Academic Catalogue
of
Bachelor of Science in Computer Science and Engineering (CSE)
for
Academic Year 2015-16 (onwards)

Department of Computer Science and Engineering (CSE)

Islamic University of Technology (IUT)

Organization of Islamic Cooperation (OIC)

January 2019

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Department of Computer Science and Engineering (CSE)

Brief History

The department of Computer Science and Engineering (CSE) started its journey as the department of Computer Science and Information Technology (CIT) in 1998. It has always proactively responded to the ever changing technological market demand. At beginning, the course curriculums were organized to include more Information Systems and database courses. The department soon included web based application development courses to meet the demand of the Internet age. When the telecommunication industry was booming and demanded human resources skilled in mobile and telecommunications and it responded to the trend. However, it was felt that solutions involving hardware and software are the key to drive the market which was established by the technology giants. Hence the department was transformed as Computer Science and Engineering (CSE) in 2013 to emphasize on engineering aspects of computing.

The product based technology industry are bringing new solutions involving hardware and software; however the domination in the market share mostly depends on the strength of the ported software and its ability to connect with the other solutions. Therefore, the need for software engineers is ever growing. To produce good software engineers, the department of CSE has started a separate bachelor programme namely B.Sc. in Software Engineering from 2017. Software are shipped to many different platforms: computers, mobile, web, manufacturing devices, avionics, medical devices and everywhere. The requirements, design, architecture and technologies are so diverse that a bunch of new courses are included in the syllabus of software engineering bachelor’s curriculum.

Currently, the department has 28 full-time faculty members along with 8 part-time faculty members from other reputed universities. In addition to this, 12 faculty members are on leave for higher education in abroad. There are about more than 520 undergraduate and more than 30 graduate students in the department.

Vision and Mission of the CSE Department

Vision

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

Mission

The missions of the CSE department are:

- To impart quality education in the undergraduate and post graduate levels.
- To provide balanced curriculum that focuses on theory and application of computer science and software engineering 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.

Programmes Offered by the CSE Department

- Doctor of Philosophy in Computer Science and Engineering,
  Ph.D. (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,
  P.G.D. (CSE)
- Post Graduate Diploma in Computer Science and Application,
  P.G.D. (CSA)
- Bachelor of Science in Computer Science and Engineering,
  B.Sc. Engg. (CSE)
- Bachelor of Science in Software Engineering
  B.Sc. (SWE)

Bachelor of Science in Computer Science and Engineering (B.Sc. in CSE)

The Bachelor of Science in Computer Science and Engineering (BSc. in CSE) is the preferred degree both for graduate study in computer science and for technical careers in software development. Our curricula, faculty and research areas focus on an array of topics including network and communications, algorithms and complexity, artificial intelligence and machine learning, bioinformatics, computer architecture and design, databases and data mining, privacy and cryptography, and human computer interaction. Students majoring in CSE should have shown considerable ability in mathematics and logical reasoning. In view of that, a number of courses on Mathematics and Basic Science have been included in the syllabus. In addition, some social science, management, accounting, economics, and communication-skills development related courses have been incorporated to make the syllabus a balanced and reasonably complete one. The objective of this undergraduate programme in Computer Science and Engineering is to develop skilled and competent graduates to meet the current and future needs at home and abroad. To achieve that goal, our students, faculty and staff are continuing to work together to build an even stronger department. To benefit from academics, students must live in an open, accepting, and compassionate community that encourages the exploration of ideas. We are a department that prides itself as a home for high quality education and research, and, as always, a home for our students and alumni.

Program Educational Objectives (PEOs)

Graduates of Computer Science and Engineering programme are expected to attain the following objectives within a few years of graduation.

1. Demonstrate the ability to apply computing and analytical approaches to analyze, design and develop solution and conduct cutting-edge research.

2. Demonstrate professionalism, understand and carry the ethical values for the welfare of society, Muslim Ummah and beyond.

3. Demonstrate strong awareness for life-long learning through self-motivation, professional trainings and higher education.

4. Demonstrate the skill for effective communication, ability to interact with people of diverse educational and cultural background and work individually or in a team.

Student Outcomes (SOs)

1 An ability to analyze a problem, define the computing requirements, and solve it by applying principles of engineering, science, and mathematics.

5. An ability to design, implement, and evaluate a computer-based solution to meet a given set of computing requirements in the context of Computer Science and Engineering.

6. An ability to communicate effectively with a range of audiences about technical information.

7. An ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to

draw conclusions.

8. An ability to function effectively in teams to establish goals, plan tasks, meet deadlines, manage risk, and produce deliverables.

9. An ability to recognize ethical and professional responsibilities in computing practices and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts.

10. An ability to apply theory in the design and implementation of computer-based solutions.

11. An ability to reason about and explain computer-based solutions at multiple levels of abstraction.

12. An ability to recognize the ongoing need to acquire new knowledge, to choose appropriate learning strategies, and to apply this knowledge.

Relation between PEOs and SOs

	PE01	PE02	PE03	PE04
SO1	√			
SO2	√			
SO3				√
SO4	√			
SO5		√		√
SO6		√	√	√
SO7	√		√	
SO8		√		√
SO9		√	√	

Assessment and Grading Systems

Distribution of Marks

The performance of a student in a course is evaluated based on a scheme of continuous assessment, mid-term and semester final examinations. 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 students and viva-voce during laboratory hours, and quizzes. The distribution of marks in the continuous assessment, mid-term and semester-final examinations is as follows.

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

Letter Grades

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

Grade	Equivalent 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%

Assignment of Credits

Each theory or lab course is assigned a weekly contact hours. The credit hours a course is directly related to the weekly contact hours of the course. The credit hours of a theory course is equal to the weekly contact hour of the course, the credit hours of a lab course is half of the weekly contact hours of the course. One contact hour refers to a 50 minute class in each week of a semester.

Grade Point Average

The overall academic progress of a student in a semester is assessed by calculating grade point average (GPA). The grade points obtained by a student in a course is the product of the credit hours of the course and the equivalent grade point corresponding to the letter grade obtained by the student in that course. Grade Point Average (GPA) is the weighted average of the grade points obtained in all the courses passed/completed by a student.

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

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 in the semester. In special circumstances,

the Vice-Chancellor on the recommendation of the Head of the Department may condone 10% of the required attendance on grounds of serious illness of the student on production of certificate by a Registered Physician, or reasons acceptable to the Vice-Chancellor.

Faculty Members of the CSE Department

Active Faculty Members

Serial No	Name, Designation and Email
1.	**Prof. Dr. Muhammad Mahbub Alam** Professor & Head of the Department mma@iut-dhaka.edu
2.	**Prof. Dr. Abu Raihan Mostofa Kamal** Professor raihan@iut-dhaka.edu
3.	**Prof. Dr. Md. Hasanul Kabir** Professor hasanul@iut-dhaka.edu
4.	**Prof. Dr. Md. Kamrul Hasan** Professor hasank@iut-dhaka.edu
5.	**Tareque Mohmud Chowdhury** Assistant Professor tareque@iut-dhaka.edu
6.	**Hasan Mahmud** Assistant Professor hasan@iut-dhaka.edu
7.	**Md. Sakhawat Hossen** Assistant Professor sakhawat@iut-dhaka.edu
8.	**Ashraful Alam Khan** Assistant Professor ashraful @iut-dhaka.edu

Faculty Members

Serial No	Name, Designation and Email
9.	**Md. Abed Rahman** Lecturer abed@iut-dhaka.edu
10.	**A.B.M Ashikur Rahman** Lecturer ashikiut@iut-dhaka.edu
11.	**Md. Hamjajul Ashmafee** Lecturer ashmafee@iut-dhaka.edu
12.	**Redwan Karim Sony** Lecturer redwankarim@iut-dhaka.edu
13.	**Raihan Islam Arnob** Lecturer raihanislam@iut-dhaka.edu
14.	**Faisal Hussain** Lecturer faisalhussain@iut-dhaka.edu
15.	**Njayou Youssouf** Lecturer njayou@iut-dhaka.edu
16.	**Tajkia Rahman Toma** Lecturer tajkiatoma@iut-dhaka.edu
17.	**Sabbir Ahmed** Lecturer sabbirahmed@iut-dhaka.edu
18.	**Md. Ridwan Kabir** Lecturer ridwankabir@iut-dhaka.edu

Serial No	Name, Designation and Email
19.	**Md. Mohayeminul Islam** Lecturer mohayemin@iut-dhaka.edu
20.	**Md. Talha Ibn Aziz** Lecturer talhaibnaziz@iut-dhaka.edu
21.	**Md. Mohsinul Kabir** Lecturer mohsinulkabir@iut-dhaka.edu
22.	**Md. Bakhtiar Hasan** Lecturer bakhtiarhasan@iut-dhaka.edu

Faculty Members on Leave

Serial No	Name, Designation and Email
1.	**Md. Mohiuddin Khan** Assistant Professor
2.	**Mahmud Hasan** Assistant Professor
3.	**Shahriar Kaisar** Assistant Professor
4.	**Kashif Nizam Khan** Assistant Professor

Faculty Members

Serial No	Name, Designation and Email
5.	**Md. Abid Hasan** Lecturer
6.	**Md. Saifur Rahman Mahdi** Lecturer
7.	**Md. Moniruzzaman** Lecturer
8.	**Mahmudun Nabi** Lecturer
9.	**Nafiul Rashid** Lecturer
10.	**Md. Sirajus Salekin** Lecturer
11.	**Ferdous Ahmed** Lecturer
12.	**Rafsanjany Kushol** Lecturer rkushol@gmail.com
13.	**Ahnaf Munir** Lecturer

Part-Time Faculty Members

Serial No	Name, Designation and Email
1.	**Prof. Dr. Nazrul Islam** Professor, Chemistry Department, BUET
2.	**Prof. Dr. Feroz Alam Khan** Professor, Physics Department, BUET
3.	**Prof. Dr. Md. Obaidur Rahman** Professor, Computer Science and Engineering, DUET
4.	**Prof. Dr. Nasrin Akter** Professor, Math Department, DUET
5.	**Prof. Dr. Abu Taher**
7.	**Dr. Ahmadullah** Associate Professor, Arabic and Islamic Studies Department, Dhaka College

Faculty Members

Academic Catalogue

Bachelor of Science
in
Computer Science and Engineering

Faculty Members

Faculty Members

Course Code Details

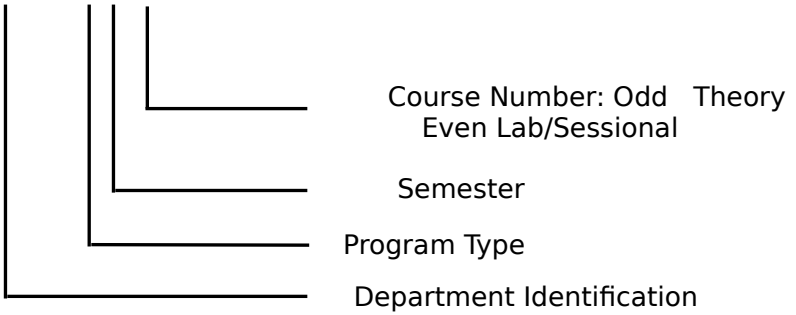
Each course is designated by a three-letter code identifying the department/program of the course followed by a four-digit number. The four-digit number represents the followings, if the course is offered by an academic department.

- The first digit corresponds to Program type. For example 4 indicates B.Sc. four year program.

- 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 course, where an odd number indicates a theory course and an even number indicates a sessional/lab course.

CSE 4107Structured Programming I (Course Title)



For Humanities, Mathematics, Physics and Chemistry courses a three/four-letter code identifies the type of the course which is followed by a four-digit number. The four-digit number represents the followings:

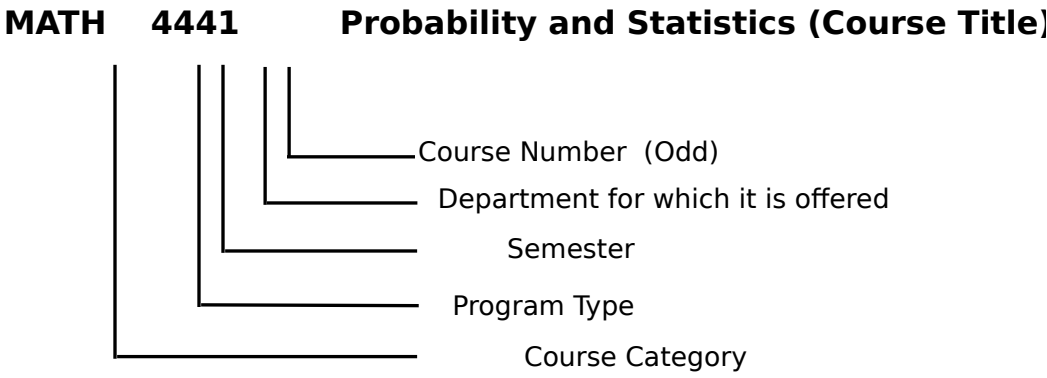
- The first digit corresponds to Program type. For example 4

indicates B.Sc. four year program.

- The second digit corresponds to the semester in which the course is normally taken by the students.

- The third digit represents the department for which the course is offered.

- The final digit refers to the number of the course, where an odd number represents a theory course and an even number indicates a sessional/Lab course.



Academic Catalogue

Part 1: Course Structure

L=Lecture, P= Practical

FIRST SEMESTER

Course Number	Course Title	Contact Hours L-P	Credit Hours
Hum 4145	Islamiat	2-0	2.0
Hum 4147	Technology, Environment and Society	3-0	3.0
Math 4141	Geometry and Differential Calculus	4-0	4.0
Phy 4141	Physics I	3-0	3.0
CSE 4105	Computing for Engineers	3-0	3.0
CSE 4107	Structured Programming I	3-0	3.0
Hum 4142 / Hum 4144	Arabic I / English I	0-2	1.0
Phy 4142	Physics I Lab	0-3/2	0.75
CSE 4104	Engineering Drawing Lab	0-3/2	0.75
CSE 4108	Structured Programming I Lab	0-3	1.5
Total		**18-8**	**22.0**

SECOND SEMESTER

Course Number	Course Title	Contact Hours L-P	Credit Hours
Hum 4241	Islamic History Science and Culture	2-0	2.0
Math 4241	Integral Calculus and Differential Equations	4-0	4.0
Phy 4241	Physics II	3-0	3.0
Chem 4241	Chemistry	3-0	3.0
CSE 4203	Discrete Mathematics	3-0	3.0
CSE 4205	Digital Logic Design	3-0	3.0
Hum 4242 / Hum 4244	Arabic II / English II	0-2	1.0
Phy 4242	Physics II Lab	0-3/2	0.75
Chem 4242	Chemistry Lab	0-3/2	0.75
CSE 4202	Structured Programming II Lab	0-3	1.5
CSE 4206	Digital Logic Design Lab	0-3/2	0.75
Total		**18-9.5**	**22.75**

THIRD SEMESTER

Course Number	Course Title	Contact Hours L-P	Credit Hours
Math 4341	Linear Algebra	3-0	3.0
EEE 4383	Electronic Devices and Circuits	3-0	3.0
CSE 4301	Object Oriented Programming	3-0	3.0
CSE 4303	Data Structures	3-0	3.0
CSE 4305	Computer Organization and Architecture	3-0	3.0
CSE 4307	Database Management Systems	3-0	3.0
EEE 4384	Electronic Devices and Circuits Lab	0-3/2	0.75
CSE 4302	Object Oriented Programming Lab	0-3	1.5
CSE 4304	Data Structures Lab	0-3	1.5
CSE 4308	Database Management Systems Lab	0-2	1.0
Total		**18-9.5**	**22.75**

FOURTH SEMESTER

Course Number	Course Title	Contact Hours L-P	Credit Hours
Hum 4441	Engineering Ethics	3-0	3.0
Math 4441	Probability and Statistics	3-0	3.0
EEE 4483	Digital Electronics and Pulse Techniques	3-0	3.0
CSE 4403	Algorithms	3-0	3.0
CSE 4405	Data and Telecommunications	4-0	4.0
CSE 4407	System Analysis and Design	2-0	2.0
EEE 4484	Digital Electronics and Pulse Techniques Lab	0-3/2	0.75
CSE 4402	Visual Programming Lab	0-3	1.5
CSE 4404	Algorithms Lab	0-2	1.0
CSE 4408	System Analysis and Design Lab	0-2	1.0
Total		**18-8.5**	**22.25**

