Academic Catalogue

of
Bachelor of Science in Software Engineering (SWE)

degree for

Academic Year 2019-2020 (onwards)

Version 1.1

Department of Computer Science and Engineering (CSE)

Islamic University of Technology (IUT)

Organization of Islamic Cooperation (OIC)

January 2020

Table of Contents

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 Software Engineering
(B.Sc. in SWE)

In this era, software is crucial to the operation of computers. It has real life implications in many industries – including medical, communications, business, military, aerospace, scientific, and general computing. Using principles and techniques of computer science, engineering, and mathematical analysis, software engineers empower computers with innovative applications to perform tasks smarter, faster, and better. Therefore, IUT started to offer Bachelor of Science in Software Engineering under the Computer Science and Engineering department from the academic year of 2017-18.

Through this programme, IUT will provide students with a strong foundation in software engineering using a combination of Classroom Study, Laboratory Sessions, Software Project Labs and Design Projects. The programme blends engineering principles, computing skills, project leadership, and software construction to equip students with a comprehensive understanding of the field and to prepare graduates for the workforce or future study.

The programme is designed around a set of core courses that introduces the fundamentals of software engineering, followed by a broader range of courses. Students could choose to augment their core with more Software Systems and Security oriented courses (e.g., Software Environments, Security Risk Analysis and Management), Data Science courses (e.g., Data Mining, Big Data and Large-scale Computing,), Web Services and Applications oriented courses (e.g., Web Programming,

User Interface Design and Evaluation), or Graphics and Game related courses (e.g., animation for computer games, Artificial Intelligence for Games). Each of these areas is covered by a dedicated set of core and extended courses. In short, by providing a careful balance between theory and practice, the programme will prepare students for central software positions in industry, government organizations, and institutions where software engineering has become a key activity.

The unique characteristics of the newly introduced software engineering programme can be summarized as follows:

1. The curriculum is designed in such a way so that the students can get, besides the regular theory and laboratory classes, the opportunity to develop software through separate software lab projects individually or in a group.

2. The curriculum includes two capstone courses, namely Design Project 1 and Design Project 2, where the students are involved in the development of a real life innovative project by integrating the knowledge of multiple areas.

3. The students need to take four selected elective courses in their senior years. Currently the selected elective courses are designed for four specialized areas of Software Engineering, namely network and system, software security, web development, and game development.

4. The programme includes a 9.0 credit extensive Internship module where the students will be sent to software industries for about five months to equip them with the real life industry experience.

Program Educational Objectives (PEOs)

The graduates of Software Engineering programme are expected to attain the following objectives within a few years of graduation:

1. Demonstrate the ability to apply software engineering theories, models and techniques to analyze, design and develop the solution of real life problems.

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 training 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)

The graduates of the Software Engineering programme are expected to attain the following outcomes after graduation:

1. An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics.

2. An ability to apply the engineering design process to produce solutions that meet specified needs with consideration for public health and safety, and global, cultural, social, environmental, economic, and other factors as appropriate to Software Engineering.

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

4. An ability to communicate effectively with a range of audience.

5. An ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental and social contexts.

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

7. An ability to function effectively as a member or leader of a team that establishes goals, plans tasks, meets deadlines, and creates a collaborative and inclusive environment.

Relation between PEOs and SOs

	PEO1	PEO2	PEO3	PEO4
SO1	√	√		
SO2	√	√		
SO3	√			
SO4				√
SO5	√	√		
SO6		√	√	
SO7				√

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.

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

Where,

n = Number of courses offered in a semester

C_i = Credit hours of the ith course

GP_i = Grade Point obtained in the ith 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
2.	**Prof. Dr. Abu Raihan Mostofa Kamal** Professor
3.	**Prof. Dr. Md. Hasanul Kabir** Professor
4.	**Prof. Dr. Md. Kamrul Hasan** Professor
5.	**Tareque Mohmud Chowdhury** Assistant Professor
6.	**Hasan Mahmud** Assistant Professor

Serial No	Name, Designation and Email
7.	**Md. Sakhawat Hossen** Assistant Professor
8.	**A.B.M Ashikur Rahman** Assistant Professor
9.	**Tajkia Rahman Toma** Assistant Professor
10.	**Md. Mohayeminul Islam** Assistant Professor
11.	**Md. Hamjajul Ashmafee** Lecturer
12.	**Redwan Karim Sony** Lecturer
13.	**Faisal Hussain** Lecturer
14.	**Njayou Youssouf** Lecturer
15.	**Sabbir Ahmed** Lecturer

Serial No	Name, Designation and Email
16.	**Md. Ridwan Kabir** Lecturer
17.	**Md. Talha Ibn Aziz** Lecturer
18.	**Md. Mohsinul Kabir** Lecturer
19.	**Md. Bakhtiar Hasan** Lecturer

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

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. **Md. Abed Rahman**

    Lecturer

13. **Rafsanjany Kushol**

    Lecturer

14. **Ahnaf Munir**

    Lecturer

15. **Raihan Islam Arnob**

    Lecturer

Part-Time Faculty Members

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

Academic Catalogue

Bachelor of Science

in

Software Engineering

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   4107   Structured Programming I (Course Title)

Course Number: Odd →Theory
                            Even →Lab/Sessional

Semester

Program Type

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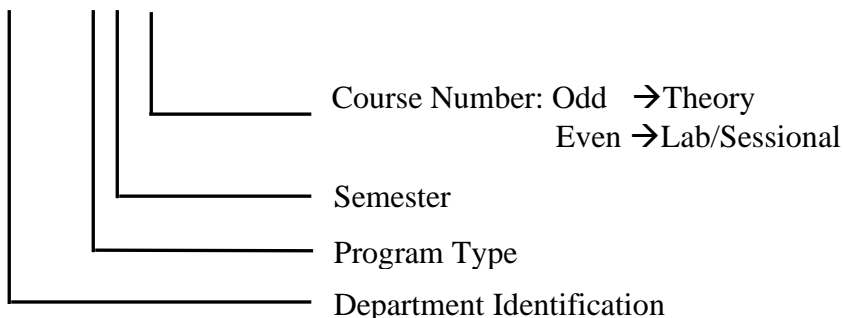
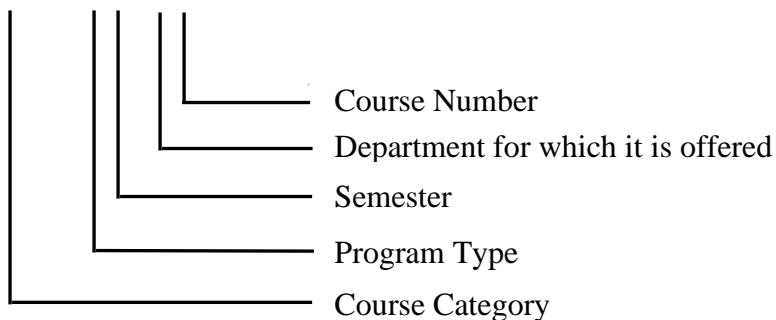For Humanities, Mathematics, Physics and Chemistry courses a three/four-letter code identifies the type of the course which is followed by a four-digit number. The four-digit number represents the followings:

- 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.

MATH   4441   **Probability and Statistics (Course Title)**

```
                                  ———————— Course Number
                                  ———————— Department for which it is offered
                                  ———————— Semester
                                  ———————— Program Type
                                  ———————— Course Category
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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 4143	Physics II	3-0	3.0
CSE 4107	Structured Programming I	3-0	3.0
SWE 4101	Introduction to Software Engineering	3-0	3.0
Hum 4142 /	Arabic I /	0-2	1.0
Hum 4144	English I		
Phy 4144	Physics II 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**	**22.00**

SECOND SEMESTER

Course Number	Course Title	Contact Hours L-P	Credit Hours
Hum 4247	Accounting	3-0	3.0
Hum 4249	Business Psychology and Communications	3-0	3.0
Math 4241	Integral Calculus and Differential Equations	4-0	4.0
CSE 4203	Discrete Mathematics	3-0	3.0
CSE 4205	Digital Logic Design	3-0	3.0
SWE 4201	Object Oriented Concepts I	3-0	3.0
Hum 4242/	Arabic II /	0-2	1.0
Hum 4244	English II		
CSE 4206	Digital Logic Design Lab	0-3/2	0.75
SWE 4202	Object Oriented Concepts I Lab	0-3	1.5
Total		**19-6.5**	**22.25**

THIRD SEMESTER

Course Number	Course Title	Contact Hours L-P	Credit Hours
Math 4341	Linear Algebra	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
CSE 4309	Theory of Computing	3-0	3.0
SWE 4301	Object Oriented Concepts II	3-0	3.0
CSE 4304	Data Structures Lab	0-3	1.5
CSE 4308	Database Management Systems Lab	0-2	1.0
SWE 4302	Object Oriented Concepts II Lab	0-3	1.5
SWE 4304	Software Project Lab I	0-3	1.5
Total		**18-11**	**23.5**

FOURTH SEMESTER

Course Number	Course Title	Contact Hrs. L-P	Credit Hours
Hum 4441	Engineering Ethics	3-0	3.0
Math 4441	Probability and Statistics	3-0	3.0
CSE 4403	Algorithms	3-0	3.0
CSE 4409	Database Management Systems II	2-0	2.0
CSE 4411	Data Communication and Networking	3-0	3.0
SWE 4401	Software Requirement and Specifications	3-0	3.0
CSE 4404	Algorithms Lab	0-2	1.0
CSE 4410	Database Management Systems II Lab	0-3	1.5
CSE 4412	Data Communication and Networking Lab	0-2	1.0
SWE 4402	Software Requirement and Specifications Lab	0-2	1.0

SWE 4404	Software Project Lab II	0-3	1.5
Total		**17-12**	**23.0**

FIFTH SEMESTER

Course Number	Course Title	Contact Hrs. L-P	Credit Hours
Math 4543	Numerical Methods	3-0	3.0
CSE 4501	Operating Systems	3-0	3.0
SWE 4501	Design Patterns	2-0	2.0
SWE 4503	Software Security	3-0	3.0
	Optional 5 I	3-0	3.0
	Optional 5 II	3-0	3.0
Math 4544	Numerical Methods Lab	0-3/2	0.75
CSE 4502	Operating Systems Lab	0-2	1.0
SWE 4502	Design Patterns Lab	0-2	1.0
SWE 4504	Software Security Lab	0-3/2	0.75
SWE 4506	Design Project I	0-3	1.5
	Optional 5 I Lab	0-3/2	0.75
	Optional 5 II Lab	0-3/2	0.75
Total		**17-13**	**23.50**

Optional 5-I (Selected Elective)

Course Number	Course Title	Contact Hrs. L-P	Credit Hours	Track
SWE 4531	Network Programming	3-0	3.0	Network and System
SWE 4537	Server Programming	3-0	3.0	Software Development
SWE 4533	Cryptography	3-0	3.0	Software Security
SWE 4535	Game Development	3-0	3.0	Game Development
SWE 4532	Network Programming Lab	0-3/2	0.75	
SWE 4538	Server Programming Lab	0-3/2	0.75	
SWE 4534	Cryptography Lab	0-3/2	0.75	
SWE 4536	Game Development Lab	0-3/2	0.75	

Optional 5-II (Free Elective)

Course Number	Course Title	Contact Hrs. L-P	Credit Hours
CSE 4553	Machine Learning	3-0	3.0
CSE 4555	Data Mining	3-0	3.0
CSE 4557	Pattern Recognition	3-0	3.0
CSE 4559	Introduction to Cloud Computing	3-0	3.0
CSE 4561	Digital Image Processing	3-0	3.0
SWE 4539	Integrated Software Development	3-0	3.0
CSE 4554	Machine Learning Lab	0-3/2	0.75
CSE 4556	Data Mining Lab	0-3/2	0.75
CSE 4558	Pattern Recognition Lab	0-3/2	0.75
CSE 4560	Introduction to Cloud Computing Lab	0-3/2	0.75
CSE 4562	Digital Image Processing Lab	0-3/2	0.75
SWE 4540	Integrated Software Development Lab	0-3/2	0.75

SIXTH SEMESTER

Course Number	Course Title	Contact Hrs. L-P	Credit Hours
Math 4643	Probability and Statistics II	3-0	3.0
CSE 4617	Artificial Intelligence	3-0	3.0
CSE 4621	Microprocessor and Interfacing	3-0	3.0
SWE 4601	Software Design and Architectures	3-0	3.0
SWE 4603	Software Testing and Quality Assurance	3-0	3.0
Optional 6-I	Optional 6-I	3-0	3.0
CSE 4618	Artificial Intelligence Lab	0-3/2	0.75
CSE 4622	Microprocessor and Interfacing Lab	0-3/2	0.75
SWE 4602	Software Design and Architectures Lab	0-3/2	0.75
SWE 4604	Software Testing and Quality Assurance Lab	0-2	1.0
SWE 4606	Design Project II	0-3	1.5

Optional 6-I	Optional 6-I Lab	0-3/2	0.75
Total		**18-11**	**23.50**

Optional 6-I (Selected Elective)

Course Number	Course Title	Contact Hrs. L-P	Credit Hours	Track
SWE 4631	System Programming and Device Driver	3-0	3.0	Network and System
SWE 4637	Web and Mobile Application Development	3-0	3.0	Software Development
SWE 4633	Network Security	3-0	3.0	Software Security
SWE 4635	Computer Graphics and Multimedia	3-0	3.0	Game Development
SWE 4632	System Programming and Device Driver Lab	0-3/2	0.75	
SWE 4638	Web and Mobile Application Development Lab	0-3/2	0.75	
SWE 4634	Network Security Lab	0-3/2	0.75	

SWE 4636	Computer Graphics and Multimedia Lab	0-3/2	0.75

SEVENTH SEMESTER

Course Number	Course Title	Contact Hrs. L-P	Credit Hours
Hum 4747	Legal Issues and Cyber Law	3-0	3.0
SWE 4701	Software Metrics and Process	3-0	3.0
Optional 7-I	Optional 7-I	3-0	3.0

CSE 4714	Technical Report Writing	0-3/2	0.75
SWE 4790	Internship	0-0	9.0
SWE 4700	Project/Thesis	0-3	1.5
Optional 7-I	Optional 7-I Lab	0-3/2	0.75
Total		**9-6.00**	**21.00**

Optional 7-I (Selected Elective)

Course Number	Course Title	Contact Hrs. L-P	Credit Hours	Track
SWE 4731	Advanced Network Protocols	3-0	3.0	Network and System
SWE 4739	Embedded Software Development	3-0	3.0	Software Development
SWE 4741	Computer and Information Security	3-0	3.0	Software Security
SWE 4737	Computer Animation	3-0	3.0	Game Development

SWE 4732	Advanced Network Protocols Lab	0-3/2	0.75
SWE 4740	Embedded Software Development Lab	0-3/2	0.75
SWE 4736	Information Security Lab	0-3/2	0.75
SWE 4738	Computer Animation Lab	0-3/2	0.75

EIGHTH SEMESTER

Course Number	Course Title	Contact Hrs. L-P	Credit Hours
CSE 4809	Algorithm Engineering	2-0	2.0
SWE 4801	Software Maintenance	3-0	3.0
SWE 4803	Software Project Management	3-0	3.0
SWE 4805	Software Verification and Validation	3-0	3.0
Optional 8-I	Optional 8-I (Selective)	3-0	3.0
Optional 8-II	Optional 8-II (Open)	3-0	3.0

CSE 4810	Algorithm Engineering Lab	0-3/2	0.75
SWE 4802	Software Maintenance Lab	0-3/2	0.75
SWE 4806	Software Verification and Validation Lab	0-3/2	0.75
SWE 4800	Project/Thesis	0-6	3.0
Optional 8-I	Optional 8-I Lab	0-3/2	0.75
Total		**17-12**	**23.00**

Optional 8-I (Selected Elective)

Course Number	Course Title	Contact Hrs. L-P	Credit Hours	Track
SWE 4831	OS Optimization and Real Time OS	3-0	3.0	Network and System
SWE 4833	UI/UX Design	3-0	3.0	Software Development
SWE 4847	Security Management	3-0	3.0	Software Security
SWE 4837	Advanced Game Development	3-0	3.0	Game Development
SWE 4832	OS Optimization and Real Time OS Lab	0-3/2	0.75	
SWE 4834	UI/UX Design Lab	0-3/2	0.75	
SWE 4836	System Security Lab	0-3/2	0.75	
SWE 4838	Advanced Game Development Lab	0-3/2	0.75	

Optional 8-II (Free Elective)

Course Number	Course Title	Contact Hrs. L-P	Credit Hours
CSE 4841	Introduction to Optimization	3-0	3.0
CSE 4849	Human Computer Interaction	3-0	3.0
SWE 4839	Big Data Analysis	3-0	3.0
SWE 4841	Natural Language Processing	3-0	3.0
SWE 4843	Concurrent and Parallel Programming	3-0	3.0
SWE 4845	E-Commerce	3-0	3.0

Academic Catalogue

Part 2: Syllabus Summary

	Islamic University of Technology (IUT)							

	Hum			**Mathematics & Science**		**CSE**		
Sem	**1**	**2**	**3**	**1**	**2**	**1**	**2**	**3**
1st	HUM 4142/ Hum 4144 Arabic I / English I (0-1)	HUM 4145 Islamiat (2-0)	HUM 4147 Technology, Environment and Society (3-0)	PHY 4143 Physics II (3-3/4)	MATH 4141 Geometry and Differential Calculus (4-0)	CSE 4104 Engineering Drawing Lab (0-3/4)	CSE 4107 Structured Programming I (3-3/2)	
2nd	HUM 4242/ Hum 4244 Arabic II / English II / (0-1)	Hum 4247 Accounting (3-0)	Hum 4249 Business Psychology and Communications (3-0)		MATH 4241 Integral Calculus and Differential Equations (4-0)	CSE 4203 Discrete Mathematics (3-0)	CSE 4205 Digital Logic Design (3-3/4)	
3rd					MATH 4341 Linear Algebra (3-0)	CSE 4303 Data Structures (3-3/2)	CSE 4305 Computer Organization and Architecture (3-0)	CSE 4307 Database Management Systems (3-1)
4th		HUM 4441 Engineering Ethics (3-0)			MATH 4441 Probability and Statistics (3-0)	CSE 4403 Algorithms (3-1)	CSE 4411 Data Communication and Networking (3-1)	CSE 4409 Database Management Systems II (2-3/2)
5th					Math 4543 Numerical Methods (3-3/4)	CSE 4501 Operating Systems (3-1)		

Islamic University of Technology (IUT)

Department of Computer Science and Engineering

Syllabus for Bachelor Science in Software Engineering (BSc Engg. in SWE)

6th					MATH 4643 Probability and Statistics II (3-0)	CSE 4621 Microprocessor and Interfacing (3-3/4)	CSE 4617 Artificial Intelligence (3-3/4)	
7th		HUM 4747 Legal Issues and Cyber Law (3-0)						CSE 4714 Technical Report Writing (0-3/4)
8th						CSE 4809 Algorithm Engineering (2-3/4)		

Selected Electives Courses				
Track/Elective	Elective 5-I (5th)	Elective 6-I (6th)	Elective 7-I (7th)	Elective 8-I (8th)
Network and Systems	SWE 4531 Network Programming (3-3/4)	SWE 4631 System Programming and Device Driver (3-3/4)	SWE 4731 Advanced Network Protocols (3-3/4)	SWE 4831 OS Optimization and Real Time OS (3-3/4)
Software Development	SWE 4537 Server Programming (3-3/4)	SWE 4637 Web and Mobile Application Development (3-3/4)	SWE 4739 Embedded Software Development (3-3/4)	SWE 4833 UI/UX Design (3-3/4)
Software Security	SWE 4533 Cryptography (3-3/4)	SWE 4633 Network Security (3-3/4)	SWE 4741 Computer and Information Security (3-3/4)	SWE 4847 Security Management (3-3/4)
Game Development	SWE 4535 Game Development (3-3/4)	SWE 4635 Computer Graphics and Multimedia (3-3/4)	SWE 4737 Computer Animation	SWE 4837 Advanced Game Development (3-3/4)

			(3-3/4)		

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<tr><td colspan="10">Islamic University of Technology (IUT)

Department of Computer Science and Engineering

Syllabus for Bachelor Science in Software Engineering (BSc Engg. in SWE)</td></tr>
<tr><td>CSE</td><td colspan="3">SWE</td><td colspan="2">Optional Courses</td><td colspan="2">Total Credit</td><td>Total Credit</td></tr>
<tr><td>4</td><td>1</td><td>2</td><td>3</td><td>Selected</td><td>Free</td><td>Theory</td><td>Lab</td><td></td></tr>
<tr><td></td><td>SWE 4101

Introduction to Software Engineering

(3-0)</td><td></td><td></td><td></td><td></td><td>18.00</td><td>4</td><td>22</td></tr>
<tr><td></td><td>SWE 4201

Object Oriented Concepts I

(3-3/2)</td><td></td><td></td><td></td><td></td><td>19.00</td><td>3.25</td><td>22.25</td></tr>
<tr><td>CSE 4309

Theory of Computing

(3-0)</td><td>SWE 4301

Object Oriented Concepts II

(3-3/2)</td><td></td><td>SWE 4304

Software Project Lab I

(0-3/2)</td><td></td><td></td><td>18.00</td><td>5.5</td><td>23.5</td></tr>
<tr><td></td><td>SWE 4401

Software Requirements and Specifications

(3-1)</td><td></td><td>SWE 4404

Software Project Lab II

(0-3/2)</td><td></td><td></td><td>17.00</td><td>6</td><td>23</td></tr>
<tr><td></td><td>SWE 4501

Design Patterns

(2-1)</td><td>SWE 4503

Software Security

(3-3/4)</td><td>SWE 4506

Design Project I

(0-3/2)</td><td>Elective 5-I

(3-3/4)</td><td>Elective 5-II

(3-3/4)</td><td>17.00</td><td>6.50</td><td>23.50</td></tr>
<tr><td></td><td>SWE 4601</td><td>SWE 4603</td><td>SWE 4606</td><td>Elective 6-I</td><td></td><td>18.00</td><td>5.50</td><td>23.50</td></tr>
</table>

	Software Design and Architectures (3-3/4)	Software Testing and Quality Assurance (3-1)	Design Project II (0-3/2)	(3-3/4)				
SWE 4700 Project / Thesis (0-3/2)		SWE 4790 Internship (0-9)	SWE 4701 Software Metrics and Process (3-0)	Elective 7-I (3-3/4)		9	12	21
SWE 4800 Project / Thesis (0-3)	SWE 4801 Software Maintenance (3-3/4)	SWE 4803 Software Project Management (3-0)	SWE 4805 Software Verification and Validation (3-3/4)	Elective 8-I (3-3/4)	Elective 8-II (3-0)	17.00	6	23
						133.00	48.75	181.75

Free Electives Courses						
Elective 5-II (5Th Semester)	CSE 4553 Machine Learning (3-3/4)	CSE 4555 Data Mining (3-3/4)	CSE 4557 Pattern Recognition (3-3/4)	CSE 4559 Introduction to Cloud Computing (3-3/4)	CSE 4561 Digital Image Processing (3-3/4)	SWE 4539 Integrated Software Development (3-3/4)
Elective 8-II (8th Semester)	CSE 4841 Introduction to Optimization (3-0)	CSE 4849 Human Computer Interaction (3-0)	SWE 4839 Big Data Analysis (3-0)	SWE 4841 Natural Language Processing (3-0)	SWE 4843 Concurrent and Parallel Programming (3-0)	SWE 4845 E-Commerce (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 normals. 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 conicoids, 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. Langrange'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. Howard Anton, Albert Herr, *Calculus with Analytic Geometry*. Wiley, 5th Edition, 1995.
2. S. L. (Sidney Luxton) Loney, *The Elements of Coordinate Geometry*, Macmillan and Co., Limited, 11th Edition, 1908.
3. Earl William Swokowski, *Calculus with Analytic Geometry,* Boston, PWS-Kent Publishing, 4th Edition, 1988.

Phy 4143   **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, Thevenen'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, Hystersis 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 4144   **Physics II Lab**   **Credit 0.75**

Sessional works based on Phy 4143.

SWE 4101   **Introduction to Software**   **Credit 3.0**
                              Engineering

Basic Computer Concepts, Concepts in Hardware and Software.

Basic Computer Organization: Processor and Memory, Secondary Storage Devices, Input-Output Devices, Networking, Introduction to Web and other emerging technologies such as Blogs, Wiki, RSS, Podcasting, Cloud applications.

Computer Software: Programming Languages, Compiler, Assembler, Linker.

Software Engineering: Software Development Life Cycle, Introduction to Software Process Models, Software Requirements Analysis, Software Documentation, Introduction to Software Design, Testing, Deliverables and Maintenance.

Recommended Texts:

1. Pradip K Sinha and Priti Sinha, *Computer Fundamentals*, BPB Publications, 6th Edition, 2007
2. Roger S. Pressman, *Software Engineering: A Practitioner's Approach*, McGraw Hill Higher Education, 7th Edition, 2010.

CSE 4104   **Engineering Drawing Lab**   **Credit 0.75**

Software will be used to practice the following:

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 I**   **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. Balagurusamy, E, *Programming in ANSI C*, Tata McGraw-Hill, 3rd Edition, 2002.

CSE 4108   **Structured Programming I Lab**   **Credit 1.5**

Sessional works based on CSE 4107.

Recommended Texts:

1. Yashavant P. Kanetkar, *Let Us C,* BPB Publications; 5th edition, 2004.

2. Byron S Gottfried, *Schaum's Outline of Theory and Problems of Programming with C,* McGraw-Hill Education; 2nd edition, 1996.

Detailed Course Description

Second Semester

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.

Hum 4247   **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, Donald E. Kieso, and Paul D. Kimmel, *Accounting Principles*, Wiley, 9th Ed, 2009.
2. Steven M. Bragg*, Accounting Best Practices*, Wiley, 7 edition, 2013.

Hum 4249	**Business Psychology and Communications**	**Credit 3.0**

Business Psychology: Introduction to Psychology, Psychology in Business; Job Analysis: Job-oriented Approach, Person-oriented Approach; Assessment Methods for Selection and Placement, Psychological Tests, Training and Development, Theories of Employee Motivation, Job Attitude and Emotion, Productive and

Counterproductive Employee Behavior, Occupational Health Psychology, Leadership, Organizational Development and Theory, Effectiveness of Organizational Development, Socio-technical System Theory.

Business Communication: The Role of Communication in Business, Importance of Communication Skills, Main Form of Business Communication, Process of Human Communication, Fundamentals of Business Writing, Basic Pattern of Business Messages, Job Search Activities, Fundamentals of Report Writing, Other Forms of Business Communication.

Recommended Texts:

1. Raymond V. Lesikar, John D. Pettit, Maire E. Flatley, *Lesikar's Basic Business Communication,* Mc Graw Hill, 8th Edition, 1999.
2. Paul E. Spector, *Industrial and Organizational Psychology:* Research and Practice, Wiley; 6th edition, 2011.

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 are 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. S.L. Ross, *Differential Equations*, John Wiley & Sons; International 2 Revised Ed edition, 1980.
2. Erwin Kreyszig, *Advanced Engineering Mathematics*, John Wiley & Sons, 8th Ed, 1998.
3. Earl A. Coddington. *An Introduction to Ordinary Differential Equations*, Dover Publications, Unabridged Ed., 1989.

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. Kenneth H. Rosen, *Discrete Mathematics and Application,* William C Brown Pub; 4th edition, 1998.
2. Ronald L. Graham & Donald Ervin Kunth & Oren Patashnik, *Concrete Mathematics: A Foundation for Computer Science,* Addison-Wesley Professional, 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 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.

SWE 4201   **Object Oriented Concepts I**   **Credit 3.0**

Introduction to Object Oriented Concepts: class, object, encapsulation, inheritance, interfaces, Using UML to model a Class Diagram, Constructor, Polymorphism, Aggregation and Composition, Error handling and The concept of scope; The Anatomy of a Class – The Name, Comments, Attributes, methods, Constructors, Accessors, Modeling Real World Systems, Designing with Reuse, Extensibility, Maintainability in Mind and Using Object Persistence;

Programming lessons - Introduction to Java – Java Virtual Machine (JVM) and Java Runtime (JRE), Java Development Kit (JDK), Integrated Development Environment (IDE) for Java, Writing programs in java and learning java syntax, features and libraries.

Recommended Texts:

1. Matt Weisfeld, *The Object Oriented Thought Process,* Addison-Wesley Professional; 4 edition, 2013.
2. Herbert Schildt, *Teach Yourself C++*, Mcgraw-Hill Osborne Media; 2nd edition, 1994.

SWE 4202   Object Oriented Concepts I Lab   Credit 1.5

Sessional works based on SWE 4201.

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.

SWE 4301   **Object Oriented Concepts II**   **Credit 3.0**

Review of Object Oriented Concept, Multi-threading, UML Diagrams for Class, Objects and Relationships, UI programming, Synchronizations, Client Server programming, RPC, Distributed Objects, XML, Web programming : URL, Request and Response, HTML and DOM, Model –View–Controller, Container, Data Objects and Business Objects, Persistent Object, Object Serialization using XML, Web Service

Objects and the Internet – Ajax, Object-Based Scripting Languages: JSON and Python.

Object Oriented Design Principles - Single Responsibility Principle, Open/Close Principle, Liskov Substitution Principal, Interface Segregation Principle and Dependency Inversion Principle; Introduction to Component Based Design, Design Patterns and Code Smells.

Recommended Texts:

1. Matt Weisfeld, *The Object Oriented Thought Process,* Addison-Wesley Professional; 4 edition, 2013.
2. Paul Deitel and Harvey Deitel. *Java How to Program*, Prentice Hall; 5th edition, 2002.
3. Herbert Schildt, *Java: The Complete Reference*, Tata Mcgraw Hill; 8 edition, 2011.

SWE 4302   Object Oriented Concepts II Lab   Credit 1.5

Sessional works based on SWE 4301.

SWE 4304   Software Project Lab I   Credit 1.5

Each student will be assigned a single complete software project individually. The size of the projects will be medium. It will focus on the application of the different features of programming language. Student will be evaluated based on their software and problem solving effort.

CSE 4303   **Data Structures**   **Credit 3.00**

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,* Addison Wesley Publishing Company, 1998.
2. Seymour Lipschutz, *Theory and Problems of Data Structures,* McGraw-Hill, 1986.

CSE 4304   **Data Structures Lab**   **Credit 1.5**

Sessional based on CSE 4303.

CSE 4305   **Computer Organization and**   **Credit 3.0**
                                      Architecture

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. Hayes J, *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, S. Sudarshan, *Database System Concepts*, The McGraw-Hill Companies Ltd.
2. C.J. Date, *An Introduction to Database Systems*, Pearson, 8th Edition, 2003.

CSE 4308   **Database Management Systems Lab**   **Credit 1.0**

Sessional works based on CSE 4307.

CSE 4309   **Theory of Computing**   **Credit 3.0**

Review of Discrete Mathematics - Binary relations, digraph, string, languages, proofs, inductive definitions.

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. John E. Hopcroft, Rajeev Motwani, Jeffrey D. Ullman , *Introduction to Automata Theory, Languages, and Computation*, 3rd Edition, Pearson Education, 2006.
2. Michael Sipser, *Introduction to the Theory of Computation*, Cengage Learning; 3 edition, 2012.

Detailed Course Description

Fourth Semester

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, Fourth Edition, 2012.
2. Introduction to Engineering Ethics: Mike W. Martin, Roland Schinzinger, McGraw-Hill Education, Second Edition, 2009.

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; 3 edition, 2014.

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. Cormen & Charles E. Leiserson & Ronald L. Rivest & Clifford Stein, *Introduction to Algorithms*, The MIT Press; 3rd edition, 2009.
2. Horowitz E and Sahni S Galgotia, *Computer Algorithms,* Silicon Pr, 2nd edition, 2007.

CSE 4404   **Algorithms Lab**   Credit **1.0**

Sessional works based on CSE 4403.

CSE 4409   **Database Management Systems II**   **Credit 2.0**

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;

Views, 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, Database Security.

Recommended Texts:

1. Scott Urman, *Oracle Database 10g/11g PL/SQL Programming,* McGraw-Hill Education; 1st edition, 2004.

CSE 4410 **Database Management Systems II** **Credit 1.5**
Lab

Sessional works based on CSE 4409.

CSE 4411 **Data Communications and** **Credit 3.0**
Networking

Introduction –Internet, Network edge, Network Core, Access Networks, Protocol Layers and Service models, Application Layer- Principles of Network applications, Web, HTTP, FTP, DNS, Socket Programming, Transport Layer –Transport Layer services, Multiplexing and De-multiplexing, Connectionless transport and connection oriented transport, Principles of congestion control, Reliability, Network Layer – Router, Internet Protocols, Routing algorithms, broadcast and multicast routing, Link Layer – Error detection and correction techniques, multiple access protocols, Link Layer addressing, Random Access techniques, Hubs and Switches, Wireless and mobile networks, Multimedia Networking- Streaming of Stored Audio and Video, Protocols of Real time Interactive applications, Physical Layer – Transmission Medium, Encoding and Decoding, Error detection and correction.

Recommended Texts:

1. James Kurose and Keith Ross, *Computer Networking,* Pearson; 7 edition, 2016.
2. B. A. Forouzan, *Data Communications and Networking*, McGraw-Hill Science/Engineering/Math; 4 edition, 2006.
3. Andrew S. Tanenbaum, *Computer Networks,* PTR PH; 3 edition, 1996.

CSE 4412   **Data Communications and**   **Credit 1.0**
                         Networking Lab

Sessional works based on CSE 4411.

SWE 4401   **Software Requirement and**   **Credit 3.0**
                          Specifications

Basics of requirements engineering, types of requirements -functional requirements, non-functional requirements, quality attributes, main requirements engineering activities, documents and processes; Requirements inception and elicitation: product vision and project scope, traditional elicitation approaches (interviews, stakeholders study, workshops, etc), scenario/use case approaches, prototyping, requirements negotiation and risk management; Requirements analysis and specification - modeling techniques: inception vs. specification, techniques for writing high-quality requirements, documentation standards, UML notations, external qualities management, contract specification; Requirements verification, and validation: detection of conflicts and inconsistencies, completeness, techniques for inspection, feature interaction analysis and resolution; Requirements management: traceability, priorities, changes, baselines, tool support; Examples of requirements for various types of systems: embedded systems, consumer systems, web-based systems, business systems; requirements engineering in RUP, requirements engineering in agile methods.

Recommended Texts:

1. R. S. Pressman, *Software Engineering. A Practitioner's Approach*, McGraw-Hill Education; 8 edition, 2014.
2. Ian Somerville, *Software Engineering*, Addison-Wesley, 7th Edition, 2004.

SWE 4402   **Software Requirements and**   **Credit 1.0**
                          Specifications Lab

Sessional works based on SWE 4401.

SWE 4404   **Software Project Lab II**   **Credit 1.5**

Each student will be assigned a single project. It will test the ability of the students to handle large projects. Students will focus on developing web based, networked, and mobile applications. The students have to follow formal methods of system analysis and software development processes. They must familiarize themselves with standard version control and software development environments such as Github, IntelliJ etc.

Detailed Course Description

Fifth Semester

Math 4543   **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; 10 edition, 2015.
2. M. A. Celia and W.G. Gray, *Numerical Methods For Differential Equations: Fundamental Concepts For Scientific & Engineering Applications*, Prentice Hall; 1 edition, 1991.
3. L.W. Johnson and R.D. Riess, *Numerical Analysis*, Addison-Wesley, 1982.

Math 4544   **Numerical Methods Lab**   **Credit 0.75**

Sessional works based on CSE 4543.

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. Silberchatz, *Operating System Concepts*, Wiley, 8 edition, 2008.
2. Tanenbaum A S, *Modern Operating Systems*, Pearson; 4 edition, 2014.

CSE 4502   **Operating Systems Lab**   **Credit 1.0**

Sessional works based on CSE 4501.

SWE 4501   **Design Patterns**   **Credit 2.0**

Design patterns: design for reuse; capture and communication of knowledge and experience; pattern languages; kinds of patterns; choosing and using patterns; History of patterns: model-view-controller in Smalltalk; Alexander's patterns in architecture; Some common patterns: model-view-controller, observer, adapter, Façade, Layer,

abstract factory, composite, command, iterator, visitor, proxy, strategy; Anti-patterns: bad situations and how to get out of them, development, architectural and managerial anti-patterns, recovery, refactoring and realignment; A case study: iterative development of an extended practical example; a case study in the application and use of patterns.

Recommended Texts:

1. Gamma, Erich. *Design patterns: elements of reusable object-oriented software*. Addison-Wesley Professional, 1 edition, 1994.

SWE 4502	**Design Patterns Lab**	**Credit 1.0**

Sessional works based on SWE 4501.

SWE 4503	**Software Security**	**Credit 3.0**

Introduction to Software Security, Major security flaws, Types of threats, OS Security: Memory, CPU and I/O, Program security: String handling, Dynamic Memory, Input validation, and others, OWASP Listed Vulnerabilities, Concurrency and race condition, Best Practices: Secure programming guidelines, Security Standards, ways to avoid security holes in new software, methodologies and tools for identifying and eliminating security vulnerabilities, Scripting.

Recommended Texts:

1. Charles P. Pfleeger, *Security in Computing*, 4th Edition, Prentice Hall, 2006.
2. William Stallings and Lawrie Brown, *Computer security: principles and practices*, Pearson, 2nd Edition, 2011.

3. Brian Chess and Jacob West, *Secure Programming with Static Analysis,* Addison-Wesley Professional, 2007.
4. David A. Wheeler, *Secure Programming for Linux and Unix HOWTO Version 3.5*, Aug 2004.

SWE 4504   **Software Security Lab**   **Credit 0.75**

Sessional works based on SWE 4503.

SWE 4506   **Design Project I**   **Credit 1.5**

This will be a group project with 3 students in each group. It will test the ability to work as a member of a group. Each student of the group will have specific responsibilities. The duration of the project will be one year. In this course, students will focus on the design portion based on Software Requirements Specification (SRS) to implement a particular project.

SWE 4531   **Network Programming**   **Credit 1.5**

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, nonblocking 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*, Volume 1, Second Edition, Sockets and XTI, Prentice Hall, 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.

SWE 4532   Network Programming Lab   Credit 0.75

Sessional works based on SWE 4531.

SWE 4537   Server Programming   Credit 3.0

Web service, HTTP protocols, IP, port, URL, routing. Web security fundamentals, CORS, authorization, authentication, OAuth, Social authentication, SSO. Database Connectivity, ORM. State Management, Session, Cookie, WebSocket, Server Push. Performance, scaling, load balancing, lazy loading, caching

Fundamentals of web service deployment. Background service, security and firewall, multi-threading.

CSE 4540   Server Programming Lab   Credit 0.75

Sessional works based on SWE 4537.

The students will incrementally deliver a web service that can be consumed by many different clients over the network. The requirements of the service will be given week-by-week, the delivery will also be in a weekly interval. The service will be tested with API client applications like postman.
Suggested Technologies: .NET/Java/Node/Python.

SWE 4533   **Cryptography**   **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- Theory: Euclidean algorithm, Euler Theorem, Fermat Theorem, Totient functions, multiplicative and additive inverse, Public Key Infrastructure (PKI)-PKI Trust Models- Certificate standard (PKIX and X.509)- Certificate authority (CA)-Certificate revocation.

Hash Function: Hash functions – Security of hash functions and MACS – MD5 Message Digest algorithm – Secure hash algorithm (SHA) – HMAC digital signatures –Digital signature standard, Elliptic Curve Cryptography (ECC)

Recommended Texts:

1. Douglas R. Stinson, *Cryptography: Theory and Practice*, CRC press, 3rd Edition, 2005.
2. William Stallings, *Cryptography Network Security: Principles and Practice*, Pearson, 6th edition, 2013.
3. Behrouz A Forouzan, *Cryptography and Network Security*, Tata McGraw-Hill, 2010.

SWE 4534   **Cryptography Lab**   **Credit 0.75**

Sessional works based on SWE 4533.

SWE 4535   **Game Development**   **Credit 3.0**

Introduction to the Class, Role of the Game Designer, Formal elements of games, Dramatic elements of games and Narrative Design, System dynamics, Challenge, Skill and Chance, Conceptualization, Communication, Social Play, Games as Culture, Game Economics, Level design and properties of living things, Functionality, Completeness and Balance, Simple Playtesting and Quality Assurance, Game Project.

Recommended Texts:

1. Jeremy Gibson, *Introduction to Game Design, Prototyping, and Development,* Addison-Wesley Professional; 1 edition, 2014.
2. Tracy Fullerton, *Game Design Workshop: A Playcentric Approach to Creating Innovative Games,* Morgan Kaufmann; 2 edition, 2008.
3. Brenda Brathwaite (now: Romero) and Ian Schreiber, *Challenges for Game Designers*. Charles River Media; 1 edition, 2008.

SWE 4536   **Game Development Lab**   **Credit 0.75**

Sessional works based on SWE 4535.

CSE 4553   **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), and Boosting and feature selection.

Unsupervised learning: Nearest neighbours 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, 2011.
2. Richard S. Sutton and Andrew G. Barto, *Reinforcement learning: An introduction*, MIT Press, Second Edition, 2018.
3. Tom Mitchell, *Machine Learning*, McGraw-Hill, 1st edition, 1997.

CSE 4554   **Machine Learning Lab**   **Credit 0.75**

Sessional works based on CSE 4553.

CSE 4555   **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*, Morgan Kaufmann, 3rd edition, 2011.

CSE 4556   **Data Mining Lab**   **Credit 0.75**

Sessional works based on CSE 4555.

CSE 4557   **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 Gaussian 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. Robert J. schalkoff, *Pattern Recognition: statistical structural and Neural Approaches*, John Wiley & Sons, Inc. 1st edition, 1991.

CSE 4558   **Pattern Recognition Lab**   **Credit 0.75**

Sessional works based on CSE 4557.

CSE 4559   **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 and Armando Escalante, *Handbook of Cloud Computing*, Springer Publicaitons, 2010.

2. Rajkumar Buyya and Christian Veccihola, *Mastering Cloud Computing: Foundations and Applications Programming,* Morgan Kaufmann; 1 edition, 2013.

CSE 4560   Introduction to Cloud Computing   Credit 0.75
Lab

Sessional works based on CSE 4559.

CSE 4561   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, Richard E. Woods, *Digital Image Processing*, Pearson, 3rd Edition, 2007.
2. M.Sonka, V.Hlavac, *Image Processing: Analysis and Machine Vision*, R.Boyle Chapman & Hall Computing, 3rd edition, 2007.
3. Tim Morris, *Image Processing & Computer Vision*, Palgrave Macmillan, 2004.

CSE 4562   Digital Image Processing Lab   Credit 0.75

Sessional works based on CSE 4561.

SWE 4539   Integrated Software Development   Credit 3.0

Distributed version control systems, unit testing and integration testing, automated building, automated packaging, automated releasing, performance monitoring, performance testing, performance tuning, scaling large application, vertical and horizontal scaling, evolutionary database design, automated deployment of production database, continuous integration, continuous testing, continuous delivery, issue tracking, software documentation.

SWE 4540   Integrated Software Development   Credit 0.75
Lab

Sessional works based on SWE 4539.

The tools and technologies used in the lab may include Git Distributed Version Control System, Jenkins/TeamCity/Bamboo for Continuous Integration and Continuous Testing, Octopus Deploy for automated release management, Jira for Issue Tracking, Confluence for Documentation, Markdown and Wiki Syntax.

Detailed Course Description

Sixth Semester

Math 4643   **Probability and Statistics II**   **Credit 3.0**

Review of Probability, Random Vectors; Stochastic processes - Stochastic process and their classifications, Bernoulli Process and Poisson Process, and their properties, Discrete-time and continuous-time Markov Process, stationary probabilities and balance equation, Introduction to queuing theory, Hypothesis testing – Test concerning the mean and variance of normal population, Regression and correlation, Analysis of variance – two factor analysis of variance and two-way analysis of variance with interaction, Goodness of fit test with specified and unspecified parameters, Non parametric hypothesis test- sign test.

Recommended Texts:

1. Sheldon M. Ross, *Introduction to Probability Models*, Academic Press, 10th edition, 2009.
2. Sheldon M. Ross, *Introduction to Probability and Statistics for Engineers and Scientists,* Academic Press, 4th edition, 2009.
3. Douglas C. Montgomery and George C. Runger, *Applied Statistics and Probability for Engineers*, John Wiley and Son, 3rd Edition, 2005.

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 Approach,* Pearson, 3rd Edition, 2009.

CSE 4618   Artificial Intelligence Lab   Credit 0.75

Sessional works based on CSE 4617.

CSE 4621   Microprocessor and Interfacing   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, Intel x86 and x64 architecture - overview. 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. V. Hall, *Microprocessor & Interfacing*, McGraw Hill Education, 2nd edition, 1991.
2. Ytha Yu, Charles Marut, *Assembly Language Programming and Organization of the IBM PC*, McGraw Hill Education, 1992.
3. Bary Bray, *The Intel Microprocessor 8086…Arch. Prog, Interfacing*
4. KlilKinm, *Computer Peripherals.*
5. P. Marwedel, *Embedded system design*, Springer, 2011.

CSE 4622   Microprocessor and Interfacing Lab   Credit 0.75

Sessional works based on CSE 4621.

SWE 4601   Software Design and Architectures   Credit 3.0

Introduction, Design Concepts, Review of UML, Object Oriented Analysis and Design, Study of the Design of some software: Library, Text Editor, Compiler, E-Commerce Site, Mobile Application, Design Patterns, Design Principles, User Interface Design: The Golden Rules, User Interface Analysis and Design, Interface Analysis, Interface Design Steps, Web App Interface Design, Design Evaluation.

Software Architecture, Architectural Views, Architectural Styles: Object Oriented Architecture, Data Driven Architecture, Client Server Architecture, Service Oriented Addison-Wesley Architecture, Component Based Architecture, Web Architecture, Mobile Software

Architecture, Connectors , Middleware, Message Queue, Web Service, XML, Non-Functional Requirements,   Architectural Trade-offs, Software Redesign and Architectural Migration.

Recommended Texts:

1. Hassan Gomaa, *Software Modeling and Design UML, Use Cases, Patterns and Software Architectures*, Cambridge University Press,1st edition, 2011.
2. Eric Evans. *Domain-Driven Design: Tackling Complexity in the Heart of Software*, Addison-Wesley Professional, 1st edition, 2003.
3. Roger S. Pressman*, Software Engineering – A Practitioner's Approach*, McGraw Hill,7th Edition, 2014.

**SWE 4602   Software Design and Architectures   Credit 0.75
Lab**

Sessional works based on SWE 4601.

**SWE 4603   Software Testing and Quality   Credit 3.0
Assurance**

Introduction to Software Testing , Testing Terminology and Methodology, Static Testing, Dynamic Testing,   Testing from small to big : Unit Testing, Integration Testing, Function Testing, System Testing, Acceptance Testing- alpha testing, beta testing, Performance Testing, Regression Testing, Exploratory Testing, Regression Test, Code Coverage, Test Management – Test Plan, Test Design and

Specifications, Test Driven Development (TDD), Test Metrics, Testing Web Applications, Testing Mobile Applications, Security Testing.

Introduction to Quality Assurance, Organogram of QA Team, QA Plan, Elements of QA, Quality of Requirement Specification (SRS), Quality of Software Design, Code Quality, Maintainability of Software, Software Requirement Validation, FTR, Code Review, Process Quality-CMM, ISO, Six Sigma, Feedback Loop, Process Improvement, Risk Identification, Software Reliability, Understanding the value of QA with equations and with real world examples.

Recommended Texts:

1. Naresh Chauhan, *Software Testing: Principles and Practices, 1ˢᵗ or higher Edition*, Oxford University Press, 28.89 edition, 2010.
2. Daniel Galin, *Software Quality Assurance: From Theory to Implementation*, Addison Wesley, 1ˢᵗ edition, 2003.
3. Jeff Tian, *Software Quality Engineering: Testing, Quality Assurance and Quantifiable Improvement*, Wiley-IEEE Computer Society Press; 1 edition, 2005.

SWE 4604	**Software Testing and Quality Assurance Lab**	**Credit 1.0**

Sessional works based on SWE 4603.

SWE 4606   **Design Project II**   **Credit 1.50**

This will be a group project with 3 students in each group. It will test the ability to work as a member of a group. Each student of the group will have specific responsibilities. The duration of the project will be one year. In this course, students will focus on the development of the project which is designed during the first phase (Design Project I).

SWE 4637   **Web and Mobile Application**   **Credit 3.0**
                                   Development
Basics of HTML, CSS, ECMA Script and JavaScript. CSS preprocessors and JavaScript transpilers. Browser compatibility, validation, authentication, authorization, OAuth, Social Login, SSO. Consuming web services with XML HTTP Request (Ajax). State Management, Session, Cookie, WebSocket, Push Notification. Client Side Database - SQLite, WebSQL, local storage, IndexedDB. Single Page Application, Routing. