCIENCE****Maximum Marks: 50**  
**Minimum Pass Marks: 40%****Maximum Time: 3 Hrs.**  
**Lectures to be delivered: 50-60**

**Course Objective:** The main objective of this course is developing in depth understanding in the students for key technologies in data science and business analytics: data mining, machine learning, visualization techniques, predictive modeling, and statistics. The students will gain practical, hands-on experience with statistics programming languages and big data tools through coursework and applied research experiences. On completion of this course, the students will be able to:

- To analyze the need and usage of various facets of data and data science process.
- To understand and apply various visualization techniques.
- To perform exploratory data analysis.
- To implement how to manage, manipulate, cleanse and analyze data.
- To understand the steps in model fitting and parameters fine-tuning.
- To apply model validation techniques.

**Course content****SECTION A**

Introduction to Data Science: Meaning of Data Science, Relationship between Big Data and Data Science, Benefits and uses of data science and big data. Facets of data: Structured versus Unstructured data, natural language, machine-generated data, graph-based data, audio, image and video data, Data Science Process: Goal setting, retrieving data, data preparation, data cleansing and transformation, exploratory data analysis, data visualization, Model building and performance evaluation, presentation.

Data set and its features, Meaning of the terms: observations and variables, Discrete and continuous variables, quantitative and qualitative variables, dependent and independent variables, variables classified on scale: Nominal, Ordinal, Interval and Ratio variables. Data Munging and data munging tasks: renaming variables, Data type conversion, encoding, decoding and recoding data, Merging datasets, transforming data, imputation, handling anomalous values, missing values and outliers.

Exploratory Data Analysis: Introduction and purpose of EDA, Descriptive statistics: measurements of location and variability, mean, median and mode, variance and measures of variance: standard deviation, range, skewness, correlation, correlation and causation.

**SECTION B**

Data Visualization: Purpose and techniques of data visualization: Histograms, Box Plots, Scatterplots.

Normal Distribution: meaning and its characteristics, concept of transformations, transformation functions: Power function, Exponential function, Polynomial function, Logarithmic function, Square root function. Model building and variable selection, Dimensionality reduction: Principle of parsimony, Feature selection methods: forward selection and backward selection procedure, stepwise selection procedure. Splitting the dataset: training versus testing datasets, Concepts of overfitting and under-fitting. Model validation and comparison: MSE, Confusion matrix: accuracy, precision and recall, K-folds cross validation technique, Leave-1 out, Repeated splits technique, Bootstrapping.

**Pedagogy:**

The Instructor is expected to use leading pedagogical approaches in the class room situation, research-based methodology, innovative instructional methods, extensive use of technology in the class room, online modules of MOOCS, and comprehensive assessment practices to strengthen teaching efforts and improve student learning outcomes.

The Instructor of class will engage in a combination of academic reading, analyzing case studies, preparing the weekly assigned readings and exercises, encouraging in class discussions, and live project based learning.

#### **Case/Class Discussion Assignments:**

Students will work in groups of up to four to prepare a brief write-up due before the start of each class covering the case study or class material to be discussed in the next session. Questions may include a quantitative analysis of the problem facing the decision-maker in the case.

#### **Class Participation:**

Attendance will be taken at each class. Class participation is scored for each student for each class.

**Text and Readings:** Students should focus on material presented in lectures. The text should be used to provide further explanation and examples of concepts and techniques discussed in the course:

- Joel Grus, Data Science from Scratch, O'Reilly.
- Davy Cielen, Arno D.B. Meysman, Mohamed Ali, Introducing Data Science - Big Data, Machine Learning and More Using Python Tools, Manning Publications Co.
- Rachel Schutt& Cathy O'Neil, Doing Data Science, O'Reilly
- Jiawei Han, MichelineKamber, Jian Pei , Data Mining Concepts and Techniques, Morgan Kaufmann

#### **Scheme of Examination**

- English will be the medium of instruction and examination.
- Written Examinations will be conducted at the end of each Semester as per the Academic Calendar notified in advance
- Each course will carry 100 marks of which 50 marks shall be reserved for internal assessment and the remaining 50 marks for written examination to be held at the end of each semester.
- The duration of written examination for each paper shall be three hours.
- The minimum marks for passing the examination for each semester shall be 40% in aggregate as well as a minimum of 40% marks in the semester-end examination in each paper.
- A minimum of 75% of classroom attendance is required in each subject.

#### **Instructions to the External Paper Setter**

The external paper will carry 50 marks and would be of three hours duration. The question paper will consist of three sections A, B and C. Sections A and B will have four questions each from the respective sections of the syllabus and each question will carry 7.5 marks. Section C will consist of 10 short answer type questions of 2 marks each covering the entire syllabus uniformly and will carry 20 marks in all. Candidates will be required to attempt four questions in all from section A and B selecting not more than two questions from each of these groups. Section C shall be compulsory.

#### **Instructions for candidates**

- Candidates are required to attempt five questions in all, selecting two questions each from section A and B and compulsory question of section C.
- Use of non programmable scientific calculator is allowed.

**CS-625 E6: MULTIMEDIA INFORMATION SYSTEMS**

**Maximum Marks: 50**  
**Minimum Pass Marks: 40%**

**Maximum Time: 3 Hrs.**  
**Lectures to be delivered: 50-60**

**Course Objective:** The main objective of this course is to provide students with a basic understanding of multimedia systems. This course focuses on topics in multimedia information representation and relevant signal processing aspects, multimedia networking and communications, and multimedia standards especially on the audio, image and video compression. On completion of this course students will be able to:

- To acquire fundamentals principles of multimedia, including digitization and data compression for non-textual information
- To understand issues in representing, processing, and transmitting multimedia data
- To understand core multimedia technologies and standards
- To gain hands-on experience in image, sound and video editing and in some aspects of multimedia authoring (incorporating images, sound, video, and animation)
- To design, capture, store and integrate sound, images and video to deliver multimodal information.

