الجامعـــة الإسلاميـــة للتكنولوجيا

ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)
ORGANISATION OF ISLAMIC COOPERATION (OIC)

COURSE STRUCTURE
AND
COURSE CONTENTS
For
ACADEMIC CALENDAR 2018-2019
(and onwards)
For
Master of Computer Science and Engineering (CSE),
Master of Engineering in CSE,
Doctor of Philosophy in CSE.

Department of Computer Science and Engineering

December 2018

BRIEF HISTORY

Islamic University of Technology (IUT) is a subsidiary organ of the Organisation of Islamic Cooperation (OIC), representing fifty-seven-member countries from Asia, Africa, Europe and South America. It is dedicated to the development of human resources of the Islamic Ummah in the fields of Engineering, Technology and Technical education and stands as the most visible demonstration of the Islamic Solidarity and Joint Islamic Action under the Makkah-Al-Mukarrarnah Declaration.

This unique educational institution was initially established as the Islamic Centre for Technical and Vocational Training and Research (ICTVTR) in pursuance of a resolution of the 9th Islamic Conference of Foreign Ministers (ICFM), held in Dakar, Senegal in 1978. The foundation stone was laid on 27 March 1981 on the 30-acre land donated by the Government of the People's Republic of Bangladesh to the OIC. ICTVTR was renamed as the Islamic Institute of Technology (IIT), by the 7th Islamic Summit and the 22nd ICFM held in Casablanca, Morocco on 10 -15 December 1994. In appreciation of the activities of IIT, the 28th session of the ICFM held in Bamako. Republic of Mali on 25-27 June 2001, renamed IIT as Islamic University of Technology (IUT).

The academic programme of ICTVTR started in 1986 with only 3 departments (Mechanical & Chemical Engineering, Electrical & Electronic Engineering, and Instructor Training & General Studies) and 65 students, offering Higher Diplomas in Mechanical and Electrical Engineering and Diploma in Technical Education. In course of time IUT added new departments and expanded its academic programmes. At present, IUT has five academic departments and 1000+ students coming from more than 20 Member States of the OIC. It offers Higher Diploma, Bachelors, Post Graduate Diploma, Master's and Doctoral programs. There is ever increasing demand on IUT for admission of more students including female students from the Member States. To meet the demand, IUT has recently expanded its physical facilities, adding a new academic building, modernizing the existing laboratories

and setting up new laboratories with a soft loan from Islamic Development Bank (IDB).

Computer Science and Engineering (CSE) was established in 1998. Back then it was known as Computer Science and Information Technology (CIT) until academic year 2011-2012, when it was renamed as Computer Science and Engineering (CSE). A combination of highly qualified faculty members and state of the art facilities has established the department as one of the leading and prestigious Computer Science departments of the country. The competency of the department is evident from the achievement of the alumni, who have created a brand value both in job sector and academia - in and outside of the country. The CSE department has been started to offer the Bachelor of Science in Software Engineering (BSc in SWE) since the Academic year 2017-18.

Currently the department has 24 full-time faculty members along with part-time faculty members from other reputed universities. There are about 250 undergraduate and 20 graduate students in the department.

REGULAR ACADEMIC PROGRAMMES

IUT has six teaching departments: Department of Technical and Vocational Education (TVE), Department of Mechanical & Chemical Engineering (MCE), Department of Electrical & Electronic Engineering (EEE), Department of Computer Science & Engineering (CSE), Department of Civil & Environmental Engineering (CEE) and Department of Business and Technology Management (BTM). The programmes offered by CSE Department are as follows:

- Doctor of Philosophy in Computer Science and Engineering, PhD (CSE)
- Master of Science in Computer Science and Engineering, M.Sc. Engg. (CSE)
- Master of Science in Computer Science and Application, M.Sc. (CSA)

- Master of Engineering in Computer Science and Engineering M.Engg. (CSE)
- Post Graduate Diploma in Computer Science and Engineering, PGD (CSE)
- Post Graduate Diploma in Computer Science and Application, PGD (CSA)
- Bachelor of Science in Computer Science and Engineering, B.Sc. Engg. (CSE)
- Higher Diploma in Computer Science and Engineering, HD (CSE)
- Bachelor of Science in Software Engineering (B.Sc. in SWE)

Besides conducting the above-mentioned programs, CSE department also offers computer science related courses to the other departments of the university. It manages the email and Internet account systems for all the students, faculty members and staffs of the university. The department also manages the university computer center, organizes programming contest and information technology (IT) festivals. The department offers a week long short-course at the end of each year, focusing on pertinent issues of technology, computing and software development. Resource persons and participants from home and abroad take part in the short-courses.

SHORT COURSES, SEMINARS AND WORKSHOPS

Besides the regular academic programmes, IUT offers short courses, seminars and workshops as part of its statutory obligations, with the objective of assisting the Member States of OIC in developing appropriate human resources in the area of modern and emerging technologies, upgrading and updating the knowledge and skills of the professionals. Some of the short courses offered in recent years are; Workshop on Academic Performance Measurement, Quality Assurance for Technical and Vocational Educations Training (TVET), Recent Applications of Digital Signal Processing and Natural Language Processing with Emphasis on Rural Development. Different

departments of IUT regularly organize seminars and workshops on various topics of current interest. Renowned persons from home and abroad are invited as speakers. Some of the seminars worth mentioning here are: Wireless Communication for Sustainable Rural Development: Delay Tolerant Networks, Competitive Supply Chain Management, Higher Studies Abroad, Renewable Energy Research and Application, Career Development in Networking Industry in Australia, Research and Co-curricular Activities in Computer Science, Huawei Training Center Collaboration - HALP, Comparative Discussion on Higher Studies in Australia and Canada, AVR Microcontroller Workshop 2012, ICRC's Activities Worldwide, Coastal Patrol and Surveillance Networks using AUVs and Delay-Tolerant Networking, Imagine Education in Canada, Non-intrusive Monitoring of 3-Phase Petroleum Carrying Pipeline, Power Electronics in Renewable Energy, Global Satellite System, Prospects of Shipbuilding Industry in the OIC Countries, 5th BSME International Conference on Thermal Engineering and Outcome Based Education.

RESEARCH ACTIVITIES

IUT gives due importance to the creation of knowledge besides dissemination of knowledge. The faculty members carry out research activities in the areas of their specializations and regularly publish papers in reputed journals and present papers in local and international conferences. Some of the current research interests are in the areas: Renewable energy, Computer aided production planning, Robotics, Manufacturing engineering, Production and Operations management, Power electronics, Medical electronics, Communication and networking, Bio-informatics, Artificial intelligence, ICT integration in TVE. IUT has a Department of Research, Extension, Advisory Services and Publication (REASP) which provides administrative support for research activities of different departments and consultancy services to industry and other organizations. REASP regularly publishes bi-monthly News Letter and other reports as required. There is also an Energy and Environment Centre (EEC) which particularly deals with relevant issues.

PHYSICAL FACILITIES OF IUT

The physical facilities of the university include one 5-storey and one 6-storey Academic Buildings, 3 Workshop Buildings, two 5-storey Dormitory Buildings, Student Centre with Gymnasium, a 3-storey Common Facilities Building, Library, Cafeteria, Central Mosque, Medical Centre, Auditorium, Staff Quarters, Laundry and Infirmary. At present, IUT has around 50 laboratories and workshops, which are used for teaching and research purposes. Recently IUT has modernized its existing laboratories and set up new, laboratories, particularly for CSE Department and newly established CEE Department with a soft loan from IDB. Laboratories for CEE Department are: Structure and Concrete laboratory, Geotechnical laboratory, Transportation laboratory, Hydraulics laboratory and Environmental laboratory. For CSE Department, a 3D laboratory, a SUN Solaris laboratory and a Cisco laboratory for CCNA training facility have been set up. The computer centre of IUT is well equipped with many microcomputers. There are a number of servers like Windows 2000 and Windows 2008 based server, Linux based mail server, Proxy server, Authentication server, Web server Radius server, Database server and DNS Server, installed for hosting the Web Site of IUT, Library Management System, Result Processing System, Student Information System, etc. A campus wide Optical Fiber Backbone Network has been installed to facilitate high-speed network and internet services to the users. The halls of residences are also connected to this network to provide the students with internet facility. IUT has a fully air-conditioned library with around 33,000 volumes for use of students, trainees, staff, and researchers. Various library functions and services are computerized. IUT subscribes to 18 hardcopy journals and about 5000 online journals.

CSE DEPARTMENT

VISION

To be recognized as an outstanding provider of future leaders and workforce in Computer Science and Software Engineering.

MISSION

The department's mission is:

- To impart a quality education in the undergraduate and post graduate levels.
- To provide balanced curriculum that focuses on theory and application of software engineering and and responsive to the dynamically changing technological world.
- To excel in research and innovation integrating the faculty knowledge and student skills.
- To prepare students with necessary communication skills pertaining to successful careers in leadership positions.

ASSESSMENT AND GRADING SYSTEMS

The performance of a student in a course is evaluated based on a scheme of continuous assessment, mid-term and semester final examination. For theory courses, this continuous assessment is made through a set of quizzes, class participation, and assignment. The assessment in laboratory/sessional courses is made through observation of the student at work during the class, viva-voce during laboratory hours and quizzes. The distribution of marks in the continuous assessment, mid-term and in the semester-final is as follows:

Class participation	10%
Quizzes and assignment	15%
Mid-term	25%
Semester final	50%

Letter grades and corresponding grade points will be awarded in accordance with the provisions shown below.