FIFTH SEMESTER

Course Number	Course Title	Contact Hours L-P	Credit Hours
CSE 4501	Operating Systems	3-0	3.0
CSE 4503	Microprocessor and Assembly Language	3-0	3.0
CSE 4511	Computer Networks	3-0	3.0
CSE 4513	Software Engineering and Object-Oriented Design	3-0	3.0
	Elective 5-I	3-0	3.0
	Elective 5-II	3-0	3.0
CSE 4502	Operating Systems Lab	0-2	1.0
CSE 4504	Microprocessor and Assembly Language Lab	0-3/2	0.75
CSE 4508	RDBMS Programming Lab	0-3	1.5
CSE 4510	Software Development	0-3/2	0.75
CSE 4512	Computer Networks Lab	0-3	1.5
	Elective 5-II Lab	0-3/2	0.75
CSE 4590	Industrial Training*	0-2	1.0
Total		**18-12.5**	**24.25**
Total*		**18-14.5**	**25.25**

*Only for Higher Diploma

ELECTIVE 5-I

Course Number	Course Title	Contact Hours L-P	Credit Hours
Math 4541	Multivariable Calculus and Complex Variables	3-0	3.0
CSE 4531	E-Commerce and Web Security	3-0	3.0
CSE 4537	Decision Support Systems	3-0	3.0
CSE 4547	Parallel and Distributed Systems	3-0	3.0

ELECTIVE 5-II

Course Number	Course Title	Contact Hours L-P	Credit Hours
CSE 4539	Web Programming	3-0	3.0
CSE 4543	Geographical Information Systems	3-0	3.0
CSE 4549	Simulation and Modeling	3-0	3.0
CSE 4551	Computer Graphics and Multimedia Systems	3-0	3.0
CSE 4540	Web Programming Lab	0-3/2	0.75
CSE 4544	Geographical Information Systems Lab	0-3/2	0.75
CSE 4550	Simulation and Modeling Lab	0-3/2	0.75
CSE 4552	Computer Graphics and Multimedia Systems Lab	0-3/2	0.75

SIXTH SEMESTER

Course Number	Course Title	Contact Hours L-T	Credit Hours
Hum 4641	Accounting	3-0	3.0
CSE 4615	Wireless Networks	2-0	2.0
CSE 4617	Artificial Intelligence	3-0	3.0
CSE 4619	Peripherals and Interfacing	3-0	3.0
	Elective 6-I	3-0	3.0
	Elective 6-II	3-0	3.0
CSE 4610	Design Project**	0-3	1.5
CSE 4614	Technical Report Writing	0-3/2	0.75
CSE 4616	Wireless Networks Lab	0-3/2	0.75
CSE 4618	Artificial Intelligence Lab	0-3/2	0.75
CSE 4620	Peripherals and Interfacing Lab	0-3/2	0.75
	Elective 6-I Lab	0-3/2	0.75
	Elective 6-II Lab	0-3/2	0.75
CSE 4600	Project/Thesis*	0-6	3.0
Total**		**17-12**	**23.00**
Total*		**17-15**	**24.50**

*Only for Higher Diploma
**Only for B.Sc. Engg.

ELECTIVE 6-I

Course Number	Course Title	Contact Hours L-T	Credit Hours
Math 4641	Numerical Methods	3-0	3.0
CSE 4641	Distributed Operating Systems	3-0	3.0
CSE 4643	Mobile Application Development	3-0	3.0
CSE 4647	Distributed Database Systems	3-0	3.0
Math 4642	Numerical Methods Lab	0-3/2	0.75
CSE 4642	Distributed Operating Systems Lab	0-3/2	0.75
CSE 4644	Mobile Application Development Lab	0-3/2	0.75
CSE 4648	Distributed Database Systems Lab	0-3/2	0.75

ELECTIVE 6-II

Course Number	Course Title	Contact Hours L-T	Credit Hours
CSE 4631	Digital Signal Processing	3-0	3.0
CSE 4635	Web Architecture	3-0	3.0
CSE 4649	Systems Programming	3-0	3.0
CSE 4651	Unix Programming	3-0	3.0
CSE 4632	Digital Signal Processing Lab	0-3/2	0.75
CSE 4636	Web Architecture Lab	0-3/2	0.75
CSE 4650	Systems Programming Lab	0-3/2	0.75
CSE 4652	Unix Programming Lab	0-3/2	0.75

SEVENTH SEMESTER

Course Number	Course Title	Contact Hours L-P	Credit Hours
Hum 4741 / Hum 4743 / Hum 4745	Business Communication and Law / Engineering Economics / International Relationship	2-0	2.0
Math 4741	Mathematical Analysis	3-0	3.0
CSE 4703	Theory of Computing	3-0	3.0
CSE 4709	Machine Learning	3-0	3.0
	Elective 7-I	3-0	3.0
	Elective 7-II	3-0	3.0
CSE 4710	Machine Learning Lab	0-3/2	0.75
	Elective 7-II Lab	0-3/2	0.75
CSE 4700	Project/Thesis	0-6	3.0
CSE 4790	Industrial Training	0-2	1.0
Total		**17-11**	**22.50**

ELECTIVE 7-I

Course Number	Course Title	Contact Hours L-P	Credit Hours
CSE 4739	Data Mining	3-0	3.0
CSE 4743	Cryptography and Network Security	3-0	3.0
CSE 4745	Embedded Systems Design	3-0	3.0
CSE 4747	Computational Biology	3-0	3.0

ELECTIVE 7-II

Course Number	Course Title	Contact Hours L-P	Credit Hours
CSE 4733	Digital Image Processing	3-0	3.0
CSE 4735	Digital Systems Design	3-0	3.0
CSE 4749	Introduction to Cloud Computing	3-0	3.0
CSE 4751	Network Programming	3-0	3.0
CSE 4753	Bioinformatics	3-0	3.0
CSE 4734	Digital Image Processing Lab	0-3/2	0.75
CSE 4736	Digital Systems Design Lab	0-3/2	0.75
CSE 4750	Introduction to Cloud Computing Lab	0-3/2	0.75
CSE 4752	Network Programming Lab	0-3/2	0.75
CSE 4754	Bioinformatics Lab	0-3/2	0.75

EIGHTH SEMESTER

Course Number	Course Title	Contact Hours L-P	Credit Hours
CSE 4801	Compiler Design	3-0	3.0
CSE 4803	Graph Theory	3-0	3.0
CSE 4807	IT Organization and Management	3-0	3.0
CSE 4809	Algorithm Engineering	2-0	2.0
	Elective 8-I	3-0	3.0
	Elective 8-II	3-0	3.0
CSE 4802	Compiler Design Lab	0-3/2	0.75
CSE 4810	Algorithm Engineering Lab	0-3/2	0.75
	Elective 8-II Lab	0-3/2	0.75
CSE 4800	Project/Thesis	0-6	3.0
Total		**17-10.5**	**22.25**

ELECTIVE 8-I

Course Number	Course Title	Contact Hours L-P	Credit Hours
CSE 4841	Introduction to Optimization	3-0	3.0
CSE 4845	Introduction to Information Retrieval	3-0	3.0
CSE 4847	Information and OS Security	3-0	3.0
CSE 4849	Human Computer Interaction	3-0	3.0
CSE 4851	Design Pattern	3-0	3.0

ELECTIVE 8-II

Course Number	Course Title	Contact Hours L-P	Credit Hours
CSE 4833	VLSI Design and Testing	3-0	3.0
CSE 4835	Pattern Recognition	3-0	3.0
CSE 4839	Internetworking Protocols	3-0	3.0
CSE 4834	VLSI Design and Testing Lab	0-3/2	0.75
CSE 4836	Pattern Recognition Lab	0-3/2	0.75
CSE 4840	Internetworking Protocols Lab	0-3/2	0.75

Academic Catalogue

Part 2: Syllabus Summary

	Islamic University of Technology (IUT) Department of Computer Science and Engineering Syllabus for Bachelor Science in Computer Science and Engineering (BSc Engg. in CSE)							
	HUM			Mathematics and General Sciences			Compulsory Courses	
	1	2	3	1	2	3	1	2
1st	Hum 4142 / 4144 Arabic I/ English I (0-2)	Hum 4145 Islamiat (2-0)	Hum 4147 Technology, Environment and Society (3-0)	Math 4141 Geometry and Differential Calculus (4-0)	Phy 4141 Physics I (3-3/2)		CSE 4105 Computing for Engineers (3-0)	CSE 4107 Structured Programming I (3-3)
2nd	Hum 4242/4244 Arabic II/ English II (0-2)	Hum 4241 Islamic History Science and Culture (2-0)		Math 4241 Integral Calculus and Differential Equations (4-0)	Phy 4241 Physics II (3-3/2)	Chem 4241 Chemistry (3-3/2)	CSE 4203 Discrete Mathematics (3-0)	CSE 4205 Digital Logic Design (3-3/2)
3rd				Math 4341 Linear Algebra (3-0)			EEE 4383 Electronic Devices and Circuits (3-3/2)	CSE 4301 Object Oriented Programming (3-3)
4th		Hum 4441 Engineering Ethics (3-0)		Math 4441 Probability and Statistics (3-0)			EEE 4483 Digital Electronics and Pulse Techniques (3-3/2)	CSE 4403 Algorithms (3-2)
5th				B. Sc. Students must take at least one course from Math 4541 and Math 4641			CSE 4501 Operating Systems (3-2)	CSE 4513 Software Engineering and Object-Oriented Design (3-0)
6th		Hum 4641 Accounting (3-0)					CSE 4619 Peripherals and Interfacing (3-3/2)	CSE 4617 Artificial Intelligence (3-3/2)
7th	Hum 4741/4743/4745 Business Communication and Law/ Engineering Economics/ International Relationship (2-0)			Math 4741 Mathematical Analysis (3-0)			CSE 4709 Machine Learning (3-3/2)	
8th		CSE 4807 IT Organization and Project Management (3-0)					CSE 4801 Compiler Design (3-3/2)	CSE 4809 Algorithm Engineering (2-3/2)

*** For Higher Diploma ** For B.Sc. Engg**

Elective Subjects of CSE (Semester-wise)			
Elective 5-I	Elective 5-II	Elective 6-I	Elective 6-II
Math 4541 Multivariable Calculus and Complex Variables (3-0)	CSE 4539 Web Programming (3-3/2)	Math 4641 Numerical Methods (3-3/2)	CSE 4631 Digital Signal Processing (3-3/2)
CSE 4531 E-Commerce and Web Security (3-0)	CSE 4543 Geographical Information Systems (3-3/2)	CSE 4641 Distributed Operating Systems (3-3/2)	CSE 4635 Web Architecture (3-3/2)
CSE 4537 Decision Support Systems (3-0)	CSE 4549 Simulation and Modeling (3-3/2)	CSE 4643 Mobile Application Development (3-3/2)	CSE 4649 Systems Programming (3-3/2)
CSE 4547 Parallel and Distributed Systems (3-0)	CSE 4551 Computer Graphics and Multimedia Systems (3-3/2)	CSE 4647 Distributed Database Systems (3-3/2)	CSE 4651 Unix Programming (3-3/2)

Islamic University of Technology (IUT) **Department of Computer Science and Engineering** **Syllabus for Bachelor Science in Computer Science and Engineering (BSc Engg. in CSE)**								
Compulsory Courses					Optional Courses		Credit Hour	Total credit = theory + lab
3	4	5	6	7	1	2		
			CSE 4104 Engineering Drawing Lab (0-3/2)				18-8 (=26)	18+ 4 = 22.00
			CSE 4202 Structured Programming II lab (0-3)				18-9.5 (=27.5)	18 + 4.75 = 22.75
CSE 4303 Data Structures (3-3)	CSE 4305 Computer Organization and Architecture (3-0)	CSE 4307 Database Management Systems (3-2)					18-9.5 (=27.5)	18 + 4.75 = 22.75
CSE 4405 Data and Telecommunications (4-0)	CSE 4407 System Analysis and Design (2-2)	CSE 4402 Visual Programming Lab (0-3)					18-8.5 (=26.5)	18 + 4.25 = 22.25
CSE 4511 Computer Networks (3-3)	CSE 4503 Microprocessor and Assembly Language (3-3/2)	CSE 4510 Software Development (0-3/2)	CSE 4508 RDBMS Programming Lab (0-3)	*CSE 4590 Industrial Training (1 credit)	Elective 5-I (3-0)	Elective 5-II (3-3/2)	18-12.5 (=30.5) + IT*	18 + 6.25 + IT* = 24.25** / 25.25*
CSE 4615 Wireless Networks (2-3/2)	*CSE 4600 Project or Thesis (0-6)	**CSE 4610 Design Project (0-3)	CSE 4614 Technical Report Writing (0-3/2)		Elective 6-I (3-3/2)	Elective 6-II (3-3/2)	17-12** / 15* (=29** / 32*)	17 + 6** / 7.5* = 23.00** / 24.5*
CSE 4703 Theory of Computing (3-0)	CSE 4700 Project/Thesis (0-6)			CSE 4790 Industrial Training (1 credit)	Elective 7-I (3-0)	Elective 7-II (3-3/2)	17-9.0 (=27) + IT	17 + 4.5 + IT = 22.50
CSE 4803 Graph Theory (3-0)	CSE 4800 Project/ Thesis (0-6)				Elective 8-I (3-0)	Elective 8-II (3-3/2)	17-10.5 (=26.5)	17 + 5.25 = 22.25
							Total	181.75** / 139.5*

Elective Subjects of CSE (Semester-wise)			
Elective 7-I	Elective 7-II	Elective 8-I	Elective 8-II
CSE 4739 Data Mining (3-0)	CSE 4733 Digital Image Processing (3-3/2)	CSE 4841 Introduction to Optimization (3-0)	CSE 4833 VLSI Design and Testi (3-3/2)
CSE 4743 Cryptography and Network Security (3-0)	CSE 4735 Digital Systems Design (3-3/2)	CSE 4845 Introduction to Information Retrieval (3-0)	CSE 4835 Pattern Recognition (3-3/2)
CSE 4745 Embedded Systems Design (3-0)	CSE 4749 Introduction to Cloud Computing (3-3/2)	CSE 4847 Information and OS Security (3-0)	CSE 4839 Internetworking Protocols (3-3/2)
CSE 4747 Computational Biology (3-0)	CSE 4751 Network Programming (3-3/2)	CSE 4849 Human Computer Interaction (3-0)	
	CSE 4753 Bioinformatics (3-3/2)	CSE 4851 Design Pattern (3-0)	

Academic Catalogue

Part 3: Detailed Course Description

Detailed Course Description

First Semester

Hum 4142 Arabic I Credit 1.0

Tajweed Rules of the Holy Quran; Letters and Pronunciation; Construction of words; Use of Numerical; Common Vocabularies; Name of Months, days and directions; Use of every day's conversation and dialogues and practice.

Recommended Texts:

1. Maha Rashed, *Learn How to Read Al-Qur'an,* 1st Edition, August 7, 2010.

Hum 4144 English I Credit 1.0

This course aims to give students of an international community accurate and meaningful communicating skills which will include expressions for personal identification (name, occupation, nationality etc.); body parts; time, day, week, months and years; daily programme; education and future career; entertainment; travel; postal, telephonic and telegraphic activities; health and welfare; food and drink; adjectives and comparatives and personal and formal written needs. Grammatical structures will emphasize the various tenses, and unit, articles, prepositions and adverbial particles; adverbs of manner, frequency, time and place; punctuation; model verbs; personal pronouns; affirmative; negative and question forms; and possessives and possessive adjectives.

This course deals with the practical and communicative aspects of the English Language by reinforcing and manipulating the sounds and grammatical patterns of the language needed in an international situation through dialogues with Audio – Language, Audio – Visual, silent way and total physical response, methods and techniques involving student participation in a language laboratory with the aids of audio and video cassettes, computer games and other communicative activities.

Hum 4145 Islamiat Credit 2.0

Tawheed: Taweedul Uluhia, Tawheedul Rububia and Tawheedul Asma-was-sifat, Aqeedah/creeds of Islam: Creeds of Ahlus-sunnah-wal-jamah; Sources of Islamic Code of Life; Social, Economic and Political system of Islam; Islamic ethics and Moral values: Human values in Islam, Dignity Family Ties; Role of Islam in eradicating social evils; Islam and the world peace.