**Course content**

**SECTION A**

Multimedia Communications: Multimedia information representation, multimedia networks, multimedia applications, applications and networking terminology.

Multimedia Information Representation: Digitization Principles, text, images, audio, video.

Text and Image Compression: Text compression-Static Huffman Coding, Dynamic Huffman Coding, LZW Coding

Image Compression: File formats: GIF and TIFF, digitized documents, Modified READ, JPEG, Forward DCT, Quantization, Entropy Encoding, Frame building, JPEG decoding.

Audio and Video Compression: Introduction, audio compression (DPCM, ADPCM, APC, LPC, CELP), perceptual coding, MPEG audio coders, Dolby audio coders.

Video compression: Video compression principles, frame types, motion estimation and compensation, implementation issues, H.<sub>261</sub>, H.<sub>263</sub>, MPEG: MPEG-1, MPEG-2, MPEG-4, MP@ML, HDTV.

**SECTION B**

Standards for Multimedia Communications: Introduction, Reference Models, TCP/IP reference model, protocol basics, standards relating to interpersonal communication, circuit-mode networks, H.<sub>320</sub>, H.<sub>321</sub>/H.<sub>310</sub>, H.<sub>322</sub>, H.<sub>323</sub>, IETF, Electronic mail.

Standards Relating to Interactive Applications over Internet: Information browsing, electronic commerce, Intermediate systems.

Standards for Entertainment Applications-video-onDemand, Interactive TV.

Entertainment Networks and High Speed Modems: Cable TV networks, HFC networks, multi-access channel operations, protocol stack, configuration and management, cable MAC, Time synchronization, Ranging, Frame transmission, frame formats, fragmentation.

Satellite TV Networks: Broadcast TV principles, Digital TV, Interactive services, Terrestrial TV networks, Broadcast TV principles, COFDM principles, High speed PSTN access technologies, ADSL, VDSL.

Application Support Functions: Introduction, ASN.<sub>1</sub> Type definitions, Transfer syntax, Security, Data Encryption, The data encryption standard, DES, Triple DES, IDEA, The RSA algorithm, Non repudiation, Authentication, Public Key Certification Authorities.

**Pedagogy:**

The Instructor is expected to use leading pedagogical approaches in the class room situation, research-based methodology, innovative instructional methods, extensive use of technology in the class room, online modules of MOOCS, and comprehensive assessment practices to strengthen teaching efforts and improve student learning outcomes.

The Instructor of class will engage in a combination of academic reading, analyzing case studies, preparing the weekly assigned readings and exercises, encouraging in class discussions, and live project based learning.

**Case/Class Discussion Assignments:**

Students will work in groups of up to four to prepare a brief write-up due before the start of each class covering the case study or class material to be discussed in the next session. Questions may include a quantitative analysis of the problem facing the decision-maker in the case.

**Class Participation:**

Attendance will be taken at each class. Class participation is scored for each student for each class.

**Text and Readings:** Students should focus on material presented in lectures. The text should be used to provide further explanation and examples of concepts and techniques discussed in the course:

- Prabhat K. Andleigh, Kiran Thakrar, “Multimedia Systems Design”, PHI.
- Multimedia Information Networking, Nalin K. Sharda, PHI.

**Scheme of Examination**

- English will be the medium of instruction and examination.
- Written Examinations will be conducted at the end of each Semester as per the Academic Calendar notified in advance
- Each course will carry 100 marks of which 50 marks shall be reserved for internal assessment and the remaining 50 marks for written examination to be held at the end of each semester.
- The duration of written examination for each paper shall be three hours.
- The minimum marks for passing the examination for each semester shall be 40% in aggregate as well as a minimum of 40% marks in the semester-end examination in each paper.
- A minimum of 75% of classroom attendance is required in each subject.

**Instructions to the External Paper Setter**

The external paper will carry 50 marks and would be of three hours duration. The question paper will consist of three sections A, B and C. Sections A and B will have four questions each from the respective sections of the syllabus and each question will carry 7.5 marks. Section C will consist of 10 short answer type questions of 2 marks each covering the entire syllabus uniformly and will carry 20 marks in all. Candidates will be required to attempt four questions in all from section A and B selecting not more than two questions from each of these groups. Section C shall be compulsory.

**Instructions for candidates**

- Candidates are required to attempt five questions in all, selecting two questions each from section A and B and compulsory question of section C.
- Use of non programmable scientific calculator is allowed.

**CS-626 : SOFTWARE LAB – II(Computer Graphics)**

**Maximum Marks: 100\***

**Minimum Pass Marks: 40%**

**Maximum Time: 3 Hrs.**

**Practical Sessions to be conducted: 55-65**

The Laboratory assignments for this lab will include the assignments from the Paper CS-624 (Computer Graphics).

\*The splitting of marks is as under:

Maximum Marks for Continuous Assessment: 60

Maximum Marks for University Examination: 40

<p><b>Continuous Assessment (Practical Labs)</b> *Maximum Marks for Continuous Assessment : 60</p>
<p>4. Two tests will be conducted during the semester. Both the tests will be considered for assessment: 60% of the marks allotted for continuous assessment. 5. Lab Assignments: 30% of the marks allotted for continuous assessment. 6. Attendance: 10% of the marks allotted for continuous assessment.</p>
<p><b>University Examination (Practical Labs)</b> *Maximum Marks for University Examination : 40</p>
<p>The evaluation will be done jointly by the team of internal and external examiner. The examiners will give due weightage to Logic development/Program execution, Lab records and viva-voce of the student while awarding marks to the student during end-semester final practical examination.</p>