Grade	Grade Point	Numerical Markings
A+	4.00	80% and above
A	3.75	75% to below 80%
A-	3.50	70% to below 75%
B+	3.25	65% to below 70%
B	3.00	60% to below 65%
B-	2.75	55% to below 60%
C+	2.50	50% to below 55%
C	2.25	45% to below 50%
D	2.00	40% to below 45%
F	0.00	below 40%

The overall academic progress of a student in a semester is assessed by calculating grade point average (GPA), an internationally recognized measure of student performance. Each course has a certain number of

credits, which describes its corresponding weights. Grade Point Average (GPA) is the weighted average of the grade points obtained of all the courses passed/completed by a student.

$$GPA = \frac{1}{\sum C_i} \sum_{i=1}^{n} (C_i \times GP_i)$$

Where,

n = Number of courses offered in a semester
C_i = Credit hours of the i^{th} course
GP_i = Grade Point obtained in the i^{th} course

ATTENDANCE REQUIREMENT

A student is required to attend at least 85% of the classes held in each course of a semester. The students failing to attend the requisite percentage of classes in any course will not be allowed to appear at the Semester Final Examinations of the course in the semester.

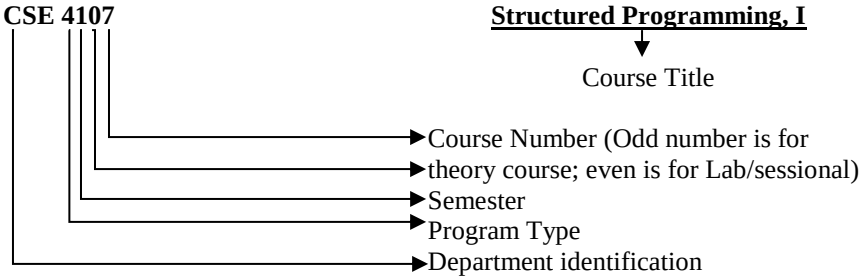
ASSIGNMENT OF CREDIT

The credit hours of a theoretical course and the credit hours of a lab/sessional course refer to contact hours per week and half of the contact hours per week of the courses, respectively.

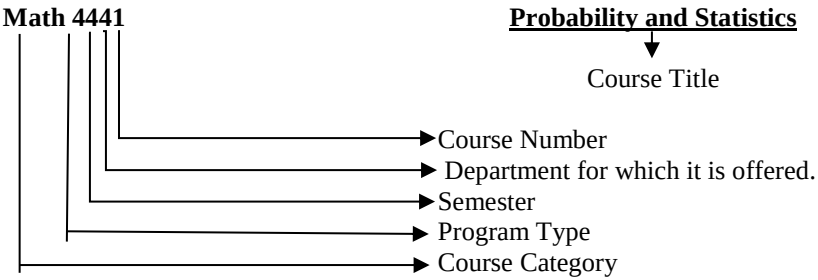
COURSE CODE DETAILS

Each course is designated by a three-letter code identifying the department offering the code followed by a four-digit number having the following interpretation:

- The first digit corresponds to Program type. For example 4 indicates B.Sc. four year course.
- The second digit corresponds to the semester in which the course is normally taken by the students.
- The final two digits refer to the number of the courses, where an odd number indicates a theory course and an even number indicates a sessional/lab course.



For Humanities, Mathematics, Physics and Chemistry the courses are named in the following way.



FACULTY MEMBERS OF CSE DEPARTMENT

Serial No	Name, Designation and Email (Not in the order of seniority)
1.	**Prof. Dr. Muhammad Mahbub Alam**, Professor mma@iut-dhaka.edu
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9.	**Md. Abed Rahman** Lecturer abed@iut-dhaka.edu
10.	**Rafsanjany Kushol** Lecturer rkushol@gmail.com

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21.	**Md. Mohayeminul Islam** Lecturer mohayeminul@iut-dhaka.edu

FACULTY MEMBERS OF CSE DEPARTMENT (ON LEAVE)

Serial No	Name, Designation and Email (Not in the order of seniority)
1.	**Md. Mohiuddin Khan** Assistant Professor mohiuddin@iut-dhaka.edu
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4.	**Kashif Nizam Khan** Assistant Professor
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6.	**Md. Saifur Rahman Mahdi** Lecturer
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9.	**Ahnaf Munir** Lecturer ahnaf@iut-dhaka.edu

PART-TIME FACULTY MEMBERS OF CSE DEPARTMENT

Serial No	Name, Designation and Email (Not in the order of seniority)
01	**Prof. Dr. Md. Obaidur Rahman** Professor, Computer Science and Engineering, DUET orahman@duet.ac.bd
02	**Prof. Dr. Abu Taher** Professor, Math Department, DUET tahermath@yahoo.com
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04	**Dr. Al Amin** Associate Professor Department of Accounting and Information System, DU al_amin130@yahoo.com
05	**Dr. Ahmadullah** Associate Professor Arabic and Islamic Studies Department Dhaka College ahmadullahdr68@gmail.com
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07	**Prof. Dr. Nasrin Akter** Professor Math Department DUET nasrin@duet.ac.bd

Courses offered for Post Graduate Program in Computer Science and Application (CSA)

Course Number	Course Title	Contact Hours	Credit Hours
		L-P	
CSE 6000	Project		*
CSE 6002	Thesis		18.0
CSE 6014	Seminar		1.0
CSE 6015	Selected Topics	3-0	3.0
CSE 6101	Computer Fundamentals & Office Automation **	2-0	0.0
CSE 6102	Computer Fundamentals & Office Automation Lab **	0-3	0.0
CSE 6103	Business Communication & Report Writing	2-0	2.0
CSE 6105	C Programming, Data Structure & Algorithms	3-0	3.0
CSE 6106	C Programming, Data Structure & Algorithms Lab	0-3	1.5
CSE 6107	Object Oriented Programming & System Development	3-0	3.0
CSE 6109	Operating Systems	3-0	3.0
CSE 6112	UNIX Programming & Systems Administration Lab	0-2	1.0
CSE 6113	Software Engineering	2-0	2.0
CSE 6115	DBMS and Database Programming	2-0	2.0
CSE 6116	DBMS and Database Programming Lab	0-2	1.0
CSE 6118	RDBMS using Oracle Lab	0-4	2.0
CSE 6119	Software Project Management	2-0	2.0
CSE 6121	Software Testing & Quality Assurance	2-0	2.0
CSE 6123	Computer Networks	3-0	3.0
CSE 6125	Web Programming & E-Commerce	2-0	2.0
CSE 6126	Web Programming & E-Commerce Lab	0-3	1.5
CSE 6127	Computer Graphics & Multimedia Systems	3-0	3.0
CSE 6129	Computer Systems Architecture	2-0	2.0

CSE 6131	Organizational Information Systems	3-0	3.0

* To be decided depending on the programme.

**CSE-6101 Computer Fundamentals & Office Automation (2-0) and CSE-6102 Computer Fundamentals & Office Automation Lab (0-3) are prerequisite course of 0-credit. Those who do not have sufficient background in computer need to take this course in the First Semester as an extra course. The student should pass the course to be qualified for the degree.

Courses offered for Post Graduate Programme in Computer Science and Engineering (CSE)

Course Number	Course Title	Contact Hours	Credit Hours
		L-P	
CSE 6100	Project		*
CSE 6200	Thesis		18.0
CSE 6024	Seminar		1.0
CSE 6025	Selected Topics	3-0	3.0
Math 6201	Advanced Applied Mathematics	3-0	3.0
CSE 6203	Advanced Graph Theory	3-0	3.0
CSE 6205	Advanced Operating Systems	3-0	3.0
CSE 6207	Advanced Software Engineering	3-0	3.0
CSE 6209	Multimedia Database Systems	3-0	3.0
CSE 6211	Computational Geometry	3-0	3.0
CSE 6213	Advanced Artificial Intelligence	3-0	3.0
CSE 6215	Neural Network	3-0	3.0
CSE 6217	Fuzzy Systems	3-0	3.0
CSE 6219	Symbolic Machine Learning	3-0	3.0
CSE 6221	Advanced Microprocessor and Microprocessor Based Systems	3-0	3.0
CSE 6223	VLSI Layout Algorithm	3-0	3.0
CSE 6225	Fault Tolerant Systems	3-0	3.0
CSE 6227	Advances in Computer Vision	3-0	3.0

Common Post Graduate Courses in CSE and CSA

L=Lecture, P= Practical

Course Number	Course Title	Contact Hours	Credit Hours
		L-P	
CSE 6141	Bioinformatics Algorithms	3-0	3.0
CSE 6143	Structural Bioinformatics	3-0	3.0
CSE 6145	Sequence Analysis	3-0	3.0
CSE 6147	Parallel & Distributed Computing	3-0	3.0
CSE 6241	Wireless Sensor Networks	3-0	3.0
CSE 6243	High Speed Network	3-0	3.0
CSE 6245	Advanced Computer Communications & Networks	3-0	3.0
CSE 6247	Advanced Database Systems	3-0	3.0
CSE 6249	Data Warehousing and Mining	3-0	3.0
CSE 6251	Cryptography	3-0	3.0
CSE 6253	IPV6 and Next Generation Internet	3-0	3.0
CSE 6255	Advanced Internet Computing	3-0	3.0
CSE 6257	Advanced Pattern Recognition	3-0	3.0
CSE 6259	Computer Animation and Virtual Reality	3-0	3.0
CSE 6261	Advanced Probability and Stochastic Processes	3-0	3.0
CSE 6263	Advanced Optimization Techniques	3-0	3.0
CSE 6265	Advanced Image Processing	3-0	3.0
CSE 6267	Networking Systems Analysis	3-0	3.0
CSE 6269	Embedded Systems Design	3-0	3.0
CSE 6271	Mobile Computing	3-0	3.0
CSE 6273	Cloud Computing	3-0	3.0
CSE 6275	Advanced Human Computer Interaction	3-0	3.0
CSE 6277	Software Architecture and Design Patterns	3-0	3.0
CSE 6279	Big Data Analysis and Management	3-0	3.0
CSE 6281	Sensor and Streaming Data Management	3-0	3.0