Recommended Texts:

1. Abu Ameenah Bilal Philips, *The Fundamentals of Tawheed*, International Islamic Publishing, 2nd Edition, 2005.

Hum 4147 Technology, Environment and Society Credit 3.0

Definition of terminology – technology, environment, society and development; Inter-dependence of technology, environment, society and development; Growth of technologies and its contribution to human development; Current state of technology and its future use as an instrument of change in twenty first century; Impact of technology upon the environment, impact of the environment upon human changes in the global climates; Environment friendly technology, Technology and development; Renewable energy and environments. Technology and environment hazards, its remedy. Major hazards of industry. The improvement of working conditions in the industry.

Recommended Texts:

1. Samuel Koenig, *Sociology: An Introduction to the Science of Society*, Barnes & Noble; Revised edition, 1957.
2. Ian Robertson, *Society: A Brief Introduction*, Worth Publishers; First edition, 1988.

Math 4141 Geometry and Differential Calculus Credit 4.0

2D Co-ordinate Geometry: Change of axes: transformation of coordinates. Simplification of equations of the curves. Pair of straight lines: Homogeneous second-degree equations. Conditions for general second-degree equations to represent a pair of straight lines. Angle between the lines. Pair of straight lines joining the origin to the points of intersection of the curve and a line. Circles and system of circles: Tangents and normal. Pair of tangents. Chord of contact. Orthogonal circles. Radical axis and its properties. Parametric coordinates**.**

3D Co-ordinate Geometry: Rectangular coordinates. Direction cosines and angle between two lines. The plane and the straight lines. The equation of a sphere. The standard forms of equations of the central conicoid, cones and cylinders.

Differential Calculus: Limits, Continuity and Differentiability. Differentiation of explicit and implicit function and parametric equations. Significance of derivatives, Differentials, Successive differentiation of various types of functions. Leibnitz's theorem. Rolle's theorem, Mean value theorems. Taylor's theorem in finite and infinite forms. Maclaurin's theorem in finite and infinite forms. LaGrange's form of remainders. Cauehy's form of remainder. Expansion of functions by differentiation and integration. Partial differentiation. Euler's theorem. Tangent, maximum and minimum values of functions and points of inflection. Applications of Differential Calculus. Evaluation of indeterminate forms by L'Hospitals rule, Curvature, center of curvature and chord of curvature. Evolutes and involutes. Asymptotes. Envelopes, Curve tracing.

Recommended Texts:

- 1. Anton, Howard, Herr, Albert, *Calculus with Analytic Geometry*, Wiley, 5th Edition, 1995.
- 2. Loney, S. L. (Sidney Luxton), *The Elements of Coordinate*

Geometry, Macmillan and Co. Limited, 11th Edition, 1908.

3. E.W. Swokowski and Earl William, *Calculus with Analytic Geometry*, Boston, PWS-Kent Publishing, 4th Edition, 1988.

Phy 4141 Physics I Credit 3.0

Modern Physics: Michelson Morley's experiment, Galilean transformation, special theory of relativity, Lorentz transformation, relative velocity, length contraction, time dilation, mass-energy relation, Photo-electric effect, Compton effect, de-Broglie wave, Bohr's atom model, radioactive decay, half-life, mean-life, isotopes, nuclear binding energy, alpha beta & gamma decay.

Electricity and Magnetism: Electric charge, Coulomb's law, electric field: calculation of the electric field strength, E, a dipole in an electric field, electric flux and Gauss's law, electric potential V, relation between E and V, electric potential energy; Capacitors: capacitance, dielectric-en atomic view, Ampere's law, Faraday's law, Lenz's law, self-inductance and mutual inductance; Magnetic properties of matter: magnetomotive force, magnetic field intensity, permeability, susceptibility, classification of magnetic materials, magnetisation curve.

Physical Optics: Theories of light: Huygen's principle and construction; Interference of light: Young's double slit experiment, Fresnel bi-prism, Newton's rings, interferometers; Diffraction of light: Fresnel and Fraunhoffer diffraction, diffraction by single slit, diffraction by double slit, diffraction gratings; Polarization: production and analysis of polarized light, optical activity.

Recommended Texts:

1. David Halliday and Robert Resnick, *Physics II*, New York: Wiley, 3rd Edition, 1978.
2. Arthur Beiser, *Modern Physics*, McGraw-Hill, 6th Edition, 2001.

Phy 4142 Physics I Lab Credit 0.75

Sessional works based on Phy 4141.

CSE 4104 Engineering Drawing Lab Credit 0.75

Introduction of Engineering Drawings, being familiar with the drawing instruments and their uses, drawing instruments including components and parts, drawing of geometrical figures.
Orthographic drawing, Isometric and oblique projections, First and Third angle projections, Drawing of block diagram and circuit diagram.

CSE 4107 Structured Programming Credit 3.0

Introduction, Programming Concepts, Algorithm and Logic, Constants, Variables, Keywords and Data Types, Operators and expressions, Managing Input and Output Operations, Decision Making and Branching, Decision Making and Looping, Arrays, Multi-dimensional Arrays, Strings, User defined functions, Recursion, Structures and Unions, File Management in C, Pointers, Dynamic Memory Allocation and Linked List, The Preprocessor and some advanced topics, Advanced data types and operators.

Recommended Texts:
1. Herbert Schildt, *Teach Yourself C,* Berkeley Osborne McGraw-Hill, 3rd Edition, 1998.
2. E. Balagurusamy, *Programming in ANSI C*, Tata McGraw-Hill, 3rd Edition, 2002.

CSE 4108 Structured Programming I Lab Credit 1.5

Sessional works based on CSE 4101.

Recommended Texts:
1. Yashavant P. Kanetkar, *Let Us C*, Infinity Science Press, 8th Edition,

2008.
2. Byron S Gottfried, *Schaum's Outline of Theory and Problems of Programming With C*, Mcgraw-Hill, 2nd Edition, 1996.

CSE 4105 Computing for Engineers Credit 3.0

How Computer Works, Internal Components of Computer, How Programs Work, Program Design, Pseudo Code, Flow Chart, Logic Design, Program Development, Operating System Basics, Introduction to Algorithm and Data Structure, Problem Solving and Understanding.
Data Representation: Number System, Conversion of Binary, Octal, Hexadecimal to Decimal, Conversion of Binary to Octal, Hexadecimal, Conversion of Octal, Hexadecimal to Binary, Binary Arithmetic, Signed and Unsigned Numbers, Binary Data Representation, Binary Coding Schemes, Logic Gates.
Internet and the Web: Internetworking Protocol, The Internet Architecture, Managing the Internet, Connecting to Internet, Internet Connections, Internet Address, Internet Services, Uses of Internet.
Algorithms and programming: Algorithms, Efficiency, High-level languages, Compilers & Interpreters.
Role of Mathematics in Computer Science: Applications and roles of Calculus, Linear Algebra, Statistics and Probability etc. in the field of computing.
Computer Science as a Discipline: CS as science, Central themes (software, hardware, theory), subfields of CS.
Diversified applications of Computer Science and Engineering: Biology/bioinformatics, Artificial intelligence, Cryptography.

Recommended Texts:

1. Anita Goel, *Computer Fundamentals*, Pearson Education India, 1st Edition, 2010.
2. Peter Norton, *Introduction to Computers*, Woodland Hills, CA: Glencoe/McGraw-Hill, 5th Edition, 2003.
3. Reed, David, Ph. D. *A Balanced Introduction to Computer*

Science, Boston: Prentice Hall, 3rd Edition, 2010.

Detailed Course Description

Second Semester

Hum 4241 Islamic History, Science and Culture Credit 2.0

Makki and madani lives of the Prophet Muhammad (PBUH). Caliphate of the rightly guided caliphs. Islamic Culture & Islamic festivals; Importance of acquiring knowledge of Science and Technology in the light of the Holy Quran and the Sunnah; Relation between Science & Technology and Islam; Scientific indications in the Holy Quran, Impact of Science, Technology and Religion on Society and Social Development. Contributions of Islamic Civilization and Scientific achievement on the development of modern Science and Technology.

Hum 4242 Arabic II Credit 1.0

Reading Comprehension: Use of determiners and pronouns; Use of interrogatives; Use of nominal and verbal sentences Use of adverbs; Use of tenses; Use of Feminine & Masculine Genders; Conjunctive Adverbs; Nouns; Singular; Plural and various modifications caused by them; Use of verbs with different persons and all pronouns; Use of new words (nouns & verbs) by changing different parts of speech.

Hum 4244 English II Credit 1.0

This course aims to develop more advanced competencies in international students of English language in reading, writing and comprehending more complex sentence structures, grammatical forms and cohesion. It will lay emphasis on awareness of better precision and fluency of structure, forms and style. It will teach organization of paragraph, noting salient points, summarizing, writing advanced discourse, reports and stories on familiar and unfamiliar subjects. It will also teach different forms of writing letters, telegrams and applications, besides reporting speeches in indirect forms. It will involve advanced listening and speaking, role-playing, interpreting, discussing, interviewing etc.

Math 4241 **Integral Calculus and Differential Equations** **Credit 4.0**

Integral Calculus: Definitions of integration, Integration by method of substitution, Integration by the method of successive reduction. Definite integrals. Beta function and Gamma function. Area under a plane curve in Cartesian and Polar co-ordinates. Area of the region enclosed by two curves in Cartesian and Polar co-ordinates, parametric and pedal equations. Intrinsic equation. Volumes of solids of revolution. Volume of hollow solids of revolution. Volume of hollow solids of revolution by shell method. Area of surface of revolution.

Ordinary Differential Equation: Degree and order of ordinary differential equations. Formation of differential equations. Solutions of first order differential equations by various methods, Solutions of general linear equations of second and higher orders with constant coefficients, Solution of homogeneous linear equations. Solution of differential equations of the higher order when the dependent of independent variables is absent. Solution of differential equation by the method based on the factorization of the operators, Frobenius' method, Bessel's and Legendre's differential equations and polynomials.

Partial Differential Equations: Four rules for solving simultaneous equations of the form. Lagrange's method of solving PDE of order one. Integral surfaces passing through a given curve. Nonlinear PDE of order one (complete, particular, singular and general integrals): standard forms $f(p,q)=0$, $z=px+qy+f(p,q)$, $f(p,q,z)=0$ $f_1(x,p)=f_2(y,q)$. Charpit's method. Second order PDE: its nomenclature and classifications to canonical (standard) – parabolic, elliptic, hyperbolic. Solution by separation of variables. Linear PDE with constant coefficients.

Recommended Texts:

1. Swokowski, Earl William, *Calculus with Analytic Geometry*, Boston: PWS-Kent Publishing, 4th Edition, 1988.
2. Anton, Howard et. al., *Calculus with Analytic Geometry*, Wiley, 5th Edition, 1995.
3. Ross, Shepley L., *Differential Equations*, New York: Wiley, 3rd Edition, 1984.
4. H.T.H. Piaggio, *Elementary Treatise on Differential Equations*,

London: Bell, 2nd Edition, 1948.
5. Bernard Epstein, *Partial Differential Equations – An Introduction*, New York: McGraw-Hill, 1st Edition, 1962.
6. Sneddon, Ian Naismith, *Elements of Partial Differential Equations*, Auckland; Singapore: McGraw-Hill, 1st Edition, 1985.

Chem 4241 Chemistry Credit 3.0

Atomic structure, quantum numbers, electronic configuration, and periodic table. Properties and uses of noble gases. Different types of chemical bonds and their properties. Molecular structure of compounds. Selective organic reactions. Different types of solutions and their compositions. Phase rule, phase diagram of monocomponent system. Properties of dilute solutions. Thermochemistry, chemical kinetics, chemical equilibria. Ionization of water and pH concept. Electrical properties of solution.

Recommended Texts:

1. Arun Bahl, B. S. Bahl, G. D. Tuli, *Physical Chemistry*, S. Chand & Company Ltd, 10th Revised Edition, 1985.
2. S. Z. Haider, *Introduction to modern inorganic chemistry*, Dhaka: Edexcel Publishers, 3rd Edition, 2008.

Chem 4242 Chemistry Lab Credit 0.75

Sessional works based on Chem 4241

CSE 4202 Structured Programming II Lab Credit 1.5

Experiments based on loop and conditional statement in C, Problem solving using Iterative control statement, Problem Solving with Array, multi-dimensional array and string data structure, Advance string processing tactics, Functions and Recursion, Structures and Unions, Linked List and Dynamic Memory Allocation, problem solving using pointers, File I/O in a Big Program, Standard Template Library (STL), Advanced data types and operators.

Recommended Texts:

1. E. Balagurusamy, *Programming in ANSI C*, Tata McGraw-Hill, 4th Edition, 2016.
2. Herbert Schildt, *Teach Yourself C*, Mcgraw-Hill, 2nd Edition, 1994.
3. Yashavant P. Kanetkar, *Let Us C*, Infinity Science Press, 8th Edition, 2008.
4. Byron S Gottfried, *Schaum's Outline of Theory and Problems of Programming With C*, Mcgraw-Hill, 2nd Edition, 1996.
5. Ahmed Shamsul Arefin, *Art of Programming Contest*, Gyankosh Prokashoni, 2nd Edition, 2006.

CSE 4203 Discrete Mathematics Credit 3.0

Set theory, Elementary number theory, Graph theory, Paths and trees, Generating functions, Algebraic structures, Semigraph, Permutation groups, Binary relations, functions, Mathematical logic, Propositional calculus and predicate calculus.

Recommended Texts:

1. K. H. Rosen, *Discrete Mathematics and Its Applications*, McGraw Hill, 4th Edition, 2000.
2. Nicodemi O., *Discrete Mathematics*, Springer, 2nd Edition, 2017.
3. Donald Ervin Knuth, *Concrete Mathematics*. Addison Wesley, 2nd Edition, 1994.

CSE 4205 Digital Logic design Credit 3.0

Number Systems and their conversion, Logic Gates, Boolean algebra, Truth Tables and K-Maps, Karnaugh map logic simplification tool, Combinational circuits analysis and design Sequential Circuit Concept: Introduction to Flip-Flops i.e. J-K F/F, Introduction to Latches, design procedures, introduction to develop state diagram and state table, Structured Sequential Circuits: Registers, shift Registers, parallel Loading of Registers, Counters: synchronous, asynchronous, serial Programmable logic: Random access memory (RAM), Programmable logic Array (PLA).

Recommended Texts:

1. M. Morris R. Mano & Charles R. Kime, *Logic and Computer Design Fundamentals*, Pearson, 4th Edition, 2007.
2. Brian Holdsworth and Clive Woods, *Digital Logic Design*, Newnes, 4th Edition, 2002.

CSE 4206 Digital Logic design Lab Credit 0.75

Sessional works based on CSE 4205.

Phy 4241 Physics II Credit 3.0

Electrical Units and Standards. Electrical Networks, circuit solutions-series, series-parallel networks, loop and Nodal methods. Delta-wye Transformation, Circuit Theorems: Superposition theorem, Thevenin's and Norton's Theorem. Concept of Dual Networks.

Basic principle of generation of Alternating and Direct Current, Introduction to phasor algebra as applied to A.C. circuit analysis. Solution of A.C. circuits: Series, Parallel and Series-Parallel circuit, R.L.C circuits series and parallel resonance. Applications of Networks theorems to A.C. circuits.

The magnetic intensity, flux/density, magnetic effects of Electric current, Magnetic circuit concepts, BH curves, characteristics of magnetic materials, magnetic force and its utilization, Hysteresis and eddy current losses, magnetic circuit with A.C. and D.C. excitation.

Recommended Texts:

1. Charles K. Alexander and Matthew N.O Sadiku, *Fundamentals of Electric Circuits*, McGraw-Hill; 4th edition, 2008.
2. R.L Boylestad, *Introductory Circuit Analysis*, Pearson, 11th Edition, 2007.
3. R.L Boylestad and L. Nushelsky, *Introduction to Electric Circuits*, 5th

Edition.

Phy 4242 **Physics II Lab** **Credit 0.75**

Sessional works based on Phy 4241.

Detailed Course Description

Third Semester

Math 4341 Linear Algebra Credit 3.0

Linear Algebra: Solving $Ax = B$ for square systems by elimination (pivots, multipliers, back substitution, invertibility of A, and factorization into $A = LU$. Complete solution to $Ax = B$ (column space containing b, rank of A, nullspace of A and special solutions to $Ax = 0$ from row reduction). Basis and dimension (bases for the four fundamental subspaces). Least squares solutions (closest line by understanding projections). Orthogonalization by Gram-Schmidt (factorization into $A = QR$).
Properties of determinants (leading to the cofactor formula and the sum over all $n!$ permutations, applications to inverse matrix calculation and volume). Eigenvalues and eigenvectors (diagonalizing A, computing powers A^k and matrix exponentials to solve difference and differential equations). Symmetric matrices and positive definite matrices (real eigenvalues and orthogonal eigenvectors, tests for $x'Ax > 0$, applications). Linear transformations and change of basis (connected to the Singular Value Decomposition - orthonormal bases that diagonalize A). Linear algebra in engineering (graphs and networks, Markov matrices, Fourier matrix, Fast Fourier Transform, linear programming).

