Faculty of Engineering and Technology
Department of Computer Science and Engineering

CSE


Session 2017-2018
DEPARTMENT AT A GLANCE

The Department of Computer Science and Engineering (CSE) was founded in 2008. The goal of CSE Department is to cultivate highly-motivated and well-trained professionals who will lead the IT area. The Department of Computer Science and Engineering offers various specialized educational programs to create many competent engineers with profound knowledge of academic theories and practical approaches for the development of our country and all human society, in general. The department offers both basic and advanced courses. In the Department of Computer Science and Engineering, students study basic and applied technologies related to CSE, information technology as well as information processing, information systems, and the diverse technologies upon which our IT society is based on. To become engineers with knowledge related to the construction and management of communication networks which serve as transmission media, software driven management, and the control of systems. They support these networks, and knowledge related to hardware design and manufacture. The department has a number of well-constructed laboratories, namely Software Laboratory, Electrical & Electronics laboratory, Communication laboratory. Well-equipped computers are provided for the students, faculty members as well as the researchers. The department has a seminar library. Students are encouraged for academic excellence by awarding various prizes, medals and certificates in per year performances. The department also arranges co-curriculum activities among the students such as programming contests, software exhibitions, cultural events, games competitions, debate etc. in every year.

1. PREAMBLE:

Pabna University of Science and Technology (PUST) have introduced M.Sc. Engg., and M.Engg. degree from the session 2016-17 in the Faculty of Engineering and Technology. The credit point system will be the deciding factor to assess this program. All the departments under this faculty will have full autonomy to develop guidelines and conduct all types of academic activities within it strictly observing this ordinance.

2. STUDENT ADMISSION

2.1 After admission test each selected student shall be assigned, by the BPGS/RAC of the department an Adviser from among the teachers of the Department. In advance of each enrolment and course registration for any semester, the Adviser or Supervisor shall check and approve his/her student’s schedule for subjects, pre-requisites as recommended by the Selection Committee and the total hours. The student is expected consult his/her Adviser/Supervisor on all academic matters but, it is the responsibility of the individual student to see that his/her schedule conforms to the academic regulations.

2.2 Every registered student shall get himself/herself enrolled on payment of prescribed
fees and other dues as per the University rules before the commencement of each semester. In an academic year there will be normally two semesters. All course registration must be completed within two weeks from the start of a semester.

2.3 No late registration will be allowed after two weeks of designated dates of registration. Late registration after this date may only be accepted for thesis/project if the student submits a written appeal to the Registrar through the concerned Head and can document extenuating circumstances such as medical problems (physically incapacitated and not able to be presented) from the Chief Medical Officer (CMO) of the University or some other academic commitments which precluded registration prior to the last date of registration. Students will be charged a late registration fee of Tk. 1000.00 (One thousand) only. This extra fee will not be waived whatever be the reason for late registration.

2.4 If a student is unable to complete the final examination of a semester due to serious illness or serious accident or official commitment he/she may apply to the Registrar in a prescribed form through Head/Director of the degree awarding Department Institute for total withdrawal from the semester within a week after the end of the semester final examination. The application must be supported by a medical certificate from the CMO, PUST or relevant Official documents. The Academic Council will take the final decision about such application on the recommendation of the BPGS/RAC.

3. ACADEMIC REQUIREMENTS AND REGULATIONS

3.1 The minimum duration of the M.Sc. Engg./ M.Engg. programme shall be three semesters. A candidate for the Master’s degree must complete all the requirements for the degree within three academic years (Session) from the date of the first admission in the respective programme.

3.2 Academic progress shall be measured in terms of credit hours earned by a student. One credit hour subject shall normally require 14 hours of lecture for one semester; while one credit hour for thesis/project/ laboratory should normally require 42 hours of work for one semester. The number of credit hours for each subject shall be as specified in the syllabus of the respective department / institute.

3.3 The credit hour requirement for the Masters Program shall be as follows:

3.3.1 For the degree of M.Sc. Engg. a student must earn a minimum of 36 credits including a thesis for which 18 credits shall be assigned.

3.3.2 For the degree of M. Engg. a student must earn a minimum of 36 credits including a project for which 6 credit shall be assigned.

3.4 There shall be two categories of students, namely, full-time students and part-time students.
3.4.1
A part time student may be assigned a maximum of 9 credits of course including thesis/project work in any semester. Full time students must register for a minimum of 12 credits and a maximum of 15 credits per semester. A full time student shall not be allowed to be in the employment of any organization (even as a part time employee). However, they may be employed as teaching/research assistant at the University. If a full time student becomes an employee (full time or part time) of any other organization in the middle of a semester, he/she may, with the approval of the Head of the Department / Director of the Institute and his/her Employer, be allowed to continue as a full time student for that semester.

3.4.2
A student may be allowed to switch from part-time to full-time or vice versa on the recommendation of the BPGS/RAC before the commencement of a semester.

3.5
The courses of study shall be as recommended by the BPGS / RAC and the Faculty / CASR and approved by the Academic Council. The BPGS / RAC may review the curriculum from time to time and recommend any changes as may be considered necessary. The courses to be offered in any semester shall also be as determined by the BPGS / RAC.

4. GRADING SYSTEM

4.1
Final grades for courses shall be recorded as follows:

<table>
<thead>
<tr>
<th>Grade</th>
<th>Merit description</th>
<th>Grade Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>A (Plus)</td>
<td>Excellent</td>
<td>4.0</td>
</tr>
<tr>
<td>A</td>
<td>Very good</td>
<td>3.5</td>
</tr>
<tr>
<td>B (Plus)</td>
<td>Good</td>
<td>3.0</td>
</tr>
<tr>
<td>B</td>
<td>Average</td>
<td>2.5</td>
</tr>
<tr>
<td>C</td>
<td>Pass</td>
<td>2.0</td>
</tr>
<tr>
<td>F</td>
<td>Failure</td>
<td>0.0</td>
</tr>
<tr>
<td>I</td>
<td>Incomplete (for theory course)</td>
<td>-</td>
</tr>
<tr>
<td>S</td>
<td>Satisfactory</td>
<td>-</td>
</tr>
<tr>
<td>U</td>
<td>Unsatisfactory</td>
<td>-</td>
</tr>
<tr>
<td>W</td>
<td>Withdrawn</td>
<td>-</td>
</tr>
<tr>
<td>X</td>
<td>In Progress (for thesis/project)</td>
<td>-</td>
</tr>
<tr>
<td>I</td>
<td>Discontinued (for thesis/project)</td>
<td>-</td>
</tr>
</tbody>
</table>

4.2
Courses in which the student gets F grades shall not be counted towards credit hour requirements and for the calculation of Grade Point Average (GPA)

4.2.1
The C grades, up to a maximum of two courses, may be ignored for calculation of GPA at the written request of the student to the Head of the Department / Director of the Institute on the recommendation of the supervisor/Advisor, provided that the student has fulfilled the total course credit hour requirement in the remaining subjects with a minimum GPA of 2.75.