Detailed outline of postgraduate courses offered by CSE Department (CSA)

CSE 6000	**Project ***		**Credit ***
* Credit depends on the programme			
CSE 6002	**Thesis**		**Credit 18.0**
CSE 6014	**Seminar**		**Credit 1.0**
Contents: The topic of the seminar should be approved by PGC. The students will present few talks on the topic in an open seminar.			
CSE 6015	**Selected Topics**	**3-0**	**Credit 3.0**
Contents: This course may be taken with the prior approval of PGC			
CSE 6100	**Project**		**Credit ***
* Credit depends on the programme			
CSE 6200	**Thesis**		**Credit 18.0**
CSE 6024	**Seminar**		**Credit 1.0**
Contents:			

The topic of the seminar should be approved by PGC. The students will present few talks on the topic in an open seminar.

CSE 6025	**Selected Topics**	**3-0**	**Credit 3.0**

Contents:
This course may be taken with the prior approval of PGC

CSE 6101	**Computer Fundamentals & Office Automation**	**2-0**	**Credit 0.0**

Contents:
Introduction to Computer: Introduction, type and generation of computers, basic organization and functional units, hardware and software, microcomputers-system unit, motherboard, system bus, interface cards, cooling, multimedia PC.
Number systems, codes and logic functions: Binary, decimal, octal and hexadecimal numbers, conversion between different number systems, BCD and ASCII code, binary arithmetic, integer and floating-point numbers representations, logic functions.
Microcomputer and microprocessors: Microcomputer and its organization, basics of microprocessors, popular microprocessors.
Input, output and memory devices: Keyboard, punched card, mouse, OMR, OCR, MICR, CD-ROM, different types of printers, CRT's computer microfilm, floppy disks, magnetic tape and other input and output devices.
Software: Types of software : system software and application software, examples of operating software-DOS, Windows, UNIX and system utilities, classification of application software, package programs (word processing, spreadsheet, database packages, graphic packages, mathematical and statistical package, modeling and simulation package, business and financial packages, communication packages), machine language, assembly language, high level language, mid-level language, language translators: interpreter, compiler and assembler.
Selection, precaution and maintenance of computers.
PC Software e.g. Windows, Microsoft Office.

CSE 6102	**Computer Fundamentals & Office Automation Lab**	**0-3**	**Credit 0.0**

Contents:
Sessional works based on CSE 6101.

CSE 6103	**Business Communication & Report Writing**	**2-0**	**Credit 2.0**

Contents:
Introduction to Communication: Meaning of communication and business communication, nature scope purpose, principles functions and importance, communication model.
Media of Communication: Introduction, written communication, oral communication, face-to-face communication, visual communication, audio-visual communication. Advantages and disadvantages of different media.
Types of Communication: External and internal, formal and informal, downward communication, upward communication, horizontal communication, grapevine, merits and demerits, Media used in different types of communication.
Barrier to effective communication and improvement of communication.
Written communication: Letters, memos, reports, writing good business letters, style and structure, pattern and writing techniques of various business letters, important commercial terms used in office correspondence.
Office memos: Meaning, function and format.
Oral Communication: Speeches, interviews, meetings, conferences, telephonic conversation, techniques, advantages and disadvantages of different oral communication.

Non-verbal Communication: Symbols, gestures, body language, etc. Visual aid in communication.

Fundamentals of Report Writing: Basics of report writing, report structure, the shorter form, long format reports.
Comprehension and Precise Writing: Passage or paragraph related to business management, decision making, developing business relations. Entering into business deals, import quotations, bids.
Art of Addressing, Meeting and Conference: Preparing and presenting seminar papers.
Technology of Business Communication: Early development of communication technology, changes resulting from new technology. A look of the future.
Use of Computer in Business Communication: Advantages and limitations.

CSE 6105	**C Programming, Data Structure& Algorithms**	**3-0**	**Credit 3.0**

Contents:
C Programming:
Program Structure, environment, programming project, Input/output statement, character I/O, string I/O, Identifier, keywords, data types, object and memory addresses, variables, constant, Storage classes, assignment, Operators, precedence, mathematical functions, if statements, case statement, bit-wise operators, Loops: While loop, do while loop, for loops, Arrays, character arrays, string arrays, Jackson structured programming, sequence, selection, iteration, pseudocode, Processor directives, lists, searching methods, sorting methods, Pointers, memory addresses, structures and unions, Sequential and random files.
Data structures:
Introduction, Arrays, Stack and queues, Linked list, Tree, Graphs.
Algorithm:
Introduction, Divide and conquer, The Greedy methods, Dynamic programming, Backtracking.

CSE 6106	**C Programming, Data Structure& Algorithms Lab**	**0-3**	**Credit 1.5**

Contents:
Sessional works based on CSE 6105.

CSE 6107	**Object Oriented Programming & System Development**	**3-0**	**Credit 3.0**

Contents:

An overview of object-oriented programming: The need of the object-oriented program procedure language, the object-oriented approach, advantage of object-oriented program, characteristics of object-oriented languages: object, classes, inheritance, reusability, new data types, polymorphism and overloading.

Object oriented programming using C++:

An overview of C, concepts of objects and OOP, C++ console I/O, C++ comments, introduction to class: difference between C and C++, C++ keywords. Assigning objects, structure and Unions. Passing objects to functions, returning objects from functions, friend functions, in-line function and automatic in–lining. Function overloading, operator overloading. Arrays, pointers and reference. Introduction to inheritance, base class access control, using protected members constructor, destructor and inheritance, multiple inheritance. Virtual functions, Virtual functions applying polymorphism, Generic functions and classes, static class members, virtual base classes, C++/I/O and file I/O basics, array based I/O, linkage specifies and the asm keyword. Creating and conversation function.

Introduction to Java:

Applets, Java bytecodes, Java applications, Introduction to Java development environment, Java operator and data types, Java variables and flow control, Java classes.

CSE 6109	**Operating Systems**	**3-0**	**Credit 3.0**

Contents:

Overview

Introduction to OS-a brief description of its functional behavior & responsibilities as: (a) resource manager, (b) interface between hardware and user etc. Need for some form monitor/command interpreter and evolution from monitor to modern Operating System.

Operating System Organization

Hierarchical/layered organization of OS; system services provided by different layers. Introduction to different software and utilities; assemblers, loaders, linkers, Compilers, editors & other utilities, application packages etc. Classification of system resources, namely, processor, memory, information, device. Separate logical OS modules for management/maintenance of different categories of system resources, interaction between these modules, simplified overall state diagram.

Processor management

Introduction of the process concepts, process scheduling on single/multi CPU systems, short term and long-term scheduling policies. Asynchronous parallel processes, synchronization methods, semaphore, monitor mutual exclusion, hardware support for synchronization and mutual exclusion. Threads/Light Weight Process, advantage of methods, multithreading at system/ user level. Multiprogramming/multitasking; batch and interactive/real time systems; notion of virtual machine. Deadly embrace-detection, avoidance and recovery; resource allocation graph. Protection in virtual m/c, system support i.e., dual mode of execution, system calls etc.

Memory Management

Memory management techniques; brief outlines of swapped, paged segmented and segmented-paged management techniques; Logical and physical address space, address mapping. Virtual memory, protection and address mapping hardware. Page fault; popular page removal algorithms; thrashing.

Device Management and I/O Programming

Classification of devices according to speed, access method and storage capacity; sharable and non-sharable devices and their management; SPOOLing, concept of virtual device. I/O processor; CPU-IOP parallel operation, CPU-IOP communication; device drivers; I/O programming, case study.

Information Management & file system

Information – an important system resource, stored and maintained in files. File Organization and access methods; logical and physical file structure; physical file system realized with device management function; logical file implemented on physical file system. File Protection and security.

Distributed & Network Operating Systems

Brief Introduction to distributed systems; special functions supported by corresponding OS. Network OS; remote login; remote file transfer. Distributed OS; transparent migration of process & data; remote procedure call; robustness, detection and recovery from failures. Distributed file system; mutual exclusion/ synchronization using centralized & distributed approaches; commit protocols, concurrency control, majority protocol & time stamping replication. Deadlock detection/prevention, centralized implementation, distributed algorithms.

Case Studies

Single user system – MSDOS, Multi user system – LINUX/UNIX/Solaris 2.0, Network OS – Novell Netware

CSE 6112	**UNIX Programming & Systems Administration Lab**	**0-2**	**Credit 1.0**

Contents:

Sessional works based on Unix.

On completion of this unit, students will understand the issues involved in user interface design, be aware of the tools available for user interface development, and be able to design and implement a user interface to a given specification.

Recommended Texts:

1. Developing user interfaces: Ensuring usability through product and process, Author: Hix D and Hartson H, John Wiley, 1993.