Recommended Texts:

1. Gilbert Strang, *Introduction to Linear Algebra*, Wellesley-Cambridge Press, 5th Edition, 2016.
2. Howard Anton and Chris Rorres, *Elementary Linear Algebra with Applications*, Wiley, 11th Edition, 2014.
3. Werner H. Greub, *Linear Algebra*, Springer, 4th Edition, 2012.

CSE 4301 Object Oriented Programming Credit 3.0

C++ programming: Concept of classes and objects, data and module encapsulation; polymorphism, inheritance, sub-typing, Advanced C++ I/O, virtual function; object-oriented design; generic classes, static and dynamic binding, generic classes; exception handling, Namespace and standard

template library, Introduction to J++, Introduction to dot net framework.

Recommended Texts:

1. Herbert Schildt, *Teach yourself C++,* McGraw-Hill, 3rd Edition, 1998.
2. Herbert Schildt, *Turbo C++,* McGraw-Hill Inc., New York, USA, 2nd Edition, 1994.
3. Deitel H. M. and Deitel P. J., *C++: How to program*, Prentice-Hall, 6th Edition, 2007.

CSE 4302 Object Oriented Programming Lab Credit 1.5

Sessional based on CSE 4301.

CSE 4303 Data Structures Credit 3.0

Introduction to data structures: what & why, Notations, Concept of efficiency. Elementary Data Structures: Arrays, Records & Pointers, Examples of Random Access, Call by Reference, Variable Length Strings, Secondary Storage, and Implementation in Memory. Lists: Concept of Linked Lists.

Lists: The implementation, Sub list, Recursive lists, Variants, Orthogonal lists, Stack & Queue, Sequential & circular implementation of stack & queue, Applications of stack & queue.

Graphs: Breadth-First-Search (BFS), Depth-First-Search (DFS), connected components & topological numbering, Applications.

Trees: Creation & representation, Traversal, Copying, Printing and Arithmetic interpretations of trees.

Memory Management: Uniform size records- explicit release and garbage collection.

Diverse Size Records: Allocation, Compaction.

Searching Techniques: Concept, Searching linked lists and Binary tree search.

Hashing: Extraction, Compression, Division and Multiplication, Collision Resolution: Chaining, Probing.

Collision Resolution, Double hash, ordered hash, Rehash, Radix distribution.

Sorting: Discussion and comparison on different kinds of sorting (i.e.

Insertion sort, Bubble sort, Quick sort, Selection sort, Merge sort etc.).

Recommended Texts:

1. Edward M. Reingold, *Data Structures*, Wesley, 1st Edition, 1998.
2. Seymour Lipschutz, *Schaum's Outline of Theory and Problems of Data Structures*, McGraw-Hill, 1st Edition, 1986.

CSE 4304 Data Structures Lab Credit 1.5

Sessional based on CSE 4303.

CSE 4305 Computer Organization and Architecture Credit 3.0

Components of a computer system: processors, memory, secondary storage devices and media, and other input output devices. Processor organization: registers, buses, multiplexers, decoders, ALUs, clocks, main memory and caches.

Information representation and transfer; instruction and data access methods; the control unit: hardwired and microprogrammed; memory organization, I/O systems, channels, interrupts, DMA. Von Neumann SISD organization. RISC and CISC machines.

Recommended Texts:

1. John P. Hayes, *Computer Architecture and Organization*, McGraw-Hill, 2nd Edition, 1992.

CSE 4307 Database Management Systems Credit 3.0

Overview of database management systems; DBMS file structures; introduction to the relational model; relational algebra, normalization and relational design; ER modeling, object-oriented modeling, advanced features of the relational model; Database Design Language; the hierarchical model; the CODASYL model; alternative data models; physical database design; fourth-generation environment; database

administration, database recovery, distributed databases and current trends in the field. Relational query languages: SQL; embedded SQL in a third-generation language (COBOL, C or C++). Transaction management; concurrency control.

Recommended Texts:

1. Abraham Silberschatz, Henry F. Korth and S. Sudarshan, *Database System Concept*s, McGraw-Hill, 6th Edition, 2009.
2. C. J. Date, *Database System,* Pearson, 8th Edition, 2003.
3. Elmasri R. and Navathe S. B., *Fundamentals of Database systems*, Pearson, 7th Edition, 2017.

CSE 4308 Database Management Systems Lab Credit 1.0

Sessional works based on CSE 4307.

EEE 4383 Electronic Devices and Circuits Credit 3.0

Semiconductors, Junction Diode and characteristics, Bipolar transistor characteristics, Small signal low frequency h parameter model, Hybird pie model. Amplifiers, darlington pairs, introduction to oscillators, differential amplifiers, operational amplifiers, linear application of OPamp, gain, input and output impedance, offset null adjustments, frequency response and noise.

Introduction to JFET, MOSFET, PMOS, NMOS and CMOS: biasing and application in switching circuits.

SCR, TRIAC, DIAC, PJT, CRT: characteristics and applications. Introduction to rectifiers, active filters, regulated power supply, stabilizer and UPS.

EEE 4384 Electronic Devices and Circuits Lab Credit 0.75

Sessional works based on EEE 4383.

Detailed Course Description

Fourth Semester

Math 4441 Probability and Statistics Credit 3.0

Probability Law: Sets, Probabilistic Models, Conditional Probability, Independence, Total Probability Theorem, Bayes' Theorem, Counting.

Discrete Random variables: Probability Mass Functions (PMF), Cumulative Distribution Functions (CDF), Expectation, Variance; Well-known distributions (Uniform distribution, Bernoulli distribution, Binomial distribution, Poisson distribution. etc.). Continuous Random variables: Probability Density Functions (PDF), Cumulative Distribution Functions (CDF), Expectation, Variance; Well-known distributions (Uniform distribution, Exponential distribution, Gaussian distribution).
Joint Random Variables: Joint PMFs, PDFs, Conditional Expectation, Covariance, Correlation, Independence of random Variables.

Inferential Statistics and Probability Models, Populations and Samples. Descriptive Statistics: Describing Data Sets, Summarizing Data Sets and Chebyshev's Inequality. The Sample Mean, the Central Limit Theorem, the Sample Variance, Sampling Distributions from a Normal Population. Parameter Estimation: Maximum Likelihood Estimators, Interval Estimates. Hypothesis Testing: Significance Levels, Tests Concerning the Mean of a Normal Population, Hypothesis Tests Concerning the Variance of a Normal Populations. Distribution of the Estimators.

Recommended Texts:

1. Sheldon M. Ross, *Probability and Statistics for Engineers and Scientists*, Academic Press, 4th Edition, 2009.
2. Roy D. Yates & David J. Goodman, *Probability and Stochastic Process*, Wiley, 2nd Edition, 2004.

EEE 4483 Digital Electronics and Pulse Techniques Credit 3.0

Diode logic gates, Transistor switches, Transistor gates, MOS gates, Logic Families: TTL, ECL, IIL and CMOS logic with operation details, Propagation delay, Product and noise immunity, Open collector and high impedance gates, Electronic circuits for flip-flops, Counters and register, Memory systems, PLAs, A/D and D/A converters with applications, S/H circuits, LED, LCD and optically coupled oscillators, Non-linear applications of OP AMPs, Analog switches.
Linear wave shaping: Diode wave shaping techniques, Clipping and Clamping circuits, Comparator circuits, switching circuits, Pulse transformers, Pulse transmission, Pulse generation, Monostable, bistable and astable Multivibrators, Schmitt trigger, Blocking oscillators and time-base circuit, Timing circuits, Simple voltage sweeps, Linear current sweeps.

Recommended Texts:

1. Herbert Taub and Donald L Schilling, *Digital Integrated Electronics*, Auckland: McGraw-Hill, 1985.
2. Jacob Millman, *Microelectronics*, McGraw-Hill, 2nd Edition, 1999.

EEE 4484 Digital Electronics and Pulse Techniques Lab Credit 0.75

Sessional based on EEE 4483.

CSE 4402 Visual Programming Lab Credit 1.5

Introduction of Java. Operators. Class and Method. Access Modifier. Constructor. Control Structure. Methods in Details. Enum. Variable Scope. Method Overloading. Get and Set methods. Garbage Collection. Inheritance. Polymorphism. Abstract Class and Methods. Final Methods. Interfaces. Swing Components: Jbuttton, Jcombobox, Jcheckbox, Jradiobutto. Event Handling. Applets. Database Connection (Basic).

Recommended Text:

1. Harvey M. Deitel and Paul J. Deitel, *Java How to Program*, Prentice Hall, 7th Edition, 2006.

CSE 4403 Algorithms Credit 3.0

Techniques for analysis of algorithms, Methods for the design of efficient algorithms: divide and conquer, greedy method, dynamic programming, back tracking, branch and bound, Basic search and traversal techniques, graph algorithms, Algebraic simplification and transformations, lower bound theory, NP-hard and NP-complete problems.

Recommended Texts:

1. Thomas H. Corman, Charles E. Leiserson, Ronald L. Rivest, *Introduction to Algorithms*, The MIT Press, 3rd Edition, 2009.
2. Horowitz E., Sahni S., S. Rajasekaran, *Computer Algorithms*, Silicon Pr., 2nd edition, 2008.

CSE 4404 Algorithms Lab Credit 1.0

Sessional works based on CSE 4403.

CSE 4405 Data and Telecommunications Credit 4.0

Basic concepts: Concepts and Terminology, Data representation, Data flow, Networks and network models, Protocol and standards, OSI reference model, TCP/IP protocol suite.
Data and signals: Analog and Digital data, Time and frequency domain concepts; Transmission impairment; Noisy and Noiseless channel.
Digital and Analog Transmission: Line coding scheme; Pulse code modulation; Delta Modulation; Amplitude shift keying; Frequency shift keying; Phase shift keying; Amplitude, Frequency and Phase modulation.
Multiplexing: Frequency-division multiplexing; Wavelength-division multiplexing; Time-division multiplexing, spread spectrum; Frequency hopping and Direct sequence spread spectrum.

Multiple Access Techniques: Random Access (ALOHA, CSMA, CSMA/CD, CSMA/CA), Controlled Access (Reservation, Polling, Token Passing) Channelization (FDMA, TDMA, SDMA, OFDMA, CDMA)

Transmission Media: Guided Media-Twisted pair cable; Coaxial cable; Fiber-optic cable; Unguided media- Radio wave; Microwave; Infrared and satellite communication.

Switching Network: Circuit switching network; Space and Time division switching; Control signaling; Soft switch architecture; Packet switching; Packet switching technique; Datagram and virtual circuit packet switching.

Error Detection and Correction: Types of error; Block coding; Linear block codes; Hamming code; Cyclic code Convolution codes; Trellis code.

Data link Control Protocols: Flow control; Error control; High level data link control.

Mobile communication: GSM Architecture, CDMA Architecture Cellular concept: Frequency reuse; Handoff; Channel assignment; Co-channel and adjacent channel interference; Cluster size; Cell size; Coverage; Capacity; Cell splitting, Sectoring, Power control, Frequency hopping.

dio Propagation and channel modeling: Signal propagation mechanisms; Multipath propagation characteristics; Signal fading; Pathloss; Propagation models: Radio wave propagation modeling; Free space propagation model; Radio wave reflection: Ground reflection model; Diffractions; Scattering; Deterministic model; Outdoor propagation model: Okumura model, Hata model.

commended Texts:

1. Behrouz A. Forouzan, *Data Communications and Networking*, McGraw-Hill, 4th Edition, 2007.
2. T. Rappaport, *Wireless communication: Principles and Practice*, Prentice Hall, 2nd Edition, 2002.
3. Yi bing Lin, *Wireless & Mobile Network Architectures*, John Wiley & Sons, NY, USA, 1st Edition, 2008.
4. Vijay K. Garg, Joseph E. Wilkes, *Principles and Applications of GSM*, Prentice Hall, 1st Edition, 1999.

CSE 4407 System Analysis and Design Credit 2.0

System concepts, System and System analysis, system planning, approach to systems development, user involvement, feasibility assessment. System investigations: objectives, methods, recording. Logic System Design, Physical Design of computer and manual sub-system, project management and documentation.
Software Project Management: life cycle, specification design, documentation, maintenance and control. Nature and sources of software tools. Program system organization, analysis of program performance, testing and verification methods, editing formatting, Microprocessing co-ordination of multiple programs.

Recommended Texts:

1. Kenneth E. Kendall & Julie E. Kendall, *System analysis and design*, Pearson, 9th Edition, 2014.
2. Elias M. Awad, *System analysis and design*. Galgotia Publications, 2nd Edition, 2010.

CSE 4408 System Analysis and Design Lab Credit 1.0

Sessional works based on CSE 4407.

Hum 4441 Engineering Ethics Credit 3.0

Introduction to Engineering ethics and professionalism: What is engineering ethics? Why study engineering ethics? Responsible Professionals, Professions, and Corporations, The Origins of Ethical Thought, Ethics and the Law,
Moral Reasoning and Codes of Ethics: Ethical decision-making strategies, Ethical dilemmas, Codes of ethics, Case studies,
Moral Frameworks for Engineering Ethics: Ethical theories, Personal commitments and professional life,
Ethical Problem-Solving Techniques: Analysis of Issues in Ethical Problems, An Application of Problem-Solving Methods,

Engineering as Social Experimentation: Engineering as Experimentation, Engineers as Responsible Experimenters,
Risk, Safety, and Accidents: Assessment of safety and risk, Design considerations, uncertainty, Risk-benefit analysis, safe-exit and fail-safe systems,
Engineer's Responsibilities and Rights: Employee/employer rights and responsibilities, Confidentiality and conflict of interest, Whistle-blowing, Case studies on whistle-blowing,
Honesty and Research Integrity: Truthfulness, Trustworthiness, Research Integrity, Protecting Research Subjects,
Computer Ethics: The Internet and Free Speech, Power Relationships, Property, Privacy, Additional Issues,
Environmental Ethics: Engineering, ecology, economics, Sustainable development, Ethical frameworks
Global Issues: Multinational corporations, globalization of engineering, Technology transfer, appropriate technology,
Cautious Optimism and Moral Leadership: Cautious optimism as a technology development attitude, Moral leadership in engineering

Recommended Texts:

1. Charles B. Fleddermann, *Engineering Ethics*. Pearson, 4th Edition, 2011.
2. Mike W. Martin, Roland Schinzinger, *Introduction to Engineering Ethics*, McGraw-Hill, 2nd Edition, 2010.

Detailed Course Description

Fifth Semester

CSE 4501 Operating Systems Credit 3.0

Types of operating systems: single user, real-time, batch, multiple access. Principles of operating systems; design objectives; sequential processes; concurrent processes, concurrency, functional mutual exclusion, processor co-operation and deadlocks, processor management. Control and scheduling of large information processing systems. Resource allocation, dispatching, processor access methods, job control languages. Memory management, memory addressing, paging and store multiplexing. Multiprocessing and time sharing, batch processing. Scheduling algorithms, file systems, protection and security; design and implementation methodology, performance evaluations and case studies.

Recommended Texts:

1. Abraham Silberschatz, *Operating System Concepts*, Wiley, 8th Edition, 2008.
2. Tanenbaum A. S., *Modern Operating Systems*, Pearson, 4th Edition, 2014.

CSE 4502 Operating Systems Lab Credit 1.0

Sessional works based on CSE 4501.

CSE 4503 Microprocessor and Assembly Language Credit 3.0

Microprocessor and Assembly Language: Microprocessors and Microcomputers, Evaluation of Microprocessors Applications, Intel 8086 Microprocessor: internal architecture, register structure, programming model, addressing modes, instruction set, Assembly language programming, Coprocessors. An overview of Intel 80186, 80286, 80386, 80486 and Pentium microprocessors, RISC processors.

Recommended Texts:

1. V. Hall, *Microprocessor & Interfacing*, McGraw-Hill, 2nd Edition, 1992.
2. Ytha Yu, Charles Marut, *Assembly Language Programming and Organization of the IBM PC*, McGraw-Hill/Irwin, 1st Edition, 1992.
3. Ramesh S. Gaonkar, *Microprocessor, architecture, programming and application with the 8085*, Prentice Hall, 4th Edition, 1998.
4. Barry B. Brey, *The Intel Microprocessors*, Pearson Education Limited, 8th Edition, 2013.

CSE 4504 Microprocessor and Assembly Language Lab Credit 0.75

Sessional works based on CSE 4503.

CSE 4508 RDBMS Programming Lab Credit 1.5

Relational Database Programming: Introduction. Its role in S/W development. Relational Database Basic Constructs: Table, Keys, Views, Cardinality. Introduction to SQL. Relational query and sub-query. Redundancy and Functional composition in Database. Concept of Joins: Natural joins.

View: its usage and restrictions. Introduction to PL/SQL. PL/SQL Control Structures. Functions and Procedures. Introduction to Cursor. Records. Transaction Management. Oracle Collection. Large Objects. PL/SQL Package. Database Triggers. Dynamic SQL. Introduction to Database Administration. Database Performance Tuning. Brief Introduction to other Relational Databases such as: MySQL, PostGRE, MS SQL Server.

Recommended Texts:

1. M. McLaughlin, *Oracle Database 11g PL/SQL Programming*, McGraw-Hill Education, 1st Edition, 2008.

CSE 4510 Software Development Credit 0.75

Over that last five years or so, the software industry has begun to explore lightweight development methodologies as alternative approaches for

building software. These so-called "agile" methodologies emphasize the value of people - programmers and clients - over rigid processes. In this course, several of these agile methodologies will be studied and evaluated. Real programming projects will be implemented. An important part of trying them out will be to use some of the of the interesting new tools that support agile methods, such as: unit testing frameworks, such as jUnit refactoring browsers, such as Eclipse and IntelliJ's IDEA build management tools such as Ant and make.

Recommended Texts:

1. Andrew Hunt and David Thomas, *The Pragmatic Programmer*, Addison Wesley, 1st Edition, 1999.
2. Kent Beck, Cynthia Andres, *Extreme Programming Explained: Embrace Change*, Addison Wesley, 2nd Edition, 2004.
3. Robert C. Martin, *Agile Software Development: Principles, Patterns, and Practices*, Pearson Higher Education, 1st Edition, 2013.

CSE 4590 Industrial Training Credit 1.0

The students will participate in an industrial training for a period of 4 weeks. The industrial training will start after the final examination of 6th semester and will end before the start of 7th semester.

CSE 4531 E-commerce and Web Security Credit 3.0

E-commerce Business Models and Concepts: Identify the key components of e-commerce business models, B2C business models, major B2B business models, Recognize business models in other emerging areas of e-commerce, key business concepts and strategies applicable to e-commerce.
The Internet and World Wide Web: E-commerce Infrastructure: The origins of the Internet, Key technology concepts behind the Internet, Role of Internet protocols and utility programs, Current structure of the Internet, How the World Wide Web works, How Internet and Web features and services support e-commerce.
E-commerce Marketing concept: Identify the key features of the Internet

audience, Basic concepts of consumer behavior and purchasing decisions, understanding how consumers behave online, Basic marketing concepts needed to understand Internet marketing, Main technologies that support online marketing.
Ethical, Social, and Political Issues in E-commerce: Main ethical, social, and political issues raised by e-commerce, A process for analyzing ethical dilemmas, Basic concepts related to privacy, Practices of e-commerce companies that threaten privacy, Different methods used to protect online privacy, Major public safety and welfare issues raised by e-commerce.
Online Security and Payment Systems: Scope of e-commerce crime and security problems, Key dimensions of e-commerce security, Key security threats in the e-commerce environment, how technology helps protect the security of messages sent over the Internet, Tools used to establish secure Internet communications channels, and protect networks, servers, and clients, Features of traditional payment systems, The major e-commerce payment mechanisms.

Recommended Texts:

1. Kenneth C. Laudon & Carol Guercio Traver, *E-Commerce: Business, Technology, Society*, Pearson, 7th Edition, 2010.
2. Jason Andress & Steve Winterfeld, *Cyber Warfare: Techniques, Tactics and Tools for Security Practitioners*, Syngress, 2nd Edition, 2013.

CSE 4537 Decision Support Systems Credit 3.0

An introduction to computer-based decision support. The nature of management, theories of decision making, approaches to decision support, decision support technologies, the development of decision support systems, executive information systems, and group decision support systems. Assessment will include the development of a small decision support system using common spreadsheet software to illustrate the concepts presented in lectures. Students will be expected to spend a significant amount of personal study time early in the semester learning the software and developing skills in representing decision situations.

Recommended Texts:

1. Arnott D. R. and O'Donnell P. A. (eds.), *Readings in decision support*

Systems, Department of Information Systems, Monash University, 2nd Edition, 1994.

CSE 4539 Web Programming Credit 3.0

Introduction: The Internet model, Web browsers, Useful tools, Layers of the Internet World Wide Web, Domain Name Service, Uniform Resource Locator, Overview of Web Applications.
Web programming using HTML and xHTML: History of Markup Language, HTML Basics, Tags, Formatting Text, Creating Links, Adding Images, Lists, Tables, Frames, Forms, Cascading Style Sheets (CSS), Graphics.
Javascript: Introduction to javascript, Javascript syntax, Variables, Simple functions.
PHP: Generating HTML Dynamically, Processing Forms, Maintaining State in Web Applications, Cookies, Data Tier, Back-end Database Support, SQL Primer, Database Interface in PHP, Searching in Web Applications, Regular Expressions and Matching, Multimedia and Interactivity, Audio on the Web, Video on the Web.
Advanced tools: AJAX, Flash, Flex.

Recommended Texts:

1. Jennifer Niederst Robbins and Aaron Gustafson, *Learning Web Design: A Beginner's Guide to (X)HTML, StyleSheets, and Web Graphics*, O'Reilly Media, 3rd Edition, 2007.
2. Luke Welling and Laura Thomson, *PHP and MySQL Web Development*, Addison-Wesley Professional, 5th Edition, 2016.
3. Shelley Powers, *Learning JavaScript.* O'Reilly Media, 2nd Edition, 2008.
4. Matt Gibbs and Dan Wahlin, *Professional ASP.NET 2.0 AJAX*, Wrox, 1st Edition, 2007.
5. Bogdan Brinzarea and Cristian Darie, *AJAX and PHP: Building Modern Web Applications*, Packt Publishing, 2nd Edition, 2010.

CSE 4540 Web Programming Lab Credit 0.75

Sessional based on CSE 4539.

CSE 4543 Geographical Information Systems Credit 3.0

The subject aims to introduce students to the key basic principles and techniques used in the development of geographical information systems. It has a particularly strong focus on the application of GIS in practice and the evolution of approaches to their development and use. The main topics addressed include introduction to GIS concepts, basic hardware, software and data requirements for GIS development, evolution of GIS technology, key areas of application of GIS in practice, issues in the management of GIS, the organizational role of GIS, and emerging trends in GIS development and usage.

CSE 4544 Geographical Information Systems Lab Credit 0.75

Sessional works based on CSE 4543.

CSE 4513 Software Engineering and Object-Oriented Design Credit 3.0

Software Engineering principles, Life cycle models, Sizing, Estimation, Planning and control, Requirements Specification, Functional specification and design. Integration and testing strategies, Quality assurance, Configuration management, Software maintenance, Management of programming teams, programming methodologies, Debugging aids, Documentation and measurement of software verification and testing techniques and the problems of maintenance, Modification and portability.
Object oriented concepts, Abstraction and modeling; Object modeling - Identification, Classification, Association, Generalization and Aggregation, Inheritance, Meta-data and Notation for object modeling; Use case, dynamic modeling - State transition diagrams and object life cycles; State chart, class diagram, Design pattern, Object oriented development methodologies - Object modeling technique, Object oriented analysis, Object oriented design; Object communication models; and Integration of

models.

Recommended Texts:

1. Roger S. Pressman and Bruce Maxim, *Software Engineering: a practitioner's approach*, McGraw-Hill Education, 7th Edition, 2010.
2. Rumbaugh J. R., Blaha M. R., Lorensen W., Eddy F. and Premerlani W., *Object Oriented Modeling and Design*. Prentice-Hall, 1st Edition, 1991.
3. Jacobson I., Rumbaugh J., Booch G., *Unified Modeling Language User Guide*, O'Reilly, 2nd Edition, 2005.
4. Craig Larman, *Applying UML and Patterns: An Introduction to Object-Oriented Analysis and Design and Iterative Development*, Prentice Hall, 3rd Edition, 2004.
5. Simon Bennet and Ray Farmer, *Object-Oriented Systems Analysis and Design Using UML*, McGraw-Hill Education, 4th Revised Edition, 2010.
6. Gamma E., Helm R., Johnson R. & Vlissides J., *Design Patterns: Elements of Reusable Object-Oriented Software*, Pearson, 1st Edition, 1995.

CSE 4511 Computer Networks Credit 3.0

Introduction to computer networks, Uses of computer networks, Network models, Network topology, Layered approach of networking protocols, Design issues of layers, and TCP/IP protocol suite.
Data link layer: Design issues; error control, detection and correction; Logical link control sub-layer, Medium access sub-layer; Multiple access protocols, Medium access mechanisms – ALOHA, slotted ALOHA, CSMA, CSMA/CD, CSMA/CA, WDMA; Medium access protocols – IEEE 802.3: Ethernet, IEEE 802.4: Token bus, IEEE 802.5: Token ring, Introduction to WiFi; High speed LANs, FDDI, Fast Ethernet, and Gigabit Ethernet; LAN extension – Bridges, Switches, and VPN, Network layer: IP addressing, IP packet forwarding, Subnetting, CIDR, Internet protocol,

ICMP, ARP, RARP, DHCP, and IPv6 overview; Routing protocols -
Transport layer: Functionalities; User datagram protocol (UDP) – UDP operations and UDP package modules, Transmission control protocol (TCP) – TCP features, TCP Connection establishment and termination, TCP Flow control and error control, Congestion control.
Application layer: DNS, Electronic mail (SMTP, POP, IMAP), FTP, WWW.

Recommended Texts:

1. Behrouz A. Forouzan, *Data Communications and Networking*, McGraw-Hill, 4th Edition, 2007.
2. Larry L. Peterson and Bruce S. Davie, *Computer Networks: A Systems Approach*, Morgan Kaufmann, 5th Edition, 2011.
3. Tanenbaum A. S., *Computer Networks*, PTR PH, 3rd Edition, 1996.

CSE 4512 Computer Networks Lab Credit 1.5

Sessional works based on CSE 4511.

Math 4541 Multivariable Calculus and Complex Variables Credit 3.0

Complex Variable: Review of analytic functions and Cauchy-Riemann equations, Paths in the complex plane, parameterization, contours, Contour integrals, re-parameterization, Cauchy's theorem, Cauchy integral formula, Liouville's theorem and fundamental theorem of algebra, Laurent and Taylor series, Singularities, residues and the residue theorem, Evaluation of real integrals
Multivariable calculus: Vectors in the plane, Vectors in three dimensions, Dot products, Cross products, Lines and curves in space, Calculus of vector-valued functions, Motion in space, Length of curves, Curvature and normal vectors
Plane and surfaces, Graph and level curves, Limits and continuity, Partial derivatives, The chain rule, Directional derivatives and the gradient, Tangent planes and linear approximation, Maximum/minimum problems, Lagrange multipliers
Double integrals over rectangular regions, Double integrals over general

regions, Double integrals over Polar Regions, Triple integrals, Triple integrals in cylindrical and spherical coordinates, Integrals for mass calculations, Change of variables in multiple integral.

Recommended Texts:

1. Brown J. W. & Churchill R. V., *Complex Variables and Applications*, McGraw–Hill Higher Education, 8th Edition, 2009.
2. George B. Thomas Jr., Maurice D. Weir & Joel R. Hass, *Thomas' Calculus: Multivariable*, Pearson, 12th Edition, 2009.

CSE 4551 Computer Graphics and Multimedia Systems Credit 3.0

Introduction to computer graphics: brief history, applications, hardware and software and the fundamental ideas behind modern computer graphics.
Two-dimensional graphics: device-independent programming; graphics primitives and attributes.
Interactive graphics: physical input devices, event-driven input; user interface. Transformations; translation, rotation, scaling, shear.
Three-dimensional graphics: 3D curves and surfaces; projections.
Multimedia System Architecture. Objects for Multimedia System: Text; Images and graphics: Basic concepts, Computer image processing; Sound/ Audio: Basic concepts, Music, MIDI, Speech; Video and animation: Basic concepts, Computer-based animation
Data Compression Techniques: JPEG; H.261 (px64); MPEG; Intel's DVI; Microsoft AVI; Audio compression; Fractal compression
Multimedia File Standards: RTF; TIFF; RIFF; MIDI; JPEG DIB; AVI Indeo; MPEG.
Multimedia Storage and Retrieval Technology: Magnetic media technology; Optical media technology: Basic technology, CD Digital audio, CD-ROM, its architecture and further development, CD-Write only (CD-WO), CD- Magnetic optical (CD-MO).
Architecture and Multimedia Communication Systems: Pen input; Video and image display systems; Specialized processors: DSP; Memory

systems; Multimedia board solutions; Multimedia communication system; Multimedia database system (MDBMS)
User Interfaces: General design; Video and Audio at the user interface
Multimedia Applications: Imaging; Image/Voice processing and recognition; Optical character recognition; Communication: Tele-service, Messaging; Entertainment: Virtual reality, Interactive audio and video, Games.

Recommended Texts:

1. James D. Foley, Andries van Dam, Steven K. Feiner, John F. Hughes and Richard L. Phillips, *Introduction to Computer Graphics*, Addision-Wesley, 1st Edition, 1993.
2. Edward Angel, *Interactive Computer Graphics: A Top-Down Approach with Shader-Based Opengl*, Pearson, 6th Edition, 2011.
3. Donald Hearn and M. Pauline Bake, *Computer Graphics*, Prentice Hall, 2nd Edition, 1996.
4. Ralf Steinmetz and Klara Nahrstedt, *Multimedia Systems*, Springer, 1st Edition, 2004.
5. Ralf Steinmetz and Klara Nahrstedt, *Multimedia: Computing, Communications and Applications*, Pearson, 6th Edition, 2009.
6. Prabhat K. Andleigh and Kiran Thakrar, *Multimedia Systems Design*, Dorling Kindesley Pearson Education, 1st Edition, 2015.

CSE 4552 Computer Graphics and Multimedia Systems Lab Credit 0.75

Sessional works based on CSE 4551.

CSE 4549 Simulation and Modeling Credit 3.0

Introduction and basic simulation procedures. Model classification like Monte Carlo simulation, discrete-event simulation, continuous system simulation, mixed continuous/ discrete-event simulation, Simulation Languages, random number generation and testing, analysis of simulation results, confidence intervals, variance reduction techniques. Case studies of analytical and simulation studies of computer systems.
Analytical versus simulation modeling, Workload modeling, Random

variables. Commonly used distributions. Stochastic processes, Markov chain models of computer systems, steady-state and transient analyses, queuing models, Single server and multi-server queues, open and closed queuing networks. model verification and validation, Petri nets, state charts, hybrid models, system dynamics and object-oriented modeling. Simulation and modeling in life.
Input and output analysis: random numbers, generating and analyzing random numbers, sample generation, trace- and execution-driven simulation, point and interval estimation. Process-oriented and parallel and component simulation and modeling
Performance evaluation methods, Performance measurement and benchmarking, workload characterization, the representation of measurement data, instrumentation: software monitors, hardware monitors, capacity planning, bottleneck detection, system and program tuning, simulation and analytical models and their application, case studies.

Recommended Texts:

1. Raj Jain, *The Art of Computer Systems Performance Analysis: Techniques for Experimental Design, Measurement, Simulation, and Modeling*, Wiley, 1st Edition, 1991.
2. Kishor Shridharbhai Trivedi, *Probability and Statistics with Reliability, Queueing and computer science Applications*, Wiley, 2nd Edition, 2016.
3. Averill M. Law and W. David Kelton, *Simulation Modeling and Analysis*, McGraw-Hill College, 2nd Edition, 1991.

CSE 4550 Simulation and Modeling Lab Credit 0.75

Sessional works based on CSE 4549.

CSE 4533 Parallel and Distributed Processing Credit 3.0

Parallel processing: Importance, architecture, hardware and software issues, Architecture for parallel processing, classification, comparative study of different architecture, hardware issues of parallel processing
Distributed processing: Definition, impact of distributed processing on

organizations, pitfalls in distributed processing.
Forms of distributed processing: Function distribution, Hierarchical distributed systems, Horizontal distributed systems, strategies of distributed data processing, control of complexity, problem of incompatibility, centralisation vs. Decentralisation, design of distributed data, location of data, multiple copies of data, conflict analysis.
Multiprocessing Control and Algorithm, Multiple Architecture and Processing, Data flow Computation and VLSI Computation.

Recommended Texts:

1. Kai Hwang and Faye A. Briggs, *Computer Architecture and Parallel Processing*, McGraw-Hill Education, 1st Edition, 1986.

Detailed Course Description

Sixth Semester

CSE 4600 Project/ Thesis Credit 3.0

CSE 4651 UNIX Programming Credit 3.0

Introduction to UNIX, History, Layering, OSI Model, UNIX Model.
C Programming tools in UNIX, The C Language, single and multi-module programme, UNIX file dependency system, UNIX Archive System, UNIX Source Code Control System, UNIX profiler, Unix Debugging, System Programming
Inter process Communication, Communication Protocols, TCP/IP, XNS, SNA, NetBIOS and OSI Protocols, UUCP, Berkley Sockets, Unix Domain Protocols, Socket Addresses, elementary and advanced socket UNIX Shells, Shell functionality, systems call, System verses Transport Layer Interface, Transport Endpoint addresses, elementary a and advanced TLI functions, I/O Multiplexing, Library Routines, time and Date Routines, Ping Routines.

Recommended Texts:

1. Graham Glass and King Ables, *UNIX for Programmers and Users*, Pearson, 3rd Edition, 2003.
2. W. Richard Stevens, *UNIX Network Programming*, Prentice Hall, 2nd Edition, 1999.
3. Meeta Handhi, Rajiv Shah, Tilak Shety and Vijay Mukhi, *The 'C' Odyssey: UNIX – The Open Boundless C*, BPB Publications, 3rd Edition, 2013.

CSE 4652 UNIX Programming Lab Credit 0.75

Sessional works based on CSE 4651.

CSE 4610 Design Project Credit 1.5

Students will develop some projects based on previously acquired subject knowledge.

CSE 4614 Technical Report Writing Credit 0.75

Issues of technical writing and effective oral presentation in Computer Science and Engineering; Writing styles of definitions, propositions, theorems and proofs; Preparation of reports, research papers, theses and books: abstract, preface, contents, bibliography and index; Writing of book reviews and referee reports; Writing tools: LATEX; Diagram drawing software; presentation tools; Definition of plagiarism; Types of plagiarism; How to detect plagiarism; Plagiarism and world wide web; How to avoid plagiarism.

Recommended Texts:

1. Baden Eunson, *Writing and Presenting Reports*, Wiley, 1st Edition,1994.
2. Roy Peter Clark, *Writing Tools: 55 Essential Strategies for Every Writer*, Little, Brown and Company; 1st Edition, 2008.
3. Heike Hering, *How to Write Technical Reports: Understandable Structure, Good Design, Convincing Presentation*, Springer, 2010.
4. Leslie Lamport, *LaTeX: A Document Preparation System*, Addison-Wesley Professional, 2nd Edition, 1994.

CSE 4635 Web Architecture Credit 3.0

The objective of this course is to introduce and explain the basic concepts of web architecture. Students of this course assume to have prior knowledge of computer network and programming languages as the prerequisite. A reasonable familiarity of java programming will be the added advantage. Throughout the course, the introductory concepts of web architectures for developing web applications will be studied. Students will learn how to write Java applications that share data across the Internet for games, collaboration, software updates, file transfer and more. A behind-the-scenes look at HTTP, CGI, Servlets, Enterprise Java Beans, ORM, which supports the Internet and the Web will be provided. This course explores the knowledge and the tools to create the next generation software that takes full advantage of the Internet.

Recommended Texts:

1. Clay Andres and Serena Herr, *Great Web Architecture*, Wiley, 1st Edition, 1999.
2. Leon Shklar and Rich Rosen, *Web Application Architecture: Principles, Protocols and Practices*, Wiley, 2nd Edition, 2009.

CSE 4636 Web Architecture Lab Credit 0.75

Sessional works based on CSE 4635.

CSE 4619 Peripherals and Interfacing Credit 3.0

Interrupts, address space partitioning, A-to-D and D-to-A converters and some related chips. Interfacing ICs of I/O devices – I/O ports, Programmable peripheral interface, DMA controller, interrupt controller, communication interface, interval time, etc. IEEE 488 and other buses, interfacing with microcomputer. Interfacing I/O devices – floppy disk, hard disk, tape, CD-ROM & other optical memory, keyboard, mouse, monitor, plotter, scanner, etc. Microprocessor in Scientific Instruments and other applications – Display, Protective Relays, Measurements of Electrical quantities, Temperature monitoring system, water level indicator, motor speed controller, Traffic light controller, etc. Microprocessor based interface design.

Recommended Texts:

1. Raycho Todorov Ilarionov, *Computer Peripherals*, Vasil Aprilov Gabrovo, 2nd Edition, 2013.
2. P. Marwedel, *Embedded System Design*, Springer, 1st Edition, 2006.
3. Arnold S. Berger, *Embedded System Design: An Introduction to Processes, Tools and Techniques*, CMP Books, 1st Edition, 2001.

CSE 4620 Peripherals and Interfacing Lab Credit 0.75

Sessional works based on CSE 4619.

CSE 4641 Distributed Operating Systems Credit 3.0

Introduction to Distributed Systems Communication in Distributed Systems. Synchronization in Distributed Systems: Clock Synchronization, Mutual Exclusion, Election Algorithms, Atomic Transactions, Deadlocks in Distributed Systems. Processes and Processors in Distributed Systems: Threads, System Models, Processor Allocation, Scheduling in Distributed Systems, Fault tolerance, Real-Time Distributed Systems. Distributed File Systems: Distributed File System Design, Distributed File System Implementation, Trends in Distributed File Systems. Distributed Shared Memory: Consistency Model, Page-Based Distributed Shared Memory, Shared-Variable Distributed Shared Memory, Object-Based Distributed Shared Memory, Comparison.
Case Study: Amoeba, Mach, Chorus.

Recommended Texts:

1. Andrew S. Tanenbaum, *Distributed Operating System*, Prentice Hall, 3rd Edition, 2006.

CSE 4642 Distributed Operating Systems Lab Credit 0.75

Sessional works based on CSE 4641.

CSE 4643 Mobile Application Development Credit 3.0

Basic concepts: Mobile computing; Mobile computing architecture, Mobile technologies, Anatomy of a mobile device, Applications of mobile computing, Technical issues for mobility, Mobile agents and process migration.
Introduction to Mobile Development Frameworks and Tools: Fully Centralized Frameworks and Tools, N-Tier Client–Server Frameworks and Tools, J2ME, WAP, Symbian EPOC, iPhone, Android, Windows CE.
Android application development: Getting started with android programming, Android architecture, Application framework and libraries, Android runtime, Linux kernel, Android user interface, Data persistence,

Messaging and networking, Location Based Services, Developing android services, Android application publishing
The User Experience: The Small Screen Problem, The Unified Look and Feel Paradigm, The iPhone Human Interface Guidelines, The Blackberry User Interface Guidelines, Common User Interface Guidelines,
Security Issues in mobile computing: Security threats, Ensuring consistency and reliability.
The Future of Mobile Computing: Upcoming Technologies, Convergence of Media and Communication Devices.

Recommended Texts:

1. Raza B'Far, *Mobile Computing Principles: Designing and Developing Mobile Applications with UML and XML*, Cambridge University Press, 2nd Edition, 2004.
2. Kumkum Garg, *Mobile Computing: Theory and Practice*. Dorling Kindersley, 1st Edition, 2010.
3. Wei-Meng Lee, *Beginning Android Application Development*, Wrox Press, 1st Edition, 2011.
4. Rick Rogers, Jhon Lombardo, Zigurd Mednieks, G. Blake Meike, *Android Application Development: Programming with the Google SDK*, Shroff, 1st Edition, 2009.
5. David Wolber, Hal Abelson, Ellen Spertus and Liz Looney, *App Inventor: Create Your Own Android Apps*, O'Reilly, 1st Edition, 2011.
6. Jonathan Knudsen, *Wireless Java: Developing with J2ME*, Apress, 2nd Edition, 2003.
7. Tommi Mikkonen, *Programming Mobile Devices: An Introduction for Practitioners*, Wiley, 1st Edition, 2007.

CSE 4644 Mobile Application Development Lab Credit 0.75

Sessional works based on CSE 4643.

Math 4645 Numerical Methods Credit 3.0

Solution of algebraic and Transcendental equation: Iterative method, Gauss elimination method, Gauss-Seidel method and their applications in Engineering fields.
Interpolation/Extrapolation: Interpolation with one and two independent variables. Formation of different difference table. Newton's forward and backward difference, Lagrange's interpolation, Neville-Aitken's interpolation, Successive iteration.
Numerical Integration: Trapezoidal rule, Gauss's Quadratic formula, Multiple integration, Romberg's method, Truncation and error estimation. Numerical solution of differential equations, Numerical solution of partial differential equations, curve fitting, Methods of least square, Estimation of linear and nonlinear parameters, formulation, different engineering experimental results.

Recommended Texts:

1. R. L. Burden and J. D. Faires, *Numerical Analysis,* Cengage Learning, 10th Edition, 2015.
2. M. A. Celia and W. G. Gray, *Numerical Methods for Differential Equations: Fundamental Concepts for Scientific & Engineering Applications*, Prentice Hall, 1st Edition, 1991.
3. L.W. Johnson and R.D. Riess, *Numerical Analysis*, Addison Wesley Longman Publishing Co, 1977.

Math 4646 Numerical Methods Lab Credit 0.75

Sessional works based on CSE 4645.

Hum 4641 Accounting Credit 3.0

Define Accounting and Book-keeping. Distinguish between Accounting and Book-keeping. Users of Accounting information. Transactions processing, Journalizing, Accounts, Classification. What are the books of accounts generally prepared by medium and small enterprises. Subdivision

of journal. Posting entries into ledger, preparation of ledger accounts. Preparation of ledger accounts. Preparation of sales and purchase day books, sales return and purchase return books, cash books and journal proper. Capital Expenditure and Revenue Expenditure, Capital Receipts and Revenue Receipts. Preparation of Final Accounts including (Manufacturing Accounts) Trading, Profit and Loss Accounts and Balance Sheets and Interpretation and analysis of Balance sheet & income Statement of accounting information in project formulation and appraisal. Cost accounting and elements of cost, preparation of cost sheet showing cost of production, Budget and budgetary control; cost- volume-profit-analysis (Break-even-analysis and Break-even point).

Recommended Texts:

1. Jerry J. Weygandt, Paul D. Kimmel and Donald E. Kieso, *Accounting Principles*, Wiley, 12th Edition, 2015.
2. Sankar Prasad Basu, Monilal Das, *Practice in Accountancy*, Rabindra Library, 9th Edition, 1999.

CSE 4617 Artificial Intelligence Credit 3.0

Survey of concepts in artificial intelligence. Knowledge representation, search and control techniques. All machines and features of the LISP and PROLOG languages. Problem representation: search, inference and learning in intelligent systems; systems for general problems solving, game playing, expert consultation, concept formation and natural language procession: recognition, understanding and translation. Case Study on Expert Systems.

Recommended Texts:

1. Stuart Russell and Peter Norvig, *Artificial Intelligence: A Modern Approarch*, Pearson, 3rd Edition, 2009.

CSE 4618 Artificial Intelligence Lab Credit 0.75

Sessional works based on CSE 4617.

CSE 4615 Wireless Networks Credit 2.0

Introduction to wireless networks: wireless access networks – wireless mesh networks, personal area networks (wireless sensor networks, body area networks, LowPan, and Bluetooth), wireless and mobile ad hoc networks, challenged networks (DTNs, VANETs).
Wireless MAC protocols: IEEE 802.11, IEEE 802.11e, IEEE 802.11n, IEEE 802.11s, IEEE 802.15.4, S-MAC, B-MAC, IEEE 802.22/20, IEEE 802.16d/e.
Wireless routing: routing matrix – ETX, ETT, WCETT, AirTime Metric, routing protocols – AODV, DSR, DSDV, HWMP, sensor network routing, VANET routing etc.
Wireless Transport protocols; Wireless TCP and its variants, Hop by Hop Congestion Control, Rate based Congestion Control etc. Quality of Service in Wireless Networks.

Recommended Texts:

1. William Stallings, *Wireless Communications and Networks*, Pearson, 2nd Edition, 2005.
2. B. H. Walke, S. Mangold and L. Berlemann, *IEEE 802 Wireless Systems*, Wiley, 1st Edition, 2006.

CSE 4616 Wireless Networks Lab Credit 0.75

Sessional works based on CSE 4615.

CSE 4647 Distributed Database Systems Credit 3.0

Introduction to Distributed Database Systems. Database System Architecture: Centralized System, Client-Server Systems, Parallel Systems, Distributed Systems, Network Types, Distributed Data Storage, Network Transparency, Data Query Processing, Data

Transaction Model, Commit protocols, Coordinator Selection, Concurrency Control, Deadlock Handle, Multi Database system, Design of Distributed Database, Location of Database, Multiple copies of Data, Distributed Database and Applications.

CSE 4648 Distributed Database Systems Lab Credit 0.75

Sessional works based on CSE 4647.

CSE 4631 Digital Signal Processing Credit 3.0

Classification of signals and systems, signal representation, discrete and analog signals.
Z-transform: Z-transformation, Inverse Z-transformation, Theorems and proposition, syste functions.
Discrete Fourier Transform (DFT): Discrete Fourier Series (DFS), Properties of DFS, Discrete Fourier Transformation (DFT), Properties and application of DFT.
Digital Filter Design Techniques: Differential and difference equations, Digital Transfer Functions, frequency response, Digital filter realization scheme, Finite Impulse response (FIR) Infinite Impulse Response (IIR) filter design.
Application of digital signal processing (DSP): Image processing, Radar systems, Telecommunications etc.

Recommended Texts:

1. John. G Proakis, Dimitris K. Manolakis, *Digital Signal Processing: Principles, Algorithms and Applications*, Prentice Hall, 3rd Edition, 1995.

CSE 4632 Digital Signal Processing Lab Credit 0.75

Sessional works based on CSE 4631.

CSE 4649 Systems Programming Credit 3.0

Concepts of system programming, assembler, compiler, loader, technical design of assembler and compiler, CPU instruction set, OS architecture, device drivers, virus and anti-virus, working principle of virus and anti-virus.
Basic concepts of security, security models. Threats to security: areas of vulnerability, physical security, data security, system security, computer system security, communication security, and personal security.
Threat Perpetration: sources, manmade, accidental, thread perpetration measures, identity verification.
Risk assessment workshop and case study, disaster recovery and contingency plan, security management, future of computer security.

Recommended Texts:

1. Leland L. Beck, *System software: An Introduction to Systems Programming*, Pearson, 3rd Edition, 1996.

CSE 4650 Systems Programming Lab Credit 0.75

Sessional works based on CSE 4649.

Detailed Course Description

Seventh Semester

Math 4741 Mathematical Analysis Credit 3.0

Review of Probability, Random variables;
Stochastic processes, Markov chains and simple queuing theory. Applications to program and algorithms analysis; Computer systems performance and reliability modeling
Renewal Theory, Distribution of N(t), Limit theorems and their applications, Renewal reward process, Semi-Markov process
Techniques and models to develop and demonstrate wide range of problems associated with the design and analysis of various probabilistic systems in Computer Science.

Recommended Texts:

1. Raj Jain, *The Art of Computer Systems Performance Analysis: Techniques for Experimental Design, Measurement, Simulation, and Modeling*, Wiley, 1st Edition, 1991.
2. Sheldon M. Ross, *Probability and Statistics for Engineers and Scientists*, Academic Press, 4th Edition, 2009.
3. Piet Van Mieghem, *Performance Analysis of Communications Networks and Systems*, Cambridge University Press, 1st Edition, 2009.

CSE 4700 Project/ Thesis Credit 3.0

CSE 4703 Theory of Computing Credit 3.0

Formal methods of automata language and computability, Finite automata and regular expressions, Properties of regular sets, Context-free grammars, Push-down automata, Properties of context-free languages, Turing machines, Halting problem, Undecidability and Computability, Recursion function theory, Chomsky hierarchy, Deterministic context-free languages, Closure properties of families of languages, Computational complexity theory, Intractable problems, Applications in parsing, pattern matching and the design of efficient algorithms.

Finite state machines, Introduction to sequential circuits, basic definition of finite state model, memory elements and their excitation functions, synthesis of synchronous sequential circuits, iterative networks, definition and realization of Moore and Mealey machines.

Recommended Texts:

1. Michael Sipser, *Theory of Computation*, Cengage Learning; 3rd Edition, 2012.
2. Hopcroft and Ullman, *Introduction to Automata Theory, Languages and Computation*, Narosa, 4th Edition, 1998.
3. Adamek, Kluwer, *Automata and Algebras*, Springer, 1990.

CSE 4790 Industrial Training Credit 1.0

The students will participate in an Industrial training for a period of 4 weeks. The Industrial training will start after the final examination of sixth semester and will end before the start of the seventh semester.

CSE 4733 Digital Image Processing Credit 3.0

Introduction to Signal Processing, Pattern Processing, Computer Graphics, Artificial Intelligence, Human Visual System, Digital Image Representation : Acquision, Storage & Display, Sampling and Quantization, Uniform and Non-uniform Sampling Image Geometry : Perspective Transformation, Synthetic Camera Approach, Stereo Imaging, Image Transform : FFT, PFT, Sine Transformation, Cosine Transformation, Image Enhancement : Spatial and Frequency Domain, Smoothing and Sharpening, Edge Detection, Histogram : Grey Level, Binary Image, Thresh Holding, Half-toning, Image Segmentation : Mathematical Morphology, Dilation and Erosion, Opening and Closing, Image Restoration : Gradation Model, Constrain and Unconstraint Restoration, Inverse Filtering, Wieners Filtering, Image Compression : Source Coding-decoding, Channel Coding-decoding, Practical Image Processing : Electronic Formation of Images, Speed / Memory Problem, Architectures, Decompositions and Algorithms, Computer Implementations for Image Processing Task.

Recommended Texts:

1. Rafael C. Gonzalez and Richard E. Woods, *Digital Image Processing*, Pearson, 3rd Edition, 2007.
2. M. Sonka, V. Hlavac, R. Boyle, *Image Processing: Analysis and Machine Vision*, Cengage Learning, 4th Edition, 2014.
3. Morris, T., *Image Processing & Computer Vision*, Palgrave Macmilan Ltd., 1st Edition, 2004.

CSE 4734 Digital Image Processing Lab Credit 0.75

Sessional works based on CSE 4733.

CSE 4735 Digital Systems Design Credit 3.0

Designing I/O system; I/O devices; Designing Microprocessor based system with interfacing chips; Programmable peripheral interface (interface to A/D and D/A converter); Keyboard/display interface; Programmable timer; Programmable interrupt controller, DMA controller; Design using MSI and LSI components; Design of memory subsystem using SRAM and DRAM; Design of various components of a computer: ALU, memory and control unit – hardwired and micro programmed; Microprocessor based designs; Computer BUS standards; Design special purpose controllers.

Recommended Texts:

1. Ian Grout, *Digital systems design with FPGAs and CPLDs*, Newnes, 1st Edition, 2008.
2. D. A. Godse and A. P. Godse, *Digital System Design*, Technical Publications, 1st Edition, 2009.

CSE 4736 Digital Systems Design Lab Credit 0.75

Sessional works based on CSE 4735.

CSE 4753 Bioinformatics Credit 3.0

Introduction of bioinformatics, Biological analysis, Software development and use of bioinformatics, Data models and web resources.
Tools for informatics, Biological databases and databanks and data mining. Applications for Bioinformatics, Biostatistics, Various biological databases, Bio tools and computer techniques.

Recommended Texts:

1. Neil C. Jones, Pavel A. Pevzner, *An Introduction to Bioinformatics Algorithms*, The MIT Press, 1st Edition, 2004.
2. Jean-Michel Claverie, *Bioinformatics for Dummies*, Wiley, 2nd Edition, 2006.
3. David W. Mount, *Bioinformatics: Sequence and Genome Analysis*, Cold Spring Harbor Laboratory Press, 2nd Edition, 2004.
4. Warren J. Ewens, Gregory Grant. *Statistical Methods in Bioinformatics: An Introduction*, Springer; 2nd Edition, 2005.
5. Cynthia Gibas, Per Jambeck, *Developing Bioinformatics Computer Skills*, O'Reilly Media, 1st Edition, 2001.

CSE 4754 Bioinformatics Lab Credit 0.75

Sessional Works based on CSE 4753.

CSE 4709 Machine Learning Credit 3.0

Introduction: Defining machine learning, Scalability, Privacy issues and social impact, Applications in AI, Computer vision, Computer games, Search engines, Marketing, Bioinformatics, Robotics, HCI and Graphics.
Graphical models: Introduction to discrete probability, Inference in Bayesian networks, Maximum likelihood and Bayesian learning Model selection.

Supervised learning: Introduction to continuous probability, Linear regression and classification (least squares and ridge), Model assessment and cross-validation, Introduction to optimization, Nonlinear regression (neural nets and Gaussian processes), Boosting and feature selection.
Unsupervised learning: Nearest neighbors and K-means, Spectral kernel methods for clustering and semi-supervised learning. The EM algorithm, Mixture models for discrete and continuous data, Temporal methods: hidden Markov models & Kalman filters, Boltzmann machines and random fields, Examples: web mining, collaborative filtering, music and image clustering, automatic, translation, spam filtering, computer games and object recognition.
Neural Network: Fundamentals of Neural Networks, Back-propagation and related training algorithms, Hebbian learning, Cohen-Grossberg learning, The BAM and the Hopfield Memory, Simulated Annealing, Different type 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.
Other forms of learning: Semi-supervised learning, Active learning, Reinforcement learning, Self-taught learning, Evolutionary learning: Genetic algorithm, Genetic programming, CGA.

Recommended Texts:

1. Christopher M. Bishop, *Pattern Recognition and Machine Learning*, Springer, 1st Edition, 2006.
2. Richard S. Sutton and Andrew G. Barto, *Reinforcement learning: An introduction*, MIT Press, 1st Edition, 1998.
3. Tom Mitchell, *Machine Learning*, McGraw-Hill, 1st Edition, 1997.
4. Richard O. Duda, Peter E. Hart & David G. Stork, *Pattern Classification*. 2nd Edition, Wiley & Sons, 2001.
5. Trevor Hastie, Robert Tibshirani and Jerome Friedman, *The Elements of Statistical Learning*, Springer, 2nd Edition, 2009.
6. David J. C. MacKay, *Information Theory, Inference and Learning Algorithms*, Cambridge University Press, 1st Edition, 2003.

7. Ethen Alpaydin, *Introduction to Machine Learning,* MIT Press, 1st Edition, 2004.

CSE 4710 Machine Learning Lab Credit 0.75

Sessional works based on CSE 4709.

CSE 4743 Cryptography and Network Security Credit 3.0

FUNDAMENTALS: OSI security architecture –Security goals- Types of attacks-Cryptography and Cryptanalysis basics -Steganography- Classical encryption techniques – Cipher principles

PRIVATE/SHARED/SYMMETRIC KEY CRYPTOGRAPHY: Data encryption standard (DES) – Block cipher design principles and modes of operation – Evaluation criteria for AES – AES cipher – Triple DES – Placement of encryption function – Traffic confidentiality- Key Management-Key distribution center (KDC)

PUBLIC/ASYMMETRIC KEY CRYPTOGRAPHY: Key management – Diffie Hellman key exchange – Elliptic curve architecture and cryptography – Introduction to number theory – Confidentiality using symmetric encryption – Public key cryptography and RSA- Public Key Infrastructure (PKI)-PKI Trust Models- Certificate standard (PKIX and X.509)- Certificate authority (CA)-Certificate revocation.

AUTHENTICATION AND HASH FUNCTION: User authentication/Authentication of people- UNIX password system- Mutual Authentication- Authentication protocols Mediated Authentication (with KDC) - Many to many authentication- Kerberos Authentication requirements – Authentication functions – Message authentication codes – Hash functions – Security of hash functions and MACS – MD5 Message Digest algorithm – Secure hash algorithm (SHA) –HMAC digital signatures – Digital signature standard,

NETWORK SECURITY: Network layer secrutiy-IP security (IPSec)- Tranasport Layer Security TLS/SSL- Electronic mail security – PGP – S/MIME – Web security -VPN and Multimedia security (SRTP and

MIKey)
SYSTEM LEVEL SECURITY: Intrusion detection – Password management – Viruses and related threats – Virus counter measures – Firewall design principles – Trusted systems.

Recommended Texts:

1. Douglas R. Stinson, *Theory and Practice*, CRC press, 3rd Edition, 2006.
2. William Stallings, *Cryptography and Network Security: Principles and Practice*, Prentice Hall, 4th Edition, 2005.
3. Behrouz A. Forouzan, *Cryptography and Network Security*, McGraw-Hill, 1st Edition, 2007.
4. Charlie Kaufman, Radia Perlman, Mike Speciner,*Network Security: Private Communication in a Public World*, Prentice Hall, 2nd Edition, 2002.

CSE 4739 Data Mining Credit 3.0

Introduction and Background: Different types of data and patterns, technologies used. Data Objects and Attribute Types. Basic Statistical Descriptions used in Data-Mining. Data Preprocessing: An Overview. Data Cleaning. Data Integration. Data Reduction. Data Transformation and Data Discretization. Data Warehouse: Basic Concepts. Data Warehouse Modeling: Data Cube and OLAP. Data Warehouse Design and Usage. Data Cube Technology: Concepts. Data Cube Computation Methods. Processing Advanced Kinds of Queries by Exploring Cube Technology. Mining Frequent Patterns, Associations, and Correlations. Classification: Basic Concepts. Decision Tree Induction. Bayes Classification Methods. Rule-Based Classification. Model Evaluation and Selection. Techniques to Improve Classification Accuracy. Cluster Analysis: Basic Concepts and Methods. Partitioning Methods. Hierarchical Methods. Density-Based Methods.

Recommended Texts:

1. Jiawei Han and et el., *Data Mining Concepts and Techniques*, MK Publishing, 3rd Edition, 2011.

CSE 4749 Introduction to Cloud Computing Credit 3.0

Fundamentals of cloud computing: Types of cloud computing, enabling technologies-virtualization, Web services, SOA, Web 2.0, cloud computing features, cloud computing 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, Virtualization technologies and its security related issues; Cloud service Models: Software as a Service (SaaS), Platform as a Service (PaaS), google AppEngine, Microsoft Azure etc, Infrastructure as a Service (IaaS), Openstack, EC2 etc, Data as a Service (DaaS); Cloud computing applications: Virtual private cloud , Scientific services and data management in cloud, Enterprise cloud, Medical information systems; Big Data Introduction: Variety of Data, Velocity of Data, Veracity of Data, Distributed file system such as Hadoop, Data centric computing such as map-reduce, Distributed database.
Cloud business models.

Recommended Texts:

1. Borko Furht, Armando Escalante, *Handbook of Cloud Computing*, Springer, 1st Edition, 2010.
2. Paul Zikopoulos, Chris Eaton, *Understanding Big Data*, *IBM*, McGraw-Hill, 1st Edition, 2011.
3. Kai Hwang, Jack Dongarra & Geoffrey C. Fox., *Distributed and Cloud Computing: Clusters, Grids, Clouds, and the Future Internet*, MK Publishing, 1st Edition, 2012.
4. R. Buyya, J. Broberg, A. Goscinski, *Cloud Computing Principles and Paradigms*, Willey, 1st Edition, 2011.

CSE 4750 Introduction to Cloud Computing Lab Credit 0.75

Sessional works based on CSE 4749.

CSE 4751 Network Programming Credit 3.0

Basic Networking Software (Protocol stacks, TCP/IP, HTTP, etc) Internet architecture and history, Elementary socket programming in C, Low level networking, Ethernet, ARP, The network layer, IP, DHCP, NAT, The network layer, routing, IPv6, Transport layer protocols, TCP, UDP, The socket interface (writing clients and servers) Advanced socket programming, non-blocking sockets, Server design (forking, threads, preforking), daemons, Network Programming in Java, DNS, email, HTTP, cgi, cookies, P2P Web services (XML, JSP, SOAP, etc) XML, DTDs, Schemas, XML Parsing, XSLT, Client side scripting, Javascript, AJAX, Web server technologies, Tomcat, servlets, Web server technologies, JSP, Web server, technologies, RPCs, Java RMI, XML-RPC, CORBA, Server scripting languages, PHP, Ruby Web services, SOAP, WSDL, UDDI, The Semantic Web, RDF, OWL
Network security Cryptography, authentication, digital signatures, Network security, Kerberos, IPSec, SSL, Implementation of security, Anonymity on the Web, tor, Multimedia and VoIP, RTP.

Recommended Texts:

1. Richard Stevens, *UNIX Network Programming*, Prentice Hall, 2nd Edition, 1998.
2. Terrence Chan, *UNIX System Programming using C++*, Prentice Hall, 1st Edition, 1996.
3. Maurice Bach *The Design of the Unix Operating System*, Prentice Hall, 1st Edition, 1986.

CSE 4752 Network Programming Lab Credit 0.75

Sessional works based on CSE 4751.

Hum 4731 Business Communications and Law Credit 2.0

Communicating in today's workplace, the writing process, communicating at work, Reporting workplace data, Professionalism, Teamwork, Meeting and speaking skill.

Principles of law of contracts; Company law: law regarding formation, incorporation, management and winding up of companies; Labor law: law in relation to wages hours, health, safety and other condition to work; The trade union legislation arbitration, the policy of the state in relation to labor; The Factory Act (1965); The Law of compensation.

Analytical mode of cyber law in security and society, Cyber law hypothesis, Cybercrime, security in cyber society sector research analysis, security in cyber society cyber law in security, General law & Cyber law, Cyber security and benefits.

Recommended Texts:

1. Dwyer J., *The business communication handbook*, Prentice-Hall, 6th Edition, 2002.
2. Mary Ellen Guffey and Dana Loewy, *Essentials of Business Communication*, Cengage Learning, 10th Edition, 2015.
3. Anupa P. Kumar, *Cyber Law*, CreateSpace Independent Publishing Platform, 1st Edition, 2009.

Hum 4743 Engineering Economics Credit 2.0

Definition of Economics, Economics and Engineering, Principles of Economics, Micro-Economics and Macro-Economics.

Micro-Economics: Introduction to various economic systems - Capitalist, Command and Mixed Economy, Fundamental Economic problems and their solutions, Theory of demand, supply and their elasticities, Consumer behavior theory, Utility analysis approaches – cardinal and ordinal approaches, Price determination, Nature of an economic theory, Applicability of economic theories to the problems of developing countries, Indifference curve techniques, Theory of production, Production function, Types of productivity, Rational region of production of an engineering firm, Concepts of market and market structure, Cost analysis and cost function, Small scale production and large scale production, Optimization, Theory of Distribution, Use of derivative in Economics, Maximizing and minimizing economic functions, Relationship among total, marginal and average concepts.

Macro-Economics: Savings, Investment, Employment, National income

analysis, Inflation, Monetary Policy, Fiscal policy, Trade policy, Economics of development and planning, Partial equilibrium theory, Representation and Solution theory, Applications in Bangladesh.

Recommended Texts:

1. Aby, Stephen H., *Economics: A Guide to Reference and Information Sources*, Libraries Unlimited, 3rd Edition, 2005.
2. Wadsworth, *The Practice of economics Research*, Edward Elgar Pub, 10th Edition, 2012.

Hum 4745 International Relationship Credit 2.0

An introduction to contemporary analysis of international relations. Students will learn major theories of international relations and apply them to understand international situations and issues in the modern world. Emphases are on clearly comprehending the relationship between international conflicts and cooperation and on recognizing the shift from "internationalization" to "globalization". Extensive use of internet information, articles from professional journals and newspapers will enable students to update information about imminent international issues today and to think about them critically.

Recommended Texts:

1. Baylis, John, Steve Smith, and Patricia Owens, *The Globalization of World Politics: An Introduction to International Relations*, Oxford University Press, 5th Edition, 2011.
2. Mingst, Karen A., and Ivan M. Arreguín-Toft, *Essentials of International Relations*, W. W. Norton & Company, 6th Edition, 2013.
3. Nau, Henry R., *Perspectives on International Relations: Power, Institutions, Ideas*, CQ Press, 3rd Edition, 2011.

CSE 4745 Embedded Systems Design Credit 3.0

Introduction to Embedded system, The Embedded Design Life Cycle, Models of Computation, State Charts, General language Characteristics

(SDL, Petri nets, Message Sequence Charts, UML, JAVA, HDL), Embedded System Hardware, (Input, Communication, Processing Unit, Memories, output) Embedded operating systems, middleware & Scheduling, Implementing, ASIC, Embedded Systems Hardware/Software codesign.

Recommended Texts:

1. Arnold Berger, Arnold S. Berger, *Embedded System Design: An Introduction to Processes, Tools and Techniques,* CMP Books, 1st Edition, 2001.

CSE 4747 Computational Biology Credit 3.0

Genomics, Bioinformatics & Molecular Biology, Systematic Literature Search, Human Genome Project, Genome and Sequence Databases, Protein Sequence and Motif Databases, Sequence Alignment, Sequence Similarity Search, Multiple Sequence Alignment, Distance based Phylogenies, Building Protein Motifs and Models, Ab initio Protein Structure Prediction, Clustering Coordinately Regulated Genes, Discovering Gene Regulatory Signals, Gene Regulatory Modules and Networks, MicroRNA Regulatory Networks, Simple Nucleotide Polymorphisms (SNPs), Genome Variations, Genome-Wide Association Studies, Metabolic Pathways and Analyses I, Metabolic Pathways and Analyses II.

Detailed Course Description

Eighth Semester

CSE 4800 Project/ Thesis Credit 3.0

CSE 4801 Compiler Design Credit 3.0

Introduction to compiler concepts; Compiling techniques including parsing, semantic processing, and optimization; Compiler-compilers and translator writing systems; Scope rules, block structure, and symbol tables; Runtime stack management and run time support; Parameter passing mechanisms; Stack storage organization and templates; Heap storage management; Intermediate code; Code generation Macros; Error management; A small project.

Recommended Texts:

1. Alfred V. Aho, Monica S. Lam, Ravi Sethi, Jeffrey D. Ullman, *Compilers: Principles, Techniques, & Tools*, Pearson, 2nd Edition, 2007.
2. Allen I. Holub, *Compiler Design in C*, Prentice-Hall, 1st Edition, 1990.
3. Trembly and Sorensen, *Theory and Practices of Compiler Writing*, McGraw-Hill College, 1st edition, 1985.

CSE 4802 Compiler Design Lab Credit 0.75

Sessional works based on CSE 4801.

CSE 4807 IT Organization and Project Management Credit 3.0

Management Fundamentals: Managers &, Management, Managing in today's world.
Planning: Foundation of planning and decision making.
Organizing: Basic organization, staffing & human resource management, managing change & innovation.
Leading: Foundations of individual & group behavior, undertaking work teams, motivating & rewarding employees, leadership & trust,

communication & inter-personnel skills.
Controlling: Foundation of Control, Technology & Operations.
IT industry Scenario: Study on various types of IT organizations - Software development, Software Testing, Network, ISP, Web development, etc. IT status in various countries, Organisation of an Information Service Centre, organogram, infrastructure, external communication, administration & management scenario of an IT organization.
IT Project Management.

Recommended Texts:

1. Stephen P. Robbins, David A., Decenzo, *Fundamentals of management*, Prentice Hall, 5th Edition, 2004.
2. Dick Billows, *Managing Information Technology Projects*, The Hampton Group, Inc., 1st Edition, 2000.
3. Dick Billows, *Essential of Project Management*, The Hampton Group, Inc., 11th Edition, 2011.
4. Prasanna Chandra, *Project, Planning, Analysis, Financing, Implementation and Review*, Mc Graw Hill India, 8th Edition, 2017.
5. Chitra Sivakumar, K S Babai, *Management of Information Services*, MC- Graw Hill, 2000.

CSE 4833 VLSI Design and Testing Credit 3.0

Introduction to basic VLSI design, Design of microelectronic circuits such as registers, technology trends and design automation algorithms, Introduction to CMOS, inverters and basic gates, Brief overview of CMOS fabrication process, layout and design rules, CMOS subsystem, adder and related functions, multipliers, programmable logic arrays via large scale integrated circuitry with emphasis on high-level structured design methods for VLSI systems.
Hardware modeling: Introduction to HDL, hardware modeling languages, Structural Specification of Hardware, logic networks, state diagrams, data flow and sequencing graphs, behavioral optimization.
Architectural synthesis: Circuit specification, strategies for architectural optimization, data path synthesis, control unit synthesis, synthesis of pipelined circuits.

Testing techniques and algorithms, Various methodologies for testing. Utilities for High Level Descriptions. Dataflow Descriptions in HDL, HDL Systems, CPU Modeling and Design. Interface Modeling and Design.

Recommended Texts:

1. Navabi Zainalabedin, *HDL: Analysis and Modeling of Digital Systems*, McGraw-Hill College, 1st Edition, 1992.
2. Perry, Douglas L., *HDL*, McGraw-Hill Professional, 4th Edition, 2002.

CSE 4834 VLSI Design and Testing Lab Credit 0.75

Sessional works based on CSE 4833.

CSE 4835 Pattern Recognition Credit 3.0

Introduction to pattern recognition, classification, Description. Patterns and Feature extraction. PR approaches, Training and Learning in PR, Common Recognition Problems.
Statistical PR, The gussian case and class dependence, Discriminant Function, classifier performance, Risk and Errors, Supervised Learning, Parametric Estimation and Supervised learning, Maximum likely hood estimation, The Bayesian Parameter Estimation Approach. Supervised Learning Using Non-Parametric Approaches, Parzen windows.
Linear Discriminant Function and the Discrete and Binary Feature cases, Unsupervised Learning and clustering, Syntactic Pattern Recognition (SPR), Syntactic Pattern Recognition via parsing and other grammars, Graphical approaches to Syntactic Pattern Recognition, Graph based structural presentation, graph Isomorphism, similarity measurements, Learning via grammatical Inference.
Introduction to Neural Recognition and Neural Pattern associators and Matrix approaches.

Recommended Texts:

1. Richard O. Duda, Peter E. Hart and David G. Stork, *Pattern*

Classification, Wiley, 2nd Edition, 2000.
2. Robert J. schalkoff, *Pattern Recognition: statistical structural and Neural Approaches*, Wiley, 1st Edition, 1991.

CSE 4836 Pattern Recognition Lab Credit 0.75

Sessional works based on CSE 4835.

CSE 4809 Algorithm Engineering Credit 2.0

Introduction and review of asymptotic analysis including big-oh notation, divide and conquer algorithms and its application in sorting, matrix multiplication etc., Median finding and selection, interval scheduling, the substitution method, the master method.
Introduction and applications of probability and randomized algorithms, quicksort and its analysis, radix sort, sorting lower bound, hashing, open addressing and amortization, amortized analysis.
The greedy algorithm design paradigms and its applications, dynamic programming design paradigm and its applications.
Graph primitives, BFS, DFS, topological sort in DAGS, all pairs shortest paths, minimum spanning trees and their applications to clustering, heaps and their applications.
Competitive analysis, network flow i.e. max flow and min cut algorithms, interlude: problem solving, van Emde Boas data structure.
Intractable problems and what to do about them, NP-completeness and the P vs. NP question, polynomial time approximations, sublinear-time algorithms, heuristics with provable performance guarantees, Approximation Algorithms, Fast Fourier Transform, local search, Linear Programming, exponential-time algorithms that beat brute-force search.

Recommended Texts:
1. Thomas H. Corman, Charles E. Leiserson, Ronald L. Rivest, *Introduction to Algorithms*, The MIT Press, 3rd Edition, 2009.
2. Anany Levitin, *The Design and Analysis of Algorithms*, Pearson, 3rd Edition, 2011.
3. J. McConnell, *Analysis of Algorithms: An Active Learning Approach*, Jones & Bartlett, 2nd Edition, 2008.

CSE 4810 Algorithm Engineering Lab Credit 0.75

Sessional works based on CSE 4809.

CSE 4803 Graph Theory Credit 3.0

Structure and Basic Definition of Graph Theory, methodology, proofs, basic properties of graphs, graph operations and their symbolic designation. Orientation of graphs, associated matrices and their relationship. Groups, automorphism graphs, symmetric graphs, graph enumeration, graph coloring, five color problem, four color conjecture, Heawood map coloring theorem, critical graphs, homomorphism.
Graph algorithms, ordered tree, Huffman tree, catalan numbers, maxflow problem and solutions, maximum matching in bipartite graph, zero-one net flow, NP-complete problems, Eular and Hamilton path and circuit.

Recommended Texts:

1. Narshingh Deo, *Graph Theory and applications to engineering and computer science*, Prentice Hall, 1st Edition, 2016.

CSE 4841 Introduction to Optimization Credit 3.0

Introduction of the principal algorithms for linear, network, discrete, nonlinear, dynamic optimization and optimal control especially their methodology and the underlying mathematical structures. The simplex method, network flow methods, branch and bound and cutting plane methods for discrete optimization, optimality conditions for nonlinear optimization, interior point methods for convex optimization, Newton's method, heuristic methods, and dynamic programming and optimal control methods.

Recommended Texts:

1. Edwin K.P. Chong and et el., *An Introduction to Optimization*, Wiley, 4th Edition, 2013.

2. G. Hadley, *Linear Programming*, Narosa Book Distributors Private Ltd., 2002.
3. Mokhtar S. Bazaraa et el, *Linear Programming and Network Flow*, Wiley, 4th Edition, 2009.

CSE 4845 Introduction to Information Retrieval Credit 3.0

Introduction: basic structure and major topics of this course, and go over some logistic issues and course requirements
Search engine architecture: basic building blocks of a modern search engine system, including web crawler, basic text analysis techniques, inverted index, query processing, search result interface.
Retrieval models: Retrieval model, a.k.a., ranking algorithm, is arguably the most important component of a retrieval system, and it directly determines search effectiveness. We will discuss classical retrieval models, including Boolean, vector space, probabilistic and language models. We will also introduce the most recent development of learning-based ranking algorithms, i.e., learning-to-rank.
Retrieval evaluation: Assessing the quality of deployed system is essential for retrieval system development. Many different measures for evaluating the performance of information retrieval systems have been proposed. We will discuss both the classical evaluation metrics, e.g., Mean Average Precision, and modern advance, e.g., interleaving.
Relevance feedback: User feedback is important for retrieval systems to evaluate the performance and improve the effectiveness of their service strategies. However, in most practical system, only implicit feedback can be collected from users, e.g., clicks, which are known to be noisy and biased. We will discuss how to properly model implicit user feedback, and enhance retrieval performance via such feedback.
Link analysis: We will discuss the unique characteristic of web: inter-connection, and introduce Google's winning algorithm PageRank. We will also introduce the application of link analysis techniques in a similar domain: social network analysis.
Search applications: We will introduce modern applications in search systems, including recommendation, personalization, and online advertising, if time allows.

Recommended Texts:

1. Christopher D. Manning, Prabhakar Raghavan, and Hinrich Schuetze *Introduction to Information Retrieval*, Cambridge University Press, 1st Edition, 2008.
2. Bruce Croft, Donald Metzler, and Trevor Strohman, *Search Engines: Information Retrieval in Practice*, Pearson, 1st Edition, 2009.
3. Baeza-Yates Ricardo and Berthier Ribeiro-Neto, *Modern Information Retrieval*, Wesley, 2nd Edition, 2011.

CSE 4839 Internetworking Protocols Credit 3.0

Introduction to wireless networks, wireless media, overview of Internet technology, Internet services, electronic mail, UseNet, SNMP, SMTP, URL, URI, HTTP, MIME and WWW.
Multi access protocols; Aloha, CSMA and its variations, token ring; error control techniques, flow and congestion control, window and rate-based schemes, TCP. ATM, ABR, hop-by-hop schemes, quality of service: in ATM, IETF integrated services model, differentiated services model, mobile IP, data link layer protocols; routing algorithms and protocols, multicast: IGMP, PIM, DVMRP, spanning tree protocol.
Overview of IEEE 802.11(e/g/h/ac): standard for Wireless Local Area Networks (WLANs), IEEE 802.15: standard for Wireless Personal Area Networks (WPANs), IEEE 802.15.1: standard for Bluetooth, IEEE 802.15.4: standard for ZigBee, IEEE 802.15.5: standard for Mesh Network, IEEE 802.16: standard for Wireless Metropolitan Area Networks (WMANs), IEEE 802.15.5: standard for Mobile Broadband Wireless Access, wireless ATM networks, voice over IP (VoIP), Mobile IP, Internet using mobile phones, roaming algorithms, handover techniques, satellite communications.

Recommended Texts:

1. A.S. Tanenbaum, *Computer Networks*, Prentice Hall, 4th Edition, 2002.

2. W. Stallings, *Data and Computer Communications*, Prentice Hall, 6th Edition, 2000.

3. F. Halsall, *Data Communications, Computer Networks and Open Systems*, Wesley, 4th Edition, 1996.

4. C. Huitema, *Routing in the Internet*, Prentice Hall, 2nd Edition, 1999.

5. W.R. Stevens, *TCP/IP Illustrated Volume 1: The Protocols*, Wesley, 1st Edition, 1994.

6. D. Comer, *Internetworking with TCP/IP Volume 1: Principles Protocols, and Architecture*, Prentice Hall, 4th Edition, 2000.

7. J.F. Kurose, K.W. Ross, *Computer Networking: A Top-Down Approach Featuring the Internet*, Wesley, 3rd Edition, 2004.

CSE 4840 Internetworking Protocols Lab Credit 0.75

Sessional works based on CSE 4839.

CSE 4847 Information and OS Security Credit 3.0

An overview of information security: confidentiality, integrity, and availability Understanding the Threats
Malicious software (Viruses, trojans, rootkits, worms, botnets) Memory exploits (buffer overflow, heap overflow, integer overflow, format string) Formalisms Access control theory, access control matrix Information flow Policy, Security policies, Confidentiality policies (BLP model), Integrity policies (Biba, and Clark-Wilson model), Hybrid policies (Chinese Wall model, role-based access control), Operating system security, Introduction to operating system security, Understanding the Threats such as Viruses and Worms, Logging, Auditing, and Recovery, OS-level Memory Protection, Virtualization Technology and Applications, Vulnerability Analysis, Malware Capture and Analysis (Honeypots and Honeyfarm), Rootkits.

Recommended Texts:

1. Michael Palmer, *Guide to Operating Systems Security*, Cengage Learning, 1st Edition, 2003.
2. Matt Bishop, *Computer Security: Art and Science*, Addison-Wesley Professional, 1st Edition, 2015.

CSE 4849 Human Computer Interaction Credit 3.0

Foundations, The Human: Input-output channels, Human memory, thinking: Reasoning and problem solving, individual Differences, Psychology and the Design of interactive Systems.
The Computer: Text Entry Devices, Output Devices, Memory, Paper: Printing and scanning, processes.
The Interaction: Models of Interaction, Frameworks and HCI, Ergonomics, Interaction styles, The context of the Interaction.
Design Practice: Paradigms for interaction, Principles to support Usability, Using Design Rules, Usability Engineering, Interactive Design and Prototyping, Modules of the user in Design: Cognitive Models, Goal and Task Hierarchies, Linguistic Models. The challenges of Display Based Systems, cognitive Architectures; Task Analysis: Task Decomposition, Knowledge Based Analysis, E-R Based Techniques, Sources Information and Data Collection, Uses of Task Analysis. Dialogues Notations and Design: Dialogue Notations, Textual Dialogue Notations, Dialogue Semantics, Dialogue Analysis and Design; Models of the System: Standard Formalisms, Interaction Models, Status/Event Analysis; Implementation Support; Evaluation Technique; Help and Documentation: Requirements of user support, Approaches to user support, Intelligent help Systems.
Groupware: Groupwave systems, Meeting and Decision support systems, Framework for Grouware. CSCW Issuses and Theory: Face to Face Communication, conversation. Multi-sensory Systems: Usable sensory Inputs, speech in the interface, Handwriting Recognition; Text Hypertext and Hypermedia; Gesture Recognition, Computer Vision, Application of Multimedia Systems.

Recommended Texts:

1. Alan Dix and Janet Finlay, *Human-Computer Interaction*, Prentice Hall, 3rd Edition, 2003.

CSE 4851 Design Pattern Credit 3.0

This course is an introduction to software design patterns. Each pattern represents a best practice solution to a software problem in a specific

context. The course covers the rationale and benefits of object-oriented software design patterns. Numerous problems will be studied to investigate the implementation of good design patterns.
Topics: Strategy, Observer, Factory, Singleton, Command, Adapter, Facade, Template Method, Iterator, Composite, State, Proxy.

Recommended Texts:

1. Eric Freeman & Elisabeth Freeman, *Head First Design Patterns*, O'Reilly Media, 1st Edition, 2012.