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4.2.2
When a course is repeated for improvement, better grade shall be counted for calculation of GPA.

4.2.3
Performance in all the subjects including all the F grades shall be reflected in the transcript.

4.3
Grade I is given only when a student is unable to sit for the examination of a course at the end of the semester because of circumstances beyond his/her control. He/She must apply to the Head of the Department / Director of the Institute within one week after the examination to get an I grade in that course. It must be completed within the next two semesters, otherwise, the I becomes an F grade. He/She may, however, be allowed to register without further payment of tuition fees for that course.

4.4
Satisfactory or Unsatisfactory- used only as final grades for thesis/project and non-credit courses. An X grade shall be recorded for thesis/project continuation. If, however, thesis/project is discontinued an I grade shall be recorded.

4.5
Students may enroll for non-credit course(s) termed as audit course(s) on recommendation of his/her thesis / project Supervisor and Head of the Department / Director of the Institute.

4.6
A student shall withdraw officially from a course within two working weeks of the commencement of the semester or else his grade in that course shall be recorded as F unless he/she is eligible to get a grade of I. A student may be permitted to withdraw and change his/her course within the specified period with the approval of his/her Adviser, Head of the Department and the respective teacher(s) concerned. (In that case his / her grade in the courses registered shall be recorded as ‘W’ in his Academic Record but shall not be reflected in the transcript.)

4.7
Numerical markings may be made in answer scripts, tests etc., but all final grading to be reported to the Controller of Examinations shall be in the letter grade system as detailed below:

<table>
<thead>
<tr>
<th>Percentage Range</th>
<th>Grade</th>
</tr>
</thead>
<tbody>
<tr>
<td>90% and above</td>
<td>A (Plus)</td>
</tr>
<tr>
<td>80% to below 90%</td>
<td>A</td>
</tr>
<tr>
<td>70% to below 80%</td>
<td>B (Plus)</td>
</tr>
<tr>
<td>60% to below 70%</td>
<td>B</td>
</tr>
<tr>
<td>50% to below 60%</td>
<td>C</td>
</tr>
<tr>
<td>Below 50%</td>
<td>F</td>
</tr>
</tbody>
</table>

5. CONDUCT OF EXAMINATION

5.1
In addition to tests, assignments and/ or examinations during the semester as may be given by the teacher(s) concerned, there shall be a written examination and / or other tests for each of the subjects offered in a semester at the end of that semester,
the dates of which shall be announced by the Controller of Examinations, PUST as advised by Dean of the Faculty at least two weeks before the commencement of the examination. The final grade in a subject shall be based on the performance in all tests, assignments and/or examinations.

5.2
The Controller of Examinations shall keep up-to-date record of all the grades obtained by a student in individual Academic Record Card. Grades shall be announced by the Controller of Examinations at the end of each semester. In addition, each student is entitled to one official transcript of the University record at the completion of his academic programme from the office of the Controller of Examinations on production of statement of clearance from the department.

6. QUALIFYING REQUIREMENTS

6.1
The qualifying requirement for graduation is that a student must earn a minimum grade point of 2.65 based on the weighted average in his course work.

6.1.1
Two courses may be repeated for improvement with the prior approval of the Head of the Department on the recommendation of the Supervisor/Advisor. Such approval shall be reported to the BPGS/RAC.

6.1.2
A student obtaining F grade in a course may be allowed to repeat the course with the prior approval of Head of the Department on the recommendation of the Supervisor/Advisor. Such approval shall be reported to the BPGS/RAC.

6.2
A student shall not be allowed to continue the program if he/she obtains a total of three or more F grades in one or more than one subjects taken together, during the course of his/her studies.

6.3
If at the end of the second or any subsequent semester, the cumulative GPA falls below 2.5 he/she shall not be allowed to continue in the program.

6.4
In addition to successful completion of course works every student shall submit a thesis on his research work or a report on his/her project work, fulfilling the requirements as detailed in the following sections.

7. THESIS

7.1.
Research work for a thesis shall be carried out under the supervision of a full-time member of the staff belonging to the department. However, in special cases, a full-time member of the staff belonging to a department outside the student’s department of the University may be appointed as Supervisor, if the research content of the thesis is within the field of specializations of the member of the staff. A Co-supervisor from within or outside the department may be appointed, if necessary.
7.2
If any change is necessary of the approved thesis (title, content, cost, Supervisor, Co-supervisor etc.) it shall be approved by the CASR on recommendation of the BPGS/RAC.

7.3
The research work must be carried out in this University or at a place(s) recommended by the BPGS/RAC. The work schedule and financial involvement should be mentioned in the research proposal for carrying out research work outside the university.

7.4
Every student shall submit to the Head of the Department through his/her Supervisor, required number of type written copies of his/her thesis in the approved format on or before a date to be fixed by the Supervisor concerned in consultation with the Head of the Department.

7.5
The student shall certify that the research work was done by him/her and that this work has not been submitted elsewhere for the award of any other diploma or degree.

7.6
The thesis should demonstrate an evidence of satisfactory knowledge in the field of research undertaken by the student.

7.7
Every student submitting a thesis in partial fulfillment of the requirements of a degree, shall be required to appear at an oral examination, on a date or dates fixed by the Supervisor concerned in consultation with the Head of the Department and must satisfy the examiners that he/she is capable of intelligently applying the results of this research to the solution of problems, of undertaking independent work, and also afford evidence of satisfactory knowledge related to the theory and technique used in his/her research work.

8. COURSE STRUCTURE FOR M.Sc. ENGG. AND M.ENG. PROGRAMS

<table>
<thead>
<tr>
<th>Course No.</th>
<th>Course Title</th>
<th>Credit Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>CSE 6101</td>
<td>Advanced Logic Design</td>
<td>3</td>
</tr>
<tr>
<td>CSE 6102</td>
<td>Computational Geometry</td>
<td>3</td>
</tr>
<tr>
<td>CSE 6103</td>
<td>Advanced Algorithms</td>
<td>3</td>
</tr>
<tr>
<td>CSE 6104</td>
<td>Graph Theory</td>
<td>3</td>
</tr>
<tr>
<td>CSE 6105</td>
<td>Advanced Algorithmic Graph Theory</td>
<td>3</td>
</tr>
<tr>
<td>CSE 6106</td>
<td>Combinatorial Optimization</td>
<td>3</td>
</tr>
<tr>
<td>CSE 6107</td>
<td>Computer Arithmetic Analysis</td>
<td>3</td>
</tr>
<tr>
<td>CSE 6108</td>
<td>Parallel Algorithms</td>
<td>3</td>
</tr>
<tr>
<td>CSE 6109</td>
<td>Meta-Heuristics</td>
<td>3</td>
</tr>
</tbody>
</table>