CSE 6113	**Software Engineering**	**2-0**	**Credit 2.0**

Contents:

Software development life cycles, development process models, Risk based evolutionary approaches: problem analysis and requirements specifications, DFD and data dictionary; Important specification languages; p Function point analysis for estimation of lines and codes; Software Economics – cost evaluation based on COCOMO models and Norden and Raleigh's stochastic model for software cost estimation; Architectural design – modularization, structured design methodology and other process oriented design methodologies, data and object oriented design methodologies; software complexity metrics: code length based, control structure based and hybrid methods; testing in the small: theoretical foundation, black – box and white – box approaches. Integration and system testing; case studies; computer Aided software engineering.

Recommended Texts:

1. Software Engineering, A Practitioner's Approach, Author: Roger S. Pressman, Second Edition.
2. Software Engineering Concepts, Author Richard Fairley:
3. Software Engineering Environments, Author: Robert N. Charette

CSE 6115	**DBMS and Database Programming**	**2-0**	**Credit 2.0**

Contents:

DBMS

Introduction, Database features, advantages & disadvantages, data abstraction and data models, database languages, Transaction Management, Storage Management, database administrator, database users E-R Model: Basic concept, Design Issues, Mapping Constraints, Key conception, Strong & Week Entity set.

Relational database: Basic concept, key/mapping constraints, relational algebra.

Relational commercial language: SQL, QUEL.

Integrity constraints: Domain Constraints, Referential integrity, Functional Dependencies.

Relational database design, Storage and file structure: File Organization, Organization of records in files.
Distributed database
Database Programming using Visual Basic
Visual Basic Data types (built in data types and user defined data types), Control Structure, VBobjects, VBclass, Project and functions (Private, Public).
Introduction to System Analysis and Design.

CSE 6116	**DBMS and Database Programming Lab**	**0-2**	**Credit 1.0**

Contents:
Sessional works based on CSE 6115

CSE 6118	**RDBMS using Oracle Lab**	**0-4**	**Credit 2.0**

Contents:
Environment under Windows NT.
Introduction to relational database Management systems (RDBMS), Understanding Oracle database server structure, Systems primary database operation, Database security, SQL and PL/SQL Concepts, command and syntax techniques, Procedures and Triggers.
Developer/2000: Forms Designer, Report Designer, Menu Designer.
Database Administration (DBA)

Recommended Texts:
1. Oracle Beginner's guide-Oracle Unleashed
2. Database Development in 21 days-Techmedia

CSE 6119	**Software Project Management**	**2-0**	**Credit 2.0**

Contents:
To know about an IT organization, how to manage it and then how a software project is completed starting from initiation of the project.
IT organization, Management of an IT organization.

Software project Management- Software, metrics estimation, planning, software tools, change management and version release assessment, software valuation.
Software Maintenance – Maintainability, documentation to facilitate maintenance, reverse Engineering.
Software reuse – measuring software reuse, reuse metrices, economic model, life cycle & reuse assessment for continuing corporate business activity.
Industrial practice in Software Engineering – software integration, systems installation/generation, and commissioning including parameter tuning for various end users, training by software developers to the marketing & customer support services personnel.

CSE 6121	**Software Testing & Quality Assurance**	**2-0**	**Credit 2.0**

Contents:
The main theme of this course is that a student should know how to debug any system and then correct code.

Introduction and review
Software Testing
Purpose, test case and expected output, test coverage, testing of various areas: unit, domain, path, equivalent class-based portion, component, aggregation, system testing, requirement-based testing, acceptance testing. Test reporting, bug fixing, regression and stress testing, testing for performance, security, installation recovery, configuration sensitivity capture/ reply, report data base, test automation.
Software quality assurance
Quality, quality plan, quality metric, validation & verification, Introduction to ISO-9000 practices for Software Quality Assurance.

CSE 6123	**Computer Networks**	**3-0**	**Credit 3.0**

Contents:

Basic concepts, server, workstation, data communication, signaling, analog and digital communication, synchronous, circuit a packet switching.

Network Topology: Bus, tree ring and star topology, transmission media, coaxial, UTP and optical fiber.
LAN, MAN, WAN, LAN architecture, IEEE standard protocols for LAN
Internetworking, bridges, routers, gateway
Protocol: OSI model and TCP/IP, TCP/IP protocol suit, layers, comparisons, TCP/IP addressing, address classes, Ipv4, Ipv6, address masking, network address, DNS and DHCP.
Domain: Primary and Secondary domain, host, name server, resolve, reverse resolution, DHCP, assigning dynamic IP.
DNS and internet configuration: Root server, cache file, boot file, zone, primary and secondary zone, reverse zone, DNS records such as A, CNAME, MX, NS, PTR, SOA etc. hosts file.
Troubleshooting and maintenance.

CSE 6125	**Web Programming & E-Commerce**	**2-0**	**Credit 2.0**

Contents:
Introduction to Internet technology, Web pages, web servers, HTTP, HTML, VRML, Global databases and digital libraries. Electronic publishing, Context indexing, searching. Introduction to online systems, writing web pages in HTML, video on demand.
Commerce: Paying money over the network, Entertainment, Enterprise, Information economies.
Security privacy and authentication: Encryption and digital signature. Education and distance learning. Public health and medicine.
Introduction to Internet: what is intranet, how and why corporations are using Intranets. Intranets effect on tradition software.
What makes up an Intranet: Intranet the big picture, the detailed picture. putting them all together.

Accessing the intranet: your user ID and password, logging onto your company's network, accessing the company's network while you travel. Using web browsers to access the company's intranet.
Introduction to Web page design:
HTML and DHTML – Concepts, tags, commands, form design, table design, build www home page, online request, dynamic functions, buttons, animations and multimedia.
Java Script, introduction to scripts language, advantages, programming concepts with Java Scripts, variables, control structures, embedding java scripts in HTML, multimedia
Electronic Commerce
Fundamental of electronic commerce, Internet, Intranet, extranet and their Applications. Network security and firewalls. Electronic commerce and the World Wide Web, secure HTTP and Layer. Consumer Oriented electronic commerce. Inter organizational commerce and electronic data interchange.

CSE 6126	**Web Programming& E-Commerce Lab**	**0-3**	**Credit 1.5**

Contents:
Sessional works based on CSE 6125

CSE 6127	**Computer Graphics & Multimedia Systems**	**3-0**	**Credit 3.0**

Contents:
Computer Graphics:
Applications: Presentation graphics, education and training, entertainment, CAD for Architecture, Mechanical engineering, Aeronautical and Automobile industry, others areas: Simulation, Animation, Video games etc.
Graphics devices:
Display systems: raster scan display: refresh CRT, gray shades, look up tables, interfacing: Color monitors: RGB, shadow masks, look up tables, Flat panel; displays: plasma panels, liquid crystal displays, VGA, SVGA resolution, Graphics- input devices: Digitizing tables: electromagnetic, electrical, acoustics types, Mouse: mechanical and optical track balls, data gloves light pens, Touch panels: optical,

capacitive, conic types, Image scanners: type, typical resolutions, sizes, output formats available.
Graphics creation: Geometry and line generation, creating points, lines, rectangles, polygons, circles, arcs curves, charts and graphs in 2D and 3D, light, color, shading, applications such as Adobe Photoshop, Paintbrush etc.
Animation: Tweeking, morphing,
Concept of multimedia: Concepts of hypertent/hypermedia, Multimedia applications: education, video conferencing, training, entertainment, electronic encyclopedias, Multimedia hardware: CD-ROM, Audio speaker, Sound card, video cameras, scanners, MIDI, Images, bit maps, windows paint brush, Currently available multimedia software.
Digital audio: Video and sound-working with digital audio-video and sound, hardware and software requirements.
CD-ROM: Creation, uses, advantage, and disadvantages.

CSE 6129	**Computer Systems Architecture**	**2-0**	**Credit 2.0**

Contents:
Hardware and Software Components
Number Systems, Boolean Logic and Circuit fundamentals, Digital system basic building blocks, Fixed and Floating-Point Binary Arithmetic, Computer Memory Systems.
Introduction to Digital Computer Architecture
Processor Design Principles, Control Unit Design: Conventional and Micro programmed, Input-output System.
Memory & I/O Organization
Interfacing with CPU; Main memory, Auxiliary memory, Cache memories, Associative memory and Virtual memory, I/O interfacing with CPU; Addressing Data transfer Techniques
Introduction to Parallel Processing
Architectural Classification Schemes, Different types of Parallel Architectures and their applications.
Principles of Pipeline and Vector Processing
Arithmetic Pipelines, Pipe lined Introduction Processing, Principles of Designing Pipeline Processors, Pipeline Scheduling Theory.

Synchronous Parallel Processing
SIMD Parallel Algorithms, SIMD Computers and Performance Enhancement.
Interconnection Networks
Usage of various types of permutations, Classifications, Complete non-blocking networks, Commonly used Interconnection Networks.

CSE 6131	Organizational Information Systems	3-0	Credit 3.0

Contents:
Basic concepts about modeling business organizations and business processes; Information system technologies and architectures used to support the operation of organizations;
Managing organization information systems and ensure Information Assurance; new trends in organizational information systems.
The structure and operation of business organizations, business processes; Modeling approaches for organizations, standards and reference architectures; Modeling and analysis approaches for business processes; Technologies and architectures for organizational information systems; OISs Management - plan, implement, deliver, monitor, evaluate, and improve organization information systems; Information Assurance – IT Goal-Risk-Compliance, IT Audit, Information Security; The effectiveness of function support and the quality of organizational information systems.

Recommended Texts:
1. Organizational Information Systems in the Context of Globalization edited by Mikko Korpela, Ramiro Montealegre, Angeliki Poulymenakou, Kluwer academic publishers.

CSE 6141	Bioinformatics Algorithms	3-0	Credit 3.0

Contents:
Introduction; Molecular biology basics: DNA, RNA, genes, and proteins; Restriction mapping algorithm; Motif in DNA sequences, motif finding algorithms; Genome rearrangements, sorting by

reversals and breakpoints; DNA sequence alignments; Gene prediction; Space-efficient sequence alignments, sub-quadratic alignment; DNA sequencing, genome sequencing, protein sequencing, spectrum graphs;
Combinatorial pattern matching: Exact pattern matching, heuristic similarity search algorithms, approximate string matching, BLAST, FASTA; Clustering: Microarrays, hierarchical clustering, K-means clustering, corrupted cliques' problem, CAST clustering algorithm; Evolutionary trees.

Recommended Texts:

1. An Introduction to Bioinformatics Algorithms, Author: Neil C. Jones and Pavel A. Pevzner - (The MIT Press)

CSE 6143	**Structural Bioinformatics**	**3-0**	**Credit 3.0**

Contents:

Introduction; protein domains , Comparative modeling, Structural Alignment, Fold recognition; MHC-peptide interactions, Protein surfaces and protein-protein docking, New fold methods for protein modeling, Macromolecular structure determination by X-ray crystallography, Macromolecular structure determination by NMR spectroscopy, Membrane proteins; antibody engineering, Protein design; RNA structure analysis and modeling, Drug design, Ligand conformation - force field methods, Oligosaccaride structure and modeling.

Recommended Texts:

1. "Structural Bioinformatics", Author: Philip E. Bourne and Helge Weissig (2003, published by Wiley-Liss, ISBN 0-471-20199-5)

CSE 6145	**Sequence Analysis**	**3-0**	**Credit 3.0**

Contents:

Alignment of pairs of sequences, multiple sequence alignment, prediction of RNA secondary structure, profiles, phylogenetic

prediction, Probabilistic approaches to phylogeny, database searching for similar sequence, Markov chains and hidden Markov models, pairwise alignment using HMMs, Profile HMMs for sequence families, Transformational grammars, gene prediction, genome analysis.

Recommended Texts:

1. Biological Sequence Analysis by Durbin et al - (Cambridge University Press, 2002). Bioinformatics Sequence and Genome Analysis, Author: D. W. Mount – (Cold Spring Laboratory Press)

CSE 6147	**Parallel & Distributed Computing**	**3-0**	**Credit 3.0**

Contents:

Parallel Computing:

Models of parallel Computer, design and analysis of parallel algorithms, different paradigms of parallel computing- pipelined, partitioned, asynchronous programs. Theoretical issues of limits to performance, NC-class, RNC class P-complete problems, Network algorithms, Network topologies, scheduling and task assignment, mapping problem, programming tools and environments.

Distributed Computing:

Distributed object systems, Retrieving and caching of distributed information, Distributed data replication and sharing, Performance issues, Algorithms for deadlock detection, concurrency control and synchronization in distributed system, Models for distributed computation, Networking facilities and resource control and management methods in network and distributed operating systems, Collaborative applications, Wide area network computing, We based commerce, Agent systems and Market based computing.

Courses offered to Post-graduate program in Computer Science and Engineering (CSE)

Math 6201	**Advanced Applied Mathematics**	**3-0**	**Credit 3.0**

Contents:

Partial differential equation, Numerical solution of partial differential equation, Laplace transformation and inverse Laplace transformation. Use of Laplace transformation in solution of ordinary and partial differential equation.

Complex function, Analytic Function, Cauchy's integral formula and theorem. Conformal mapping, multiple integration.

Axiomatic theory-propositional calculus, predicate calculus, first order peano arithmetic; Decision procedure and first order logic-resolution theorem provers some theoretical issues; Introduction to prolog as a logic programming language; Model logic; Temporal logic.; Non-monotonic reasoning model theory; Proof theory; Lambda calculus; Theory proving in lambda calculus; Intuitionistic first order logic; Fuzzy logic; Genetic algorithm.

CSE 6203	**Advanced Graph Theory**	**3-0**	**Credit 3.0**

Contents:

Introduction and Fundamental Concepts, Structure and basic definition in graph theory, methodology, proofs, basic properties of graphs; graph operations and their symbolic designation. Orientation of graphs, assocated matrices and their relationship. Groups; automorphism groups, symmetric graphs, graph enumeration, Polya's power group enumeration theorem. Colorability: five color theorem, four color conjecture, Heawood map coloring theorem, critical graphs, homomorphism, chromatic polyonomial. Graph algorithms: DFS for non-separable components, ordered trees, application of Hoffman tree to sort by merge technique, Catalan numbers, maxflow problem, Ford and Flukerson's algorithms, Dinic's algorithm, zero-one net flow, maximum matching in bipartite graphs, NP-complete problems, vertex cover, Hamiltonian paths and circuits, coloring, Steiner tree; max-cut, multicommodity integral flow.

CSE 6205	**Advanced Operating Systems**	**3-0**	**Credit 3.0**

Contents:

Brief review of process synchronization in a multiprocessing/ multiprogamming systems. Inter process communication and co-ordination in large distributed systems.

Information management: information management in distributed network: security, integrity and concurrency problems in sharing of information-techniques in distributed systems. Case studies of contemporary systems.

CSE 6207	**Advanced Software Engineering**	**3-0**	**Credit 3.0**

Contents:

Introduction and review

Software quality assurance – quality, quality plan, quality metric, validation & verification, Introduction to ISO-90000 practices for Software Quality Assurance

Software Testing – Purpose, test case and expected output, test coverage, testing of various areas: unit, domain, path, equivalent class-based portion, component, aggregation, system testing, requirement-based testing, acceptance testing. Test reporting, bug fixing, regression and stress testing, testing for performance, security, installation recovery, configuration sensitivity capture/ reply, report data base, test automation.

Software project Management- Software, metrics estimation, planning, software tools, change management and version release assessment, software valuation.

Software Maintenance – Maintainability, documentation to facilitate maintenance, reverse Engineering.

Software reuse – measuring software reuse, reuse metrices, economic model, life cycle & reuse assessment for continuing corporate business activity.

Industrial practice in Software Engineering – software integration, systems installation/generation, and commissioning including parameter tuning for various end users, training by software developers to the marketing & customer support services personnel, ISO-9000 Certified Quality Assurance Programme.

CSE 6209	**Multimedia Database Systems**	**3-0**	**Credit 3.0**

Contents:

Introduction to multimedia database – Type of multimedia information, multimedia database applications, characteristics of multimedia objects, components of a multimedia database management system.

Multimedia storage and retrieval – Multimedia object storage, file retrieval structures, disk scheduling, server admission.

Multimedia information modeling – Metadata for multimedia, multimedia data access, object-oriented models, temporal models, models and multimedia authoring.

Querying multimedia databases – Query process and query languages.

MMDBMS architecture – Distributed MMDBMS architecture, client server components, implementation consideration

CSE 6203	**Computational Geometry**	**3-0**	**Credit 3.0**

Contents:

Introduction and Fundamental Concepts, Structure and basic definition in graph theory, methodology, proofs, basic properties of graphs; graph operations and them

CSE 6211	**Advanced Graph Theory**	**3-0**	**Credit 3.0**

Contents:

Searching and Geometric Data Structures : Balanced binary search trees, Priority-search trees, Range searching, Interval trees, Segment trees, Algorithms and complexity of fundamental geometric objects:

Polygon triangulation and Art gallery theorem, Polygon partitioning, Convex-hulls in 2-and 3- dimension, Dynamic convex-hulls,; Geometric intersection: Line segment intersection and the plane-sweep algorithm, Intersection of polygons; proximity: Voronoi diagrams, Delunay triangulations, closest and
furthest pair; Visualization: Hidden surface removal and binary space partition (BSP) trees; Graph Drawings: Drawings of rooted trees (Layering, Radial drawings, HV-Drawings, Recursive winding), Drawings of planar graphs (Straight-line drawings, Orthogonal drawing, Visibility drawings); Survey of recent developments in computational geometry.

CSE 6213	**Advanced Artificial Intelligence**	**3-0**	**Credit 3.0**

Contents:
Introduction, Advanced search techniques in AI, Knowledge based system design, Advance plan generating systems, Bayesian network and probabilistic reasoning, Learning in neural belief networks, Practical natural language processing, Computer vision, Introduction to Robotics.

CSE 6215	**Neural Network**	**3-0**	**Credit 3.0**

Contents:
Fundamentals of Neural Networks; Backpropagation and related training algorithms; Hebbian learning; Cohen-grossberg learning; The BAM and the Hopfield Memory; Simulated Anealling; Different type of Neural Networks: Counterpropagation, Probabilistic, Radial Basis Function, Generalised Regression, etc; Adaptive Resonance Theory; Dynamic Systems and Neural Control; The Boltzmann Machine; Self-organising Maps; Spatiotemporal Pattern Classification, The Neocognition; Practical Aspects of Neural Networks.