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<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>CSE 6201</td>
<td>Advanced Computer Architecture</td>
<td>3</td>
</tr>
<tr>
<td>CSE 6202</td>
<td>Computer Organization and Design</td>
<td>3</td>
</tr>
<tr>
<td>CSE 6203</td>
<td>Advanced Microprocessors</td>
<td>3</td>
</tr>
<tr>
<td>CSE 6204</td>
<td>Multicore Architecture</td>
<td>3</td>
</tr>
<tr>
<td>CSE 6205</td>
<td>High-Performance Computer Architecture</td>
<td>3</td>
</tr>
<tr>
<td>CSE 6206</td>
<td>Real Time Systems</td>
<td>3</td>
</tr>
<tr>
<td>CSE 6207</td>
<td>Computer Aided Instrumentation and Sensor Application</td>
<td>3</td>
</tr>
<tr>
<td>CSE 6208</td>
<td>Computer Aided Optoelectronics Application</td>
<td>3</td>
</tr>
<tr>
<td>CSE 6209</td>
<td>User Interface Design and Development</td>
<td>3</td>
</tr>
<tr>
<td>CSE 6301</td>
<td>Advanced Artificial Intelligence</td>
<td>3</td>
</tr>
<tr>
<td>CSE 6302</td>
<td>Soft Computing</td>
<td>3</td>
</tr>
<tr>
<td>CSE 6303</td>
<td>Machine Learning</td>
<td>3</td>
</tr>
<tr>
<td>CSE 6304</td>
<td>Pattern Recognition</td>
<td>3</td>
</tr>
<tr>
<td>CSE 6305</td>
<td>Speech Recognition</td>
<td>3</td>
</tr>
<tr>
<td>CSE 6306</td>
<td>Natural Language Processing</td>
<td>3</td>
</tr>
<tr>
<td>CSE 6307</td>
<td>Text-to-Speech Synthesis</td>
<td>3</td>
</tr>
<tr>
<td>CSE 6308</td>
<td>Machine Translation</td>
<td>3</td>
</tr>
<tr>
<td>CSE 6309</td>
<td>Evolutionary Algorithms</td>
<td>3</td>
</tr>
<tr>
<td>CSE 6310</td>
<td>Data Mining and Warehousing</td>
<td>3</td>
</tr>
<tr>
<td>CSE 6311</td>
<td>Biometrics</td>
<td>3</td>
</tr>
<tr>
<td>CSE 6312</td>
<td>Bioinformatics</td>
<td>3</td>
</tr>
<tr>
<td>CSE 6313</td>
<td>Stringology</td>
<td>3</td>
</tr>
<tr>
<td>CSE 6314</td>
<td>Neural Network</td>
<td>3</td>
</tr>
<tr>
<td>CSE 6401</td>
<td>Analysis and Organization of Information Systems</td>
<td>3</td>
</tr>
<tr>
<td>CSE 6402</td>
<td>Software Quality Assurance</td>
<td>3</td>
</tr>
<tr>
<td>CSE 6403</td>
<td>Information System Audit</td>
<td>3</td>
</tr>
<tr>
<td>CSE 6404</td>
<td>Software Project Management</td>
<td>3</td>
</tr>
<tr>
<td>CSE 6405</td>
<td>Software Testing</td>
<td>3</td>
</tr>
<tr>
<td>CSE 6406</td>
<td>Geographical Information System</td>
<td>3</td>
</tr>
<tr>
<td>CSE 6407</td>
<td>Information and Social Networks</td>
<td>3</td>
</tr>
<tr>
<td>CSE 6501</td>
<td>Advanced Digital Image Processing</td>
<td>3</td>
</tr>
<tr>
<td>CSE 6502</td>
<td>Multimedia Systems</td>
<td>3</td>
</tr>
<tr>
<td>CSE 6503</td>
<td>Statistical Signal Theory</td>
<td>3</td>
</tr>
<tr>
<td>CSE 6504</td>
<td>Computer Animation and Virtual Reality</td>
<td>3</td>
</tr>
<tr>
<td>CSE 6505</td>
<td>Advanced Computer Graphics</td>
<td>3</td>
</tr>
<tr>
<td>CSE 6506</td>
<td>Speech Signal Processing</td>
<td>3</td>
</tr>
</tbody>
</table>
# Networks and Communications

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credit</th>
</tr>
</thead>
<tbody>
<tr>
<td>CSE 6601</td>
<td>Web Technology</td>
<td>3</td>
</tr>
<tr>
<td>CSE 6602</td>
<td>Advanced Computer Networks</td>
<td>3</td>
</tr>
<tr>
<td>CSE 6603</td>
<td>Wireless Sensor Networks</td>
<td>3</td>
</tr>
<tr>
<td>CSE 6604</td>
<td>Wireless AdHoc Networks</td>
<td>3</td>
</tr>
<tr>
<td>CSE 6605</td>
<td>Mobile Computing</td>
<td>3</td>
</tr>
<tr>
<td>CSE 6606</td>
<td>Wireless Resource Management</td>
<td>3</td>
</tr>
<tr>
<td>CSE 6607</td>
<td>Optical Fiber System</td>
<td>3</td>
</tr>
<tr>
<td>CSE 6608</td>
<td>Optical Fiber Communication</td>
<td>3</td>
</tr>
<tr>
<td>CSE 6609</td>
<td>Satellite Communication</td>
<td>3</td>
</tr>
<tr>
<td>CSE 6610</td>
<td>Computer Ethics</td>
<td>3</td>
</tr>
<tr>
<td>CSE 6611</td>
<td>Cryptography and Network Security</td>
<td>3</td>
</tr>
</tbody>
</table>

# Database and Computer Systems

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credit</th>
</tr>
</thead>
<tbody>
<tr>
<td>CSE 6701</td>
<td>Advanced Database Management System</td>
<td>3</td>
</tr>
<tr>
<td>CSE 6702</td>
<td>High Dimensional Data Management</td>
<td>3</td>
</tr>
<tr>
<td>CSE 6703</td>
<td>Distributed Database Systems</td>
<td>3</td>
</tr>
<tr>
<td>CSE 6704</td>
<td>Parallel Computing</td>
<td>3</td>
</tr>
<tr>
<td>CSE 6705</td>
<td>Embedded Systems</td>
<td>3</td>
</tr>
<tr>
<td>CSE 6706</td>
<td>Advanced Operating Systems</td>
<td>3</td>
</tr>
<tr>
<td>CSE 6707</td>
<td>Optimization Techniques for Compilers</td>
<td>3</td>
</tr>
<tr>
<td>CSE 6708</td>
<td>Cloud Computing</td>
<td>3</td>
</tr>
</tbody>
</table>

## Detail Syllabus

### CSE 6101: Advanced Logic Design

**Credit:** 3  
**Contact Hours/week:** 3

Functional decomposition and Symmetric functions; Linear sequential machines; Reed-Muller expansions and their minimizations; Exor based logic design; self-timed circuits; asynchronous design techniques; Digital logic circuit testing and testable design: testing of combinational and sequential logic circuits, design for test ability and built-in self test; Digital logic simulation.

### CSE 6102: Computational Geometry

**Credit:** 3  
**Contact Hours/week:** 3

(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 6103: Advanced Algorithms**  
Credit: 3 Contact Hours/week: 3  

**CSE 6104 : Graph Theory**  
Credit: 3 Contact Hours/week: 3  
Introduction: Fundamental concepts, Trees, Spanning trees in graphs, Distance in graphs, Eulerian graphs, Digraphs, Matching and factors, Cuts and connectivity, k-connected graphs; Network flow problems; Graph coloring: vertex coloring and edge coloring, Line graphs, Hamiltonian cycles, Planar graphs, Perfect graphs.

**CSE 6105 : Advanced Algorithmic Graph Theory**  
Credit: 3 Contact Hours/week: 3  
Vertex Orderings: st-Numbering and Canonical Orderings; Graph Decompositions and Their 5 Algorithmic Applications: Ear Decomposition, Canonical Decomposition, Tree Decomposition, Path Width and Tree Width, PQ-tree, SPQR-tree, Split Decomposition, Recursively Decomposable Graphs, Clique Separator Decomposition; Graph Representations: Implicit Representations, Intersection and Containment Representations; Graph Classes Defined by Forbidden Subgraphs; Graph Classes Defined by Elimination Schemes; Classes of Graphs with Bounded Treewidth and Their Algorithmic Implications; Characterization, Construction and Recognition Algorithms for Some Special Classes of Graphs.

**CSE 6106 : Combinatorial Optimization**  
Credit: 3 Contact Hours/week: 3  
Introduction to Optimization; Linear Programming: Different forms, Simplex Method, Primal-Dual theory; Max-Flow: The Max-Flow-Min-Cut Theorem, Ford-Fulkerson Labeling Algorithm, Dijkstra's Algorithm, The Floyd-Warshall Algorithm; Some Network Flow Algorithms: The Minimum Cost Network Flow Method, Transportation Problem; Capacitated Transportation Problem, Assignment Problem; Integer Linear Programming; Relaxation; Cutting-Plane Algorithm; Branch and Bound Technique; Dynamic Programming; NP-Completeness; TSP and Heuristics; Approximation.
CSE 6107: Computer Arithmetic Analysis
Credit: 3 Contact Hours/week: 3

Integer arithmetic, Floating point arithmetic; Single precision and double precision; Interrupt handling high-speed adders; Standard and recorded multipliers, Booth's multiplier, Canonical and multi bit scanning multipliers, Array multipliers; High radix non- restoring division, SKT division, Robertson division, Convergence division and cellular array dividers; Floating point processors; Binary squares and square roots, evaluation of trigonometric Functions and polynomials, Chen convergence Computation, CORDIC computations, Logarithmic number system (LNS) processor.

CSE 6108: Parallel Algorithms
Credit: 3 Contact Hours/week: 3

Introduction, Parallel processing, Parallel models, Performance of Parallel Algorithms, The work-time presentation framework, Basic techniques: Pointer jumping, Balanced trees, Divide and Conquer, Pipelining, Partitioning and symmetry breaking, List ranking, Euler-Tour technique, Tree contraction; Parallel searching, merging, sorting and selection, Connected components, Minimum spanning trees, Biconnected Components, Directed graphs, Plane sweeping, Visibility problems, Simulation between PRAM models, Lower hounds for EREW, CREW and CRCW PRAMs.

CSE 6109: Meta-Heuristics
Credit: 3 Contact Hours/week: 3

Heuristics and meta-heuristic: notation, motivations, applications; Representations: vectors, graphs, trees, lists, rulesets; Single-state methods: hill-climbing, global optimization algorithms, simulated annealing, tabu search, iterated local search, guided local search, reactive local search, greedy randomized adaptive search procedures; Nature inspired methods: evolution strategies, genetic algorithms, particle swarm optimization, ant colony optimization, bee colony optimization, artificial immune systems; Hybrid methods; Parallel methods: multiple threads, island models, master-slave fitness assessment, spatially embedded models; Multiobjective optimization; Performance evaluation.

CSE 6201: Advanced Computer Architecture
Credit: 3 Contact Hours/week: 3

Introduction to High Performance Computing: Overview, Pipeline vs Parallel Processing; Parallel Architectures: Classification and Performance; Pipeline Processing: Pipeline Performance, design of arithmetic pipelines, multifiction pipes, concept of reservation table, collision vector and hazards; Instruction Processing Pipes: Instruction and data hazard, hazard detection and resolution, delayed jumps, delayed execution; RISC Philosophy; Pipeline scheduling Theory: Greedy pipeline scheduling algorithm, state diagram, modified state diagram, Latency cycles, Optimal cycles, scheduling of static and dynamic Pipelines; Implementation of

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pipeline schedulers Interconnection Networks: Interconnection network classification, Single stage/ Multistage Networks, crossbars, clos Networks, Benes Networks, Routing algorithms; Omega, Cub-connected and other networks.

CSE 6202: Computer Organization and Design
Credit: 3 Contact Hours/week: 3
Classification and addressing modes, Operands and Operations for Media and signal processing, instructions for control flow, Encoding an instruction set; Pipelined and Superscalar processors, Data hazards, Dynamic scheduling, Branch prediction, Hardware based speculation, Thread level parallelism; ILP with software approaches: Compiler Techniques, static branch prediction, static multiple issue, advanced compiler support for ILP; Basic Techniques of Integer Arithmetic, Floating-point Arithmetic, Speeding up Integer Addition, Speeding up Integer Multiplication and Division; Memory technology, RAIDs, organization for improving performance, Virtual memory and protection, Cache organization, Reducing cache miss rate and penalty; Busses, Performance measures, Designing I/O system, Reliability, Dependability and Availability; Symmetric shared memory architectures, Cache coherence protocols, Distributed shared memory architectures, Synchronization, Models for memory consistency, Multithreading. Interconnection Networks- Practical issues, Network on chip, Designing cluster; Advanced RISC, CISC and Embedded processors architectures.

CSE 6203: Advanced Microprocessors
Credit: 3 Contact Hours/week: 3
Review of different microprocessors: 80486, 68040, V70, Gmicro processors; Comparing the architectures: RISC and CISC; Instruction set of machines: SPARC, INTEL, and MIPS; Study of microprocessors: Pentium II, Alpha 21064, MIS 6400, PA-RISC; Math coprocessors and microprocessors.

CSE 6204: Multicore Architecture
Credit: 3 Contact Hours/week: 3
Fundamentals of Superscalar Processor Design; Limitations of ILP, Super Scalar Processor Design, Multi Threading, Thread Level Parallelism; Introduction to Multicore Architecture; Multicore Vs MultiThreading, Symmetric shared memory architectures, distributed shared memory architectures, Issues related to multicore caches, Design of multicore core caches, levels of caches, cache optimization, Models of memory consistency, Virtual Memory; Cache coherence protocols (MSI, MESI, MOESI), Scalable cache coherence, Snoop-based Multiprocessor Design: Correctness requirements, design with single-level caches and an atomic bus, multilevel cache hierarchies, dealing with split-transaction bus, coherence for shared caches and virtually indexed caches, TLB coherence Overview of directory based approaches, design challenges of directory protocols, memory based directory protocols, cache based directory protocols, protocol design tradeoffs, synchronization; PowerPC architecture; RISC design, PowerPC ISA, PowerPC Memory Management, Power 5 Multicore architecture design, Power 6 Architecture; Cell Broad band engine architecture, PPE (Power Processor Element), (Session: 2017-2018) M.Sc. Engg. and M.Engg., Department of Computer Science and Engineering (Page 12 of 26)
SPE (Synergistic processing element) Interconnection Network Design; Interconnection topologies, routing techniques, flow control mechanisms, router architecture, arbitration logic.

**CSE 6205: High-Performance Computer Architecture**
Credit: 3 Contact Hours/week: 3

Basic principles and techniques in the design of high performance computer architecture; Memory architecture: cache structure and design, virtual memory structures; Pipelined processor architecture; Pipeline control and hazard resolution, pipelined memory structures, interrupt, evaluation techniques; vector processing, RISC and CISC architecture; VLSI architecture issues.

**CSE 6206: Real Time Systems**
Credit: 3 Contact Hours/week: 3


**CSE 6207: Computer Aided Instrumentation and Sensor Application**
Credit: 3 Contact Hours/week: 3

Review of different types of sensors and their operation characteristics; Signal conditioning and driver circuits; ADC and DAC applications; Signal multiplexing, interfacing techniques interfacing external circuit with PC, Serial and parallel port, Port programming, Reading data from outside PC, Sending data to port loop and closed loop instrumentation; Practical examples dealing with linear and angular

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displacement, force, light, temperature and acoustic signals; Introduction to different types of standard interfacing bus such as GPIB, HPIB IEEE488 etc.

**CSE 6208: Computer Aided Optoelectronics Application**  
Credit: 3 Contact Hours/week: 3

Elements of optoelectronics light and laser light; Laser system; Photo detectors; Radiometry and light coupling systems and applications; Fiber optics telephone link, optical imaging using CCD cameras; Laser scanning camera, interfacing camera with PC.

**CSE 6209: User Interface Design and Development**  
Credit: 3 Contact Hours/week: 3

Human-computer interaction and the importance of good interface design; Interface quality and methods of evaluation; Prototyping and implementation techniques. Task analysis and iterative design cycle; Dialog techniques, Basic computer graphics, Use of color and sound; I/O device; Menus and their use; Command languages; Screen formatting; Natural language facilities.

**CSE 6301: Advanced Artificial Intelligence**  
Credit: 3 Contact Hours/week: 3

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

**CSE 6302: Soft Computing**  
Credit: 3 Contact Hours/week: 3

Introduction to Soft-computing tools, Fuzzy logic, Genetic algorithms, Neural Networks and probabilistic reasoning; Application of Fuzzy logic concepts in Engineering problems; Engineering optimization problem solving using genetic algorithms; Neural network approaches in engineering analysis, design and diagnostics problems; applications of probabilistic reasoning approaches.

**CSE 6303: Machine Learning**  
Credit: 3 Contact Hours/week: 3

Prediction as regression and classification; Bias-variance tradeoff Non-parametric approaches; Max-margin and support vector machines Basics of PAC learning; Model averaging and ensembles Unsupervised learning; Time series analysis and prediction Sequential models; hidden markov models; Semi supervised learning, Graphical models.

**CSE 6304: Pattern Recognition**  
Credit: 3 Contact Hours/week: 3

Introduction to pattern recognition and applications to OCR, Speech recognition, Fingerprint, Signatures etc; Commercial importance of applications; Introduction
to Statistical, Neural and Structural Approaches; Statistical Pattern Recognition: Patterns and classification, Discriminant functions, Bayes decision rule, Nearest neighbour rule, Probability of error; Linear discriminant functions: Perceptrons and training, LMSE approaches; Unsupervised learning and clustering; Feature extraction; Neural Approach: Introduction to artificial neural networks, Feed forward networks, Delta rule and back propagation, Hopfield networks and unsupervised learning, Adaptive resonance architectures, Related techniques; Pattern associators and content addressable memories, Hardware realizations; Syntactic pattern recognition: Formal languages and grammars Pattern grammars and higher dimensional grammars, Parsing, Automata realizations, Stochastic grammars, Grammatical Inference, Computational learning theory, Valiant’s framework.

**CSE 6305: Speech Recognition**
Credit: 3  
Contact Hours/week: 3

Introduction; Speech signal: Production, Perception and characterization, Signal processing and analysis; Pattern comparison techniques: Distortion measures, Spectral-distortion measures, Time alignment and normalization; Recognition system design and implementation: Source-coding, Template training, Performance analysis; Connected word models: Two level DP, Level building algorithm, One-pass algorithm; Continuous speech recognition: Sub word units, Statistical modeling, Context- dependent units; Task oriented models.

**CSE 6306: Natural Language Processing**
Credit: 3  
Contact Hours/week: 3

A computational framework for natural language; A framework such as LFG, GPSG or Panlni in some depth; Partial description of English or an Bengali language in the framework, lexicon, algorithms and data structures for implementation of the framework; Introduction to semantics and knowledge representation; Some applications like machine translation, Satabase interface.

**CSE 6307: Text-to-Speech Synthesis**
Credit: 3  
Contact Hours/week: 3

Introduction and definition, composition and production of speech; Human hearing, acoustics and phonetics; Text parsing and processing: Grammars and lexicons, Segmentation, Transducers; Morphological and contextual analysis; Phonetization: phonemes, modules and systems; Intonation and prosody: Levels, Acoustic, Perceptual and linguistic models, Prosodic parsing; Techniques: Architectures, Formalisms, Databases, Rule based, Formant, Concatenative, Linear predictive and Stochastic synthesis.

**CSE 6308: Machine Translation**
Credit: 3  
Contact Hours/week: 3

Theoretical problems: Definition, Context dependency, Interpretation and translation; Engineering problems of machine translation: Maintainability,
Tunability, Modularity and efficiency; Linguistics-based MT: Compositionality and isomorphism, Declarative frameworks, Constraint-based formalisms; Knowledge-based MT: Translation and understanding, Design of interlinguas, The conceptual lexicon; Statistics-based MT: E-M algorithms, Alignment of bilingual corpora, Translation templates; Example-based MT: Similarity measures, Levels of comparison; Treatment of context dependency: Knowledge-based transfer, Sublanguage-based MT, Translation units.

**CSE 6309: Evolutionary Algorithms**  
Credit: 3  
Contact Hours/week: 3

Introduction to evolutionary algorithm; Selection: Rank-based, Roulette wheel, Stochastic, Local, Truncation and tournament; Recombination: Discrete, Real valued and binary valued; Mutation: Real valued and binary valued; Reinsertion: Global and local; Population models; Co-evolution: Cooperative and competitive; Learnable evolution model: Fast evolutionary programming; Application of evolutionary algorithms to: System design, Telecommunication, Robotics and other industrial areas.

**CSE 6310: Data Mining and Warehousing**  
Credit: 3  
Contact Hours/week: 3

Basic concept of data mining, issues and techniques; Data warehouse and OLTP technologies for data mining, Classification of data mining techniques and models, Data pre-processing, Data mining primitives, Query languages and system architecture, Characterization and comparison; Mining association rules in large database; Cluster analysis, Multidimensional analysis and descriptive mining of complex data object; Data mining in distributed heterogeneous database systems; Data mining applications and future research issues.

**CSE 6311: Biometrics**  
Credit: 3  
Contact Hours/week: 3

Overview of Biometrics: Biometric Identification, Biometric Verification, Biometric Enrollment, Biometric, System Security; Authentication and Biometrics: Secure Authentication Protocols, Access Control Security Services, Authentication Methods, Authentication Protocols, Matching Biometric Samples, Verification by humans; Common biometrics: Finger Print Recognition, Face Recognition, Speaker Recognition, Iris Recognition, Hand Geometry, Signature Verification, Positive and Negative of Biometrics; Matching: kinds of errors, Score distribution, Estimating Errors from Data, Error Rate of Match Engines.

**CSE 6312: Bioinformatics**  
Credit: 3  
Contact Hours/week: 3

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.

CSE 6313: Stringology
Credit: 3
Contact Hours/week: 3

CSE 6314: Neural Network
Credit: 3
Contact Hours/week: 3
Fundamentals of Neural Networks; Back propagation and related training algorithms; Hebbian learning; Cohonen-Grossberg learning; The BAM and the Hopfield Memory; Simulated Annealing; Different types of Neural Networks: Counter propagation, Probabilistic, Radial Basis Function, Generalized Regression, etc; Adaptive Resonance Theory; Dynamic Systems and neural Control; The Boltzmann Machine; Self-organizing Maps; Spatiotemporal Pattern Classification, The Neocognition; Practical Aspects of Neural Networks.

CSE 6401: Analysis and Organization of Information Systems
Credit: 3
Contact Hours/week: 3
Organization and representation of information and access to information; Categorization, Indexing and content analysis; Use of codes, Formats and standards; Analysis and evaluation of search and navigation techniques; Project management and scheduling; Analysis of information needs and systems requirements; Design of alternatives; Quantitative methods and tools for decision making; Documentation management; Social and behavioural aspects of information production.

CSE 6402: Software Quality Assurance
Credit: 3
Contact Hours/week: 3
Definition and concept of software quality assurance (SQA); quality models; specification of quality requirements; Product development and delivery issues; Software development processes and maturity; Software quality management

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process: Total quality management, Improvement cycle, SQA planning and management, Organizing the SQA effort; Software verification and validation; Typical software development errors; Fagan inspections; Software audit; Software testing: Testing objectives and testing fundamentals, Testing theory, Coverage criteria, Equivalence class testing, Value-based testing, Decision table, Syntax and state transition testing, Statement and path testing, Branch and condition testing, Data flow testing, Thread-based testing, Integration and integration testing, System testing; Testing in object-oriented systems; Test tools and test automation; Test management; Problem reporting and corrective action.

CSE 6403: Information System Audit
Credit: 3 Contact Hours/week: 3

CSE 6404: Software Project Management
Credit: 3 Contact Hours/week: 3
Overview of Project Management; Project tracking and scheduling; Risk management and analysis; Cost estimation models; Project metrics; Function Point Estimation; Software quality assurance; Program verification and validation techniques; Software testing techniques, Black-box and white-box techniques; Testing of various areas: Unit, Domain, Path, Equivalent class based portion, Component, Aggregation, System testing, Requirement based testing, Acceptance testing; Software reuse and maintenance; Industrial practices in software engineering; ISO certification standards for software quality assurance; Software capability maturity model and its impact.

CSE 6405: Software Testing
Credit: 3 Contact Hours/week: 3
Objectives of software testing, Test process, Testing and development, Test case, Test execution, Test harness, Testing and debugging, Test adequacy, Control flow graph, Errors, Faults and failures, Types of testing; Test generation from requirements: Equivalence partitioning, Boundary value analysis, Category partitioning, Fault model for predicates, Boolean operator (BOR), Boolean and relational operator (BRO) and Boolean and relational expression (BRE) methods, Limitations of test generation from requirements; Test adequacy assessment: Adequacy criteria, Control flow based criteria, Data flow based criteria, Mutation based criteria, Adequacy as a stopping criterion, Adequacy as a tool for test enhancement; GUI testing, Security testing, Random testing, Combinatorial testing; Testing tools: Open source and commercial software testing tools.
CSE 6406: Geographical Information System
Credit: 3
Contact Hours/week: 3

Introduction to GIS/LIS, Database Design and Development, Feature Extraction from Satellite Imagery, data Acquisition using GPS, Spatial Analysis, Digital Cartography and Visualization.

CSE 6407: Information and Social Networks
Credit: 3
Contact Hours/week: 3

Information networks: different types of information networks, the World Wide Web, structure of the web; Social networks: structures and properties, social links and ties, connectivity and clustering, centrality and community; Network dynamics: various models, information cascade and contagion, small world phenomenon; Human-centric computation: social sensing, crowd sourcing, crowd intelligence; Integration of information and social networks with communication networks.

CSE 6501: Advanced Digital Image Processing
Credit: 3
Contact Hours/week: 3

Image sampling and quantization; Image smoothing, Sharpening and contrast enhancement in spatial and frequency domains: Basic gray level transformation, Histogram processing, Image subtraction, Image averaging, Gaussian and Laplacian filters in spatial and frequency domains, Convolution theorem; Image de- noising: Noise models, Noise reduction by spatial and frequency domain filters, Mean filter, Adaptive filter, Bandpass and band reject filters, Notch filter, Inverse filter, Minimum mean square error filter; Multi-resolution image processing: Wavelet transform in one and two dimensions, Tree structured wavelet transform, pyramid structured wavelet transform, Curvelet transform; Morphological image processing: Erosion, Dilation, Opening, Closing, Hole filling, Connected components, Thinning, Skeletons, Extension of morphological operations to gray scale images; Image segmentation: Thresholding, Region based segmentation, Contour based segmentation, Graph based segmentation; Color image processing: Color models and transformations, Edge detection and segmentation in color images, Color image compression; Digital image security; Image content feature extraction, Representation and image retrieval; Concept learning and object recognition.

CSE 6502: Multimedia Systems
Credit: 3
Contact Hours/week: 3

Overview to Multimedia Systems; Multimedia storage; Data compression techniques for audio and video; Synchronization; Multimedia networking and protocols; QOS principles; Video streams on ATM; Mobile multimedia communications; Operating system support for multimedia; Hypermedia system; Standards for multimedia; Multimedia database and Multimedia Applications.
CSE 6503: Statistical Signal Theory
Credit: 3  Contact Hours/week: 3

Representation of deterministic signals: Orthogonal representation of signals; Dimensionality of signal spaces; Construction of orthogonal basis functions; Time-bandwidth relationship: RMS duration and bandwidth, Uncertainty relations; Random Processes: Definition and classification, Stochastic integrals, Fourier transforms of random processes, Stationary and non-stationary processes, Correlation functions; Ergodicity, Power spectral density, Transformations of random processes by linear systems; Representation of random processes (via sampling, K-L expansion and narrow band representations), Special random processes (white Gaussian noise, Wiener-Levy processes, shot-noise processes, Markov processes); Optimum Filtering : Matched filters for deterministic signals in white and colored Gaussian noise; Wiener filters for random signals in white and colored Gaussian noise; Discrete and continuous time filters.

CSE 6504: Computer Animation and Virtual Reality
Credit: 3  Contact Hours/week: 3

Introduction to Virtual Reality, Virtual reality systems, Real-time computer graphics, Overview of application areas; Virtual Reality Systems: Virtual environment, 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, Colour 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: 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 6505: Advanced Computer Graphics
Credit: 3  Contact Hours/week: 3

CSE 6506: Speech Signal Processing
Credit: 3  Contact Hours/week: 3

Production and classification of speech sounds; Pole-zero models; Homomorphic signal pr 19; Short-time Fourier transform analysis and synthesis; Filter-bank analysis and synthesis, Sinusoidal analysis and synthesis; Pitch estimation and speech coding; Speech recognition and synthesis.

CSE 6601: Web Technology
Credit: 3  Contact Hours/week: 3

Introduction to advanced web technology; Technological issues: XML processing, RDF processing, Middleware technologies (CORBA, IIOP), RMI, RPC; Taxonomies and ontologies for advanced web applications: Ontology modeling, Languages for representing ontologies on the web, Rules and inferences; Web services, Design and modeling of web services, Technologies for Implementing web services; Current applications of advanced web technologies.

CSE 6602: Advanced Computer Networks
Credit: 3  Contact Hours/week: 3

Overview of OSI model, TCP/IP, Circuit switching and Packet switching, multiplexing, routing and congestion control and deadlock prevention; Driving forces for high speed networking, High speed LANs, Fast Ethernet and Gigabit Ethernet, FDDI and DQDB, Frame relay architecture, Standards and protocols, Switched Multi Megabit Data Services, ATM standards protocols, ATM LANs, Optical Communication and SONET/SDH, Broadband access technologies, x-DSL; BISDN protocol and architecture, Broadband service aspects and access architecture, Broadband transmission networks, Broadband intelligent network; Broadband access network technology, Encryption and network security, Advanced topics for network management.

CSE 6603: Wireless Sensor Networks
Credit: 3  Contact Hours/week: 3

Introduction: Applications; Localization and tracking: Tracking multiple objects; Medium Access Control: S-MAC, IEEE 802.15.4 and ZigBee; Geographic and energy-aware routing; 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.
CSE 6604: Wireless Ad Hoc Networks
Credit: 3  Contact Hours/week: 3

Introduction: Applications and motivations; Broadcasting protocols: Algorithmic aspect, Optimization techniques, Power-efficient broadcasting; Routing protocols: DSDV, AODV, DSR, position based routing protocols, Load balancing techniques, Multi-path routing; Medium access control protocols: Reservation-based MAC protocols, Bluetooth technology, IEEE 802.11 based MAC protocols; Channel propagation models; Topology control protocols; Power aware protocol design; Cross layer design principles; Mobility awareness; Fairness and security issues: Attacks and preventions; Stimulating cooperation: Self policing schemes, Economic incentive based schemes.

CSE 6605: Mobile Computing
Credit: 3  Contact Hours/week: 3


CSE 6606: Wireless Resource Management
Credit: 3  Contact Hours/week: 3

Resource management architecture: Evolution and components of QoS and cross-layer architecture for bandwidth management; Tri-band and smart antenna; Handoff management; Mobility prediction; Resource management and connection admission control; Bandwidth allocation and scheduling: Real-time guaranteed and fair real-time scheduling; Inter-domain radio resource management; High performance broadband architecture; Wireless truthful computing; Resource allocation of spatio-temporal division multiple access control; Resource management schemes for connectivity: Piconet and scatternet; Energy efficient MAC layer protocols for wireless ad-hoc networks; Routing and resource discovery for wireless ad-hoc networks: QoS based routing, Topology management, Efficient resource discovery, Hybrid routing protocols and localization; Energy efficient broadcasting and multicasting algorithms; Power-conserving broadcasting and multicasting algorithms; Scopes of increasing wireless resources, Research and future developments.

CSE 6607: Optical Fiber System
Credit: 3  Contact Hours/week: 3

Review of semiconductor physics: Radiative recombination; LEDs, Optical cavity, DH and other lasers; P-I-N and APD detectors, Detector noise; Optical fibers: Ray and mode theories, Multimode and single-mode fibers, Attenuation, Dispersion. Gaussian beams; Power coupling, Splices and Connectors.
CSE 6608: Optical Fibre Communication
Credit: 3  Contact Hours/week: 3
Fiber optic transmitter and receiver designs; Link analyses; Line Coding; Coherent optical communication systems; Multiplexing schemes; Local area networks, FDDI, SONET and SDH; Fiber optic sensors and signal processing; Optical Amplifiers; Photonic Switching; Solutions in optical fibers.

CSE 6609: Satellite Communication
Credit: 3  Contact Hours/week: 3
Introduction; Historical background and overall perspective; Satellite network modeling; Link calculations; FM analysis; TV Transmission; Digital modulation; Error control; Multiple access; FDMA, TDMA, CDMA; Orbital considerations; Launching; Atmospheric effects; Transponders; Earth Stations; VSATs.

CSE 6610: Computer Ethics
Credit: 3  Contact Hours/week: 3
Responsibilities of Computer Scientists: responsibilities influences by growth in computer use and networks, Professional and Ethical Responsibilities; Intellectual Property; Piracy; Hacking, Viruses, Liability, Privacy, Crime and Civil Liabilities.

CSE 6611: Cryptography and Network Security
Credit: 3  Contact Hours/week: 3
Network security policies, strategies and guidelines; Network security assessments and matrices; Different attacks: Denial of Service attack (DoS), Distributed Denial of Service (DDoS) attack, Eavesdropping, IP spoofing, Sybil attack, Blackhole attack, Grayhole attack, Man-in-the-middle attack, Passwords-based offline attacks; Network security threats and attackers: Intruders, Malicious software, Viruses and Spy-ware; Classical Cryptography: Introduction to simple cryptosystems, Cryptanalysis; Shannon's Theory: Perfect secrecy, Entropy, Product cryptosystems; Data Encryption Standard: Description of DES, Differential cryptanalysis; RSA System and Factoring: Public-key cryptography, RSA cryptosystem, Attacks on RSA, Factoring algorithms; Other Public-key cryptosystems: ElGamal cryptosystem and discrete logs, Merkle-Hellman Knapsack System; Signature Schemes: ElGamal signature schemes, Digital signature standard, Fail-stop signatures; Hash Functions: Signatures and Hash functions, Collision-free Hash functions, Birthday attack; Key Distribution and Key Agreement: Key predistribution, Kerberos, Diffie-Hellman key exchange; Identification Schemes: Schnorr identification scheme, Okamoto identification schemes; Authentication Codes: Computing deception probabilities, Combinatorial bounds, Entropy bounds; Secret Sharing Schemes: Shamir threshold scheme, Access structure and general secret sharing; Pseudo-random Number Generation: Indistinguishable probability distribution, probabilistic encryption; Zero-knowledge proofs: Interactive proof systems, computational Zero-knowledge proofs.
CSE 6701: Advanced Database Management System  
Credit: 3  Contact Hours/week: 3

Physical storage and indexing structures; Query processing algorithms, Query optimization; Transaction processing and serializability, Concurrency Control, Recovery, Parallel and distributed databases; XQuery and XML query evaluation; Emerging database trends, Data mining, Data warehousing, Object oriented database, Spatial and temporal database.

CSE 6702: High Dimensional Data Management  
Credit: 3  Contact Hours/week: 3

Spatial database systems; Spatial data types; Indexing and Querying spatial data; Spatial networks; Temporal database systems; Moving object data management systems; Moving object indexing techniques; Query processing on moving object data; Multidimensional indexing methods; Similarity search; Dimension reduction methods; Time series data; Indexing techniques for massive time series data; State-of-the-art systems for managing high dimensional data; Emerging issues in high-dimensional data management systems.

CSE 6703: Distributed Database Systems  
Credit: 3  Contact Hours/week: 3

Relational database theory, query processing and optimization; Recovery techniques, Concurrency control; Crash recovery; Distributed database systems: Security and integrity; Database paradigms: Deductive and Object oriented issues; Heterogeneous databases.

CSE 6704: Parallel Computing  
Credit: 3  Contact Hours/week: 3

Fundamental theoretical issues in designing parallel algorithms and architectures; Parallel computers based on interconnection networks such as hyper cubes, Shuffle-exchanges, Trees, Meshes and Butterfly networks; Parallel algorithms for arithmetic, Linear algebra, Sorting, Fourier Transform, Recurrence evaluation and Dense graph problems; Use of graph embedding techniques to compare different networks; Shared memory based parallel computers; Algorithms for list ranking, Maximal independent set, Arithmetic expression evaluation, Convex hull problems and others; Message routing on multidimensional meshes, Butterfly networks, Hyper cubes, Shuffle Exchange networks, Fat-trees and others; Simulation of shared memory on networks; Routing on expander-based networks; Limits to parallelizability and P-completeness; Thompson grid model for VLSI; Layouts for standard interconnection networks; Lower bound techniques for area and area time-squared tradeoffs; Area-Universal networks.
CSE 6705: Embedded Systems
Credit: 3
Contact Hours/week: 3

Introduction to Embedded systems, Hardware/software code sign, Embedded micro controller cores, Embedded memories, Examples of embedded systems, Sensors and interfacing techniques, Real- time concepts, Real-time operating systems, Required RTOS services/capabilities (in contrast with traditional OS); Resource Management/scheduling paradigms: Static priorities, Static schedules, Dynamic scheduling, Best effort current best practice in scheduling (e.g. Rate Monotonic vs. static schedules); Real world issues: Blocking, Unpredictability, Interrupts, Caching; Examples of OSs for embedded systems: RT Linux, VRTX. Programming languages for embedded systems e.g., Handel-C and Esterel, System support for embedded systems, Selected embedded system-based applications: Process control, Robotics, etc; Software Development Methodology: Model based development, Statecharts, etc. Case studies, Controlling an Injection molding process, Flight simulator, Digital call center handler, codec.

CSE 6706: Advanced Operating Systems
Credit: 3
Contact Hours/week: 3

In-depth analysis of advanced topics of operating systems: Performance analysis of memory management and scheduling algorithms; Advanced virtual memory issues; Advanced issues in interprocess communication; File system design; Multiprocessor and distributed operating systems: Highly concurrent machines; Distributed synchronization and resource allocation algorithms; Distributed file system and transactions, Security issues; Interfaces with network protocols.

CSE 6707: Optimization Techniques for Compilers
Credit: 3
Contact Hours/week: 3

Control flow and data-flow analysis, Program optimisation and Code generation across basic blocks, Procedures and Complete programs; Interprocedural and intraprocedural analysis, Intermediate representations, Register allocation and scheduling in the context of modern uniprocessors; Dependence analysis and loop transformations: Building blocks for optimising for memory hierarchies and parallel machines.

CSE 6708: Cloud Computing
Credit: 3
Contact Hours/week: 3

Cloud computing: concepts, cloud characteristics, advantages and limitations; Cloud computing service models: infrastructure as a service, platform as a service, software as a service; Public cloud, private cloud and hybrid cloud; Cloud storage infrastructure and key- value stores; Cloud programming frameworks; Transactional vs. analytical data management in the cloud; Scientific data management in the cloud; Big data analytics and cloud; Mobile cloud computing: architecture, applications and data management; Data privacy and security in the cloud.
## CHAIRMAN OF THE DEPARTMENT

<table>
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## FACULTY MEMBERS OF THE DEPARTMENT

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