CSE 6217	**Fuzzy Systems**	**3-0**	**Credit 3.0**

Contents:

Basic Concepts of Fuzzy set theory; Fuzzy numbers; Aggregation operations of Fuzzy sets; The theory of approximate reasoning; Introduction to Fuzzy logic control; Fuzzy System Models and Developments; Fuzzy logic controllers; Defuzzification methods; Linguistic descriptions and their analytical forms; The flexible structure of fuzzy systems; Practical Aspects of Neural Networks.

CSE 6219	**Symbolic Machine Learning**	**3-0**	**Credit 3.0**

Contents:

Introduction, Supervised and unsupervised learning in propositional logic, Induction of decision trees, noise and over-fitting issues, minimum description length principle, conceptual clustering, version space, nearest neighbor classifier, genetic algorithm, computational learning theory, neural network and fuzzy logic.

Learning in first order logic, top-down approaches for inducing first order theory, handing noise, first order theory revision, predicate invention, application of inductive logic programming, multiple predicate learning, different types of language bias, PAC learnability, knowledge discovery in database and data mining, text and image retrieval.

CSE 6221	**Advanced Microprocessor and Microprocessor Based Systems**	**3-0**	**Credit 3.0**

Contents:

Architecture of 16-bit and 32-bit microprocessors, - a comparative study, Review of different microprocessors 80484 / V70, microprocessors; Comparing the architectures: RISC and CISC Instruction set of machines: SPARC, INTEL and MIPS; Study of microprocessors Pentium U, Alpha 21064, MIS 6400, PA-RISC; Math coprocessors for microprocessors.

Concepts of memory mapping and management, virtual memory management, memory protection and support. Numeric data processor; Multi-user and real time multitasking support; multiprocessing support: bus interfacing, arbitration and

communication mechanism; architecture of signal processing microprocessors, real time signal processing.

CSE 6223	**VLSI Layout Algorithm**	**3-0**	**Credit 3.0**

Contents:

Technique for repaid implementation for very large-scale integration (VLSI) circuits. Selection of technology and logic; Design process, Design rules.

Basic graph algorithms and computational geometry algorithms related to VLSI layout; Partitioning algorithms; group migration algorithms, simulated annealing and evaluation, performance driven partitioning; Floor planning and placement algorithms: constraint based floor planning, rectangular dualization and rectangular drawings, integer programming based floor planning simulation based placement algorithms, partitioning based placement algorithms; Pin assignment algorithms; Routing algorithms: maze routing algorithm, line prob algorithms, shortest-path based and Steiner tree based algorithms, river routing algorithms, orthogonal drawing based algorithms; Compaction algorithms: constraint-graph based compaction, virtual grid based compaction, hierarchical compaction, algorithms for multi-chip module (MCM) physical design automation.

CSE 6225	**Fault Tolerant Systems**	**3-0**	**Credit 3.0**

Contents:

Introduction to redundancy theory, limit theorems, decision theory in redundant systems. Hardware fault tolerance: Computer redundancy techniques – detection of faults-replication and compression techniques – self repairing techniques- concentrated and distributed voters, models of fault tolerant computer-case study of existing systems. Software fault-tolerance: Fault tolerance versus fault intolerance, fault tolerance objectives; errors and their

management strategies, implementation of error management strategies. Software fault tolerance techniques –software defense, protective redundancy. Architectural support of faul-tolerant software protection mechanisms, recovery mechanisms.

CSE 6227	Advances in Computer Vision	3-0	Credit 3.0

Contents:

Early Vision

Simple Vision System; Image Formation; Image Processing: Color, Linear Filtering, Pyramids and Wavelets, Texture; Feature Detection and Matching: Detectors and Descriptors;

Mid-Level Vision

Clustering and Segmentation: Active Contours, Split and Merge, Mode Finding; Feature-based Alignment: 2D and 3D alignment, Pose Estimation, Geometric Intrinsic Calibration; Structure from Motion; Dense Motion Estimation; Image Stitching;

High-Level Vision

Computational Photography: Photometric Calibration, High Dynamic Range Imaging, Super-resolution, Blur Removal, Image Matting; Stereo Correspondence; 3D Reconstruction: Shape from X, Surface Representation, Model-based Reconstruction; Image-based and Video-based Rendering; Recognition: Object Detection, Face Recognition, Instance Recognition, Category Recognition, Context and Scene Understanding; Computer Vision: State-of-the-art and the Future.

Recommended Texts:

1. Richard Szeliski, Computer Vision: Algorithms and Applications, Springer, 2010.
2. David A. Forsyth and Jean Ponce, Computer Vision: A Modern Approach, Prentice Hall, 2002.

CSE 6241	Wireless Sensor Networks	3-0	Credit 3.0

Contents:

Introduction: applications; Localization and tracking: tracking multiple objects;
Medium Access Control: IEEE 802.15.4, S-MAC, T-MAC, P-MAC, B-MAC, Z-MAC, and ZigBee; Geographic and energy-aware routing;
Challenges of low power wireless networking protocols and applications.
The OSI model, IEEE-802.11, Bluetooth, IEEE-802.15.4, IEEE 1451, hardware considerations, traffic patterns, media access (CSMA, TDMA, RTS/CTS, idle listening), DSSS, UWB, radio propagation models, cross-layer interactions, flooding, dissemination, gossip, epidemics, probabilistic approaches, global versus local communication, and in-network processing.
Attribute-Based Routing: directed diffusion, rumor routing, geographic hash tables;
Infrastructure establishment: topology control, clustering, time synchronization;
Sensor tasking and control: task-driven sensing, information-based sensor tasking, joint routing and information aggregation;
Sensor network databases: challenges, querying the physical environment, in-network aggregation, data indices and range queries, distributed hierarchical aggregation;
Sensor network platforms and tools: sensor node hardware, sensor network programming challenges; other state-of-the-art related topics.
Students read papers and build working protocols on TinyOS, a low-power embedded operating system.

Recommended Texts:

1. Sensor Network Operations. Shashi Phoha, Thomas La Porta, Christopher Griffin, IEEE press. ISBN-13978-0-471-71976-2
2. Wireless Sensor Networks, Technology, Protocols, and Applications, Author: Kazem Sohraby, Daniel Minoli, Taieb Znati, Wiley-Interscience, ISBN 978-0-471-74300-2

CSE 6243	**High Speed Network**	**3-0**	**Credit 3.0**

Contents:

Introduction to high-speed networks, real-time data transfer applications, virtual meeting, video conferencing and online treatment.

High speed local area networks, Fast Ethernet, FDDI, 100VG-AnyLAN, Gigabit Ethernet, HIPPI and Fiber Channel.

Components of multimedia networks, multimedia network protocols, multimedia information loading, ISDN and BISDN, ATM networks, ATM cells, ATM AAL protocols, ATM switching and a comparative study of Gigabit Ethernet and ATM networks.

High speed Internet connections, T/E-carrier multiplexing, SONET, SDH and STM networks in details.

Multimedia traffic requirements – performance of network carrying video traffic, quality requirements and measures – frame size – frame depth – compression ratio – multimedia network management protocols – reliability issues

CSE 6245	**Advanced Computer Communications & Networks**	**3-0**	**Credit 3.0**

Contents:

Overview of Internet Technology, Internet services, Electronic Mail, Usenet, SNMP, SMTP, URL, URI, HTTP, MIME, WWW and E-commerce

Networking with TCP/IP, TCP/IP sub protocols, TCP/IP administration and troubleshooting, the Internet protocol, Routing algorithms, Congestion Control Algorithms, IP addressing, Subnetting, Gateways, Sockets and ports,

ARP, RARP, multicasting, IPV4 and IPV6, ICMPV6, Host names and DNS, Name servers, BOOTP, DHCP and WINS

Introduction to wireless networks, wireless media, wireless LAN, wireless LAN protocols, wireless ATM networks, voice over IP (VoIP), Mobile IP, Internet using mobile phones, Roaming Algorithms, Handover techniques, satellite communications.

Network security, security requirements, security audits, security risks, data encryption, cryptographic principles, different key-algorithms, digital signatures and firewalls

Managing and Maintaining a network, network troubleshooting, performance evaluation, network upgrade, ensuring integrity and availability, fault tolerance, data backup, disaster recovery.

CSE 6247	Advanced Database Systems	3-0	Credit 3.0

Contents:

Object Oriented Database; Data Model, Design, Languages;

Object Relational Database: Complex data types, Querying with complex data types, Design;

Distributed Database: Levels of distribution transparency, Translation of global queries to fragment queries, Optimization of access strategies, Management of distributed transactions, Concurrency control, Reliability, Administration; Parallel Database: Different types of parallelism, Design of parallel database; Multimedia Database Systems Basic concepts, Design, Optimization of access strategies, Management of Multimedia Database Systems, Reliability; Database Wire-housing/Data mining: Basic Concepts and algorithms.

File organization and access, buffer management, performance analysis, and storage management. Database system architecture, query optimization, transaction management, recovery, concurrency control. Reliability, protection, and integrity. Design and management issues.

Recommended Texts:

1. Advanced Database Systems (Lecture Notes in Computer Science), Author: Nabil R. Adam, Bharat K. Bhargava
2. Advanced Database Technology and Design (Artech House Computer Library), Author: Mario Piattini

CSE 6249	Data Warehousing and Mining	3-0	Credit 3.0

Contents:

Introduction; Data warehousing and OLAP technology for data mining; Data preprocessing; Data mining primitives, languages and systems; Descriptive data mining: characterization and comparison;

Association analysis; Classification and prediction; Cluster analysis, Mining complex types of data; Applications and trends in data mining.

CSE 6251	**Cryptography**	**3-0**	**Credit 3.0**

Contents:

Classical cryptography: Intro to simple cryptosystems (Shift Cipher, Substitution Cipher, Hill Cypher, Permutation Cipher etc.), Cryptanalysis; Shanon's Theory: Perfect Secrecy, Entropy, Perfect Cryptosystems; The Data Encryption Standard: Description, Modes of operation, Differential Cryptanalysis; RSA System and Factoring: Intro to Public-key cryptography, The RSA cryptosystem, Attacks on RSA, Factoring Algorithms; Other Public key cryptosystems: The ElGamal cryptosystem and discrete Logs, The Merkle-Hellman Knansack System; Signature Schemes: The ElGamal Signature Scheme, The Digital Signature Standard, FailStopSigntures; Hash Functions: Signatures and Hash Functions, Collision-Free Hash Functions, TheBirthday Arrach; Key Distribution & Key Agreement: Key Pre-distribution, Kerboros, DiffieHellmanKeyKeyExchange; Identifi-cation Schemes: The Schnorr Identification Scheme, The Okamoto Identification Schemes; Authentication Codes: Computing Deception Probabilities, Combinatorial Bounds, Entropy Bounds; Secret Sharing Schemes: The Shamir Threshild Scheme, Access Signatures and General Secret Sharing; Pseudo Random Number Generation: Indistinguishable Probability Distribution; Zero Knowledge Proofs: Interactive Proof Systems, Computation Zero knowledge proofs.
Computer systems and Network Security

CSE 6253	**IPV6 and Next Generation Internet**	**3-0**	**Credit 3.0**

Contents:

IPv6 Versus IPv4, The Structure of the IPv6 Protocol, IPv6 Addressing, ICMPv6, Security in IPv6, Quality of Service in IPv6, Networking Aspects, Routing Protocols, Upper-Layer Protocols, Interoperability, Dual-Stack Techniques, Tunneling Techniques, Network Address and Protocol Translation, Comparison, Vendor Support

Recommended Texts:

1. Understanding IPv6, 1st Edition, Author: Youngsong Mun, Hyewon K. Lee, Springer
2. IPv6 in Practice: A Unixer's Guide to the Next Generation Internet, Author: Benedikt Stockebrand, Springer
3. IPv6 Essentials 1st edition, Author: Silvia Hagen, O'Reilly Media, Inc.

CSE 6255	**Advanced Internet Computing**	**3-0**	**Credit 3.0**

Contents:

Introduction to Internet Technology, web servers and HTTP, URLs, Forms and CGI, JavaScript, Cookies, Java and Servlets, Databases and ASP, JDBC

Markup languages – SGML, HTML, DHTML, XML, WML, their standards, Publishing information in XML and WML, Extracting product information and application development with XML or WML.

Active server pages, IIS and PWS environment, ASP variables and control structures, data storage and access, ASP object models, Advanced data handling techniques.

Application development using Java Scripts, Java applets, Java Servlets, Java Database Connectivity (JDBC)

Introduction to PHP programming, variables and control structures, Database connectivity and Application development with PHP

CSE 6257	**Advanced Pattern Recognition**	**3-0**	**Credit 3.0**

Contents:

Introduction, Review of the basic concept of Pattern Recognition, Statistical PR, supervised and unsupervised learning, Syntactic pattern recognition

Introduction to neural recognition and neural pattern associators and matrix approach. Application in various area e.g. Printed character recognition, Transforming scanned information to text Computer vision, Speech, Hand-written character, etc.

CSE 6259	Computer Animation and Virtual Reality	3-0	Credit 3.0

Contents:

Animation:

Introduction - Computer graphics, Two- and three-dimensional geometry, Vectors in graphics.

Three–dimensional modeling and representation - Representation and modeling of objects, Polygonal representation, Parametric representation, Constructive solid geometry.

Transformation and viewing - Frames of reference, Viewing systems, 3D transforms, Projections. Clipping.

Reflection and Illumination Models - Theoretical considerations in reflection, Geometric considerations, Color, Phong reflection model.

Surface rendering - Incremental shading algorithms, Rasterization, Hidden surface elimination algorithms, Hidden line removal methods.

Splines - Spline specifications, Cubic splines, Bezier curves, B-spline curves and surfaces, Rendering parametric surfaces

Shadows and Textures - Function of shadows, Shadow algorithms, Textures, Texture domain techniques.

Graphics Animation - Real-time graphics, Graphics display and updates, Keyframing systems, Motion specification.

Virtual Reality

Introduction - Virtual reality, Virtual reality systems, Real-time computer graphics, Overview of application areas.

Virtual Reality Systems - The virtual environment, The computer environment, VR technology, Modes of interaction.

Virtual reality hardware - Sensor hardware, Display Systems, Acoustic hardware, Integrated VR systems.
Virtual reality software - Modeling of virtual worlds, Simulation, VR toolkits.
3D Computer Graphics - The virtual world space, Perspective projection, Stereo vision, 3D clipping, Color theory, 3D modeling, Illumination models, Shading algorithms, Hidden surface removal, Realism
Geometrical transforms - Frames of reference, 3D transforms, Instances, Picking, Flying, Scaling the VE, Collision detection.
Animating the virtual environment - Introduction to animation, the dynamics of numbers, Updating real-time graphics, Shape and object inbetweening, Free-form deformation.
Human factors - Perception, Persistence of vision, Stereopsis, Sound perception, Equilibrium.
Physical simulation - Simulation of physical systems, Mathematical modeling, Collisions, Projectiles, Introduction to dynamics, Motion kinematics.

CSE 6261	**Advanced Probability and Stochastic Processes**	**3-0**	**Credit 3.0**

Contents:
Review of Probability Theory, Random Variables, Conditional Probability and Expectation, Combinatorial Methods, Discrete Functions and Discrete Random variables, Probability Density Functions, Different distributions, Joint Distribution of two Random Variables, Independent Random Variables, Transformation of two Random Variables, Multivariate Distributions, Joint PMF, Joint PDF, Random Samples, Order Statistics, Multinomial Distributions, Covariance, Correlation, Sums of Independent Random Variables and Limit Theorems, Moment Generating
Functions, Markov and Chebyshev Inequalities, Central Limit Theorem. Introduction to stochastic processes, Random walks, Finite- Order Systems and State Variables, Entropy, Markov Chains, Higher Transitions Probabilities, Classification of States of Markov Chains, The Exponential Distribution and the Poisson Process, Continuous Time Markov Chains, Renewal Theory, Markov

Processes and Queuing Theory, Reliability Theory, Brownian Motion and Stationary Processes.

Recommended Texts:

1. Introduction to Probability Models, Sheldon M. Ross, Elsevier.
2. Probability and Stochastic Process, Roy D. Yates & David J. Goodman.
3. Probability, Random Variables and Stochastic Processes, Athanasios Papoulis & S. Unnikrishna Pillai- Tata McGraw- Hill Edition

CSE 6263	**Advanced Optimization Techniques**	**3-0**	**Credit 3.0**

Contents:

Linear Programming review, Basic solution, Geometric solution, Linear algebra and convex analysis, Convex sets and convex functions, Polyhedral sets and polyhedral cones, Simplex method, Extreme points and optimality, Basic feasible solutions, Terminations: optimality and unboundedness, Initial basic feasible solution, Two-phase method, Big-M method, Single artificial variable technique, Degeneracy and cycling, Special simplex forms and optimality conditions, Revised simplex method, Simplex method for bounded variables, The Kuhn-Tucker conditions, Duality and sensitivity, Primal-Dual relationships, Dual simplex method, Primal-Dual method, Artificial constraint technique, Sensitivity analysis, Parametric analysis, Decomposition principle and algorithm, Unconstrained minimization, Equality constrained minimization, Inequality constrained minimization problems, Logarithmic barrier function and central path, Barrier method, complexity analysis via self-concordance, Primal-Dual interior-point methods, Equality Constrained Minimization.

Recommended Texts:

1. Linear Programming and Network Flows, Mokhtar S. Bazaraa, Johnn J. Jarvis John Willey & sons, Inc.
2. Convex Optimization, Stephen Boyd & Lieven Vandenberghe, Cambridge University Press.

3. Convex Analysis and Optimization, Dimitri P. Bertsekas, Belmont, MA: Athena Scientific, 2003.

CSE 6265	Advanced Image Processing	3-0	Credit 3.0

Contents:

Basic Terminologies, Image Enhancement in Spatial and Frequency Domain, Fourier Transform, Frequency Domain, Filters and Filtering Techniques, Image restoration; noise reduction using spatial filters; adaptive filtering; noise reduction using frequency domain techniques; image degradation; Color Image Processing, Color Models, Color Transformation Color Segmentation, Wavelets and Multiresolution Processing, Image Compression Models and Standards, Elements of Information Theory, Error-Free Compression, Lossy Compression, Morphological operators, Basic Morphological Algorithms, Image Segmentation, Detection of Discontinuities, Region-Based Segmentation, Motion in Segmentation, Representation and Description, Object Recognition, Patterns and Pattern Classes, Edge and Corner Detection, SIFT Features, Distance Transforms and Matching, 3D Camera Geometry, Stereo Vision, Markov Random Field (MRF) Models, Optical, Flow, Parametric Motion, Structure from Motion.

Recommended Texts:

1. Digital Image Processing, Rafael C. Gonzalez, Richard E. Woods, Prentice-Hall.
2. Image Processing: Analysis and Machine Vision, M.Sonka, V.Hlavac, R.Boyle Chapman & Hall Computing, 3rd edition, 2007.
3. Image Processing & Computer Vision: Morris, T. (Palgrave Macmillan, 2004)

CSE 6267	Networking Systems Analysis	3-0	Credit 3.0

Contents:

Review of probability theory, conditional probabilities and Bayes' Formula, Random variables, expectation and variance, conditional expectations, Poisson Process and Markov Chain, Renewal Process.

Introduction to performance analysis of communication networks, Concepts of mathematical modeling, analysis of error correction codes, modeling random access techniques in data networks and their performance analysis, Queuing models for communication networks, Analysis of routing protocols, Modeling TCP and its variants and analyzing their performance, delay modeling and analysis, fairness analysis.

Recommended Texts:

1. Introduction to Probability Models, Sheldon M. Ross, Elsevier.
2. An Introduction to Communication Method Analysis, George Kesidis, Wiley InterScience
3. Performance Analysis of Communication Networks and Systems, PIET Van Mieghem, Cambridge University Press.

CSE 6269	**Embedded Systems Design**	**3-0**	**Credit 3.0**

Contents:

Review of Embedded System Architecture and Instruction Set; ARM Architecture and Instruction Set; Embedded Hardware Basics; Embedded Microprocessors; Input/output Management in Embedded Systems; Embedded Board Buses; Software Library Development, Debugging Strategies and Techniques, Device Driver Development; Monitors, Boot Loaders, Microprocessor Supervisory Circuits, Watchdog Timers, Tolerances and Margins; Embedded OS Middleware; Embedded System Design Architectures, Design Patterns and Reference Models; Peripherals Interfacing; Embedded Design Implementation and Testing, Software Tools for Embedded System Implementation; Embedded Software Optimization & Power Aware Programming; Networks-on-chips; Memory Management and Interfacing.

Recommended Texts:

1. Wayne Wolf, Computers as Components: Principles of Embedded Computing System Design, 2nd Edition, Morgan Kaufman Publishers, 2008
2. John Shen, Mikko Lipasti, Modern Processor Design
3. Sreekrishnan Venkateswaran Essential Linux Device Drivers (Prentice Hall Open Source Software Development Series)

CSE 6271	Mobile Computing	3-0	Credit 3.0

Contents:

Introduction, Business Contexts of Mobile Applications, Mobile Application Architectures, Mobile Infrastructure, The Wireless Internet World Stage,The Equipment and Technology of Wireless, Wireless Networks (1G, 2G, 2.5G, 3G),Wireless Internet Applications and Content , Wireless Services , Mobile Client User Interface, Mobile Client Applications, Servlets, SORCER Services, J2ME/MIDP 2.0 Programming, Building MIDlets, CLDC (Connected, Limited Device Configuration), Creating MIDP UIs , Client-Server Data Transfer, Connecting to the World (services).
Mobilizing Existing Application Architectures, Mobility and Location Management, Mobile Application Development Management, Persistent Storage, Mobile Applications, Pocket Web Host Design, The Game API, Sound and Music, Sample MIDP Applications, Data Management, Performance Tuning, Parsing XML, Security, Protecting Network Data, Mobile Ad Hoc and Sensor Networks, Security for Mobile and Wireless Computing

Recommended Texts:

1. Mobile Design and Development - Practical concepts and techniques for creating mobile sites and web apps, Brian Fling, O'Reilly Media, August 2009.
2. Mobile Applications; Architecture, Design, and Development, V. Lee, H. Schneider, and R. Schell, 2004, HP Professional Books / Prentice Hall PTR
3. Mobile Computing - A Systems Integrator's Hanbook, Chander Dharwan, McGraw-Hill, 2000.

CSE 6273	Cloud Computing	3-0	Credit 3.0

Contents:

Review of cloud computing: Types of cloud computing; enabling technologies-virtualization, Web services, SOA, Web 2.0, mashup; cloud features; platforms. Comparable technologies: Grid Computing; Utility Computing; The role of grid computing in cloud computing; Difference between cloud and utility computing. Cloud architecture: Cloud scheduling; Scalability, reliability and security of the cloud; Workflow management in cloud; Network infrastructure for cloud computing. Cloud service Models: SaaS, PaaS, IaaS, DaaS. Cloud computing applications and solutions: Virtual private cloud; Scientific services and data management in cloud; Enterprise cloud; Medical information systems. Cloud business models.

Recommended Texts:

1. Handbook of Cloud Computing, First Edition, 2010, Springer.
2. "Cloud Computing, Implementation, Management, and Security", by John W. Rittinghouse and James F. Ransome, ISBN:978-1-4398-0680-7, CRC Press, 2010.
3. "Cloud Application Architectures", by George Reese, ISBN: 978-0-596-15636-7, O'Reilly, 2009.

CSE 6275	Advanced Human Computer Interaction	3-0	Credit 3.0

Contents:

Overview of Human-Computer Interaction basics; human factors and ergonomics, human cognitive capabilities and limitations, human information processing; interaction techniques and interface types, metaphors; design principles and guidelines for intelligent user interface; interaction framework; interaction paradigm: ubiquitous computing, pervasive computing, context-aware computing; requirement analysis tools and techniques, ethnographic approach of data gathering, contextual design, contextual inquiry; tools and techniques for developing prototypes; evaluation of design,

different evaluation tools and techniques; user centered design, HCI as a software engineering lifecycle model; usability engineering.
Representative research area topics: Animation in interfaces, computer supported co-operative work, design environments and their design, hypermedia interfaces to information networks (World Wide Web), localization (tailoring to cultural requirements), natural language interfaces, object-oriented design and HCI, participative design, public use systems, speech interaction, usability evaluation, user interface management systems, user modeling, virtual reality.

Recommended Texts:

1. Human-Computer Interaction: An Empirical Research Perspective by I. Scott MacKenzie, published by Morgan Kaufmann / Elsevier.
2. The Human–Computer Interaction Handbook - Fundamentals, Evolving Technologies, and Emerging Applications; Edited by Andrew Sears, UMBC and Julie A. Jacko, Georgia Institute of Technology.

CSE 6277	**Software Architecture and Design Patterns**	**3-0**	**Credit 3.0**

Contents:

Introduction to software architectures, Architectural Styles, creating an architecture, analyzing an architecture, documenting an architecture, Software product lines, Reconstructing a software architecture, Component-based development, Aspect-Oriented design: Aspects, themes, concerns.
Overview of Object-oriented design, Overview of UML: Use cases, class diagrams, and other UML diagrams, Object constraint language (OCL).
Introduction to design patterns, Coupling and cohesion, Why design patterns, Creational patterns: Singleton, Abstract Factory, Builder, Prototype, Structural patterns: Facade, Composite, Bridge, Proxy, Adapter, Decorator, Behavioral patterns: Chain of responsibility, Visitor, Observer, Iterator, Command, Mediator, Strategy, Interpreter, Memento.

Recommended Texts:

1. "Design Patterns: Elements of Reusable Object-Oriented Software", E. Gamma, R. Helm, R. Johnson, and J. Vlissides, Addison -Wesley Professional, 1995.
2. Essential Software Architecture", Ian Gorton, Springer,2006.
3. Patterns in Java: A Catalog of Reusable Design Patterns Illustrated with UML, 2nd Edition, Volume 1, Mark Grand, Wiley, 2002.

CSE 6279	Big Data Analysis and Management	3-0	Credit 3.0

Contents:

Reservoir sampling; sampling from databases; Monte Carlo estimation; approximate counting; sketching and synopses techniques; statistical analysis using open source frameworks like Mahout, R and other statistical tools.

Existing tools and applications managing big data on large clusters of commodity machines, initiated by Google, and followed by many other web companies such as Yahoo, Amazon, AOL, Facebook, Spotify, Twitter etc. MapReduce techniques for parallel processing and Hadoop framework. Discussions on big data file systems (Google FS), programming languages and query languages (e.g. Sawzall, Pig Latin, Hive), and 'NoSQL' database paradigms (e.g. Bigtable, Dynamo and HBase).

Recommended Texts:

1. Understanding Big Data: Analytics for Enterprise Class Hadoop and Streaming Data, Paul Zikopoulos, IBM, Chris Eaton, Paul Zikopoulos, McGrawHill, ISBN: 978-0-071-79053-6, 2011.
2. Mining of Massive Datasets, Anand Rajaraman, Jeffrey David Ullman, Cambridge University Press. ISBN: 978-1-107-01535-7, 2011.

CSE 6281	Sensor and Streaming Data Management	3-0	Credit 3.0

Contents:

Introduction to the general architecture of sensor data management systems from data acquisition to data processing, sensor metadata standards, query processing in wireless sensor networks, event processing in sensor streams, mining sensor data streams, distributed data mining in sensor networks.

Introduction to data streams, differences between data streams processing and traditional data management, clustering and classification methods in data streams, sliding window computational model in data streams, indexing and querying data streams, acquisition of provenance data for data streams, standardized representation methods of data provenance such as open provenance model, PROV etc.

Recommended Texts:

1. Managing and Mining Sensor Data, Editor: Charu C. Aggarwal, Springer Verlag, ISBN: 978-1-4614-6309-2, 2013.
2. Data Streams – Models and Algorithms, Editor: Charu C. Aggarwal, Springer US, ISBN: 978-0-387-28759-1, 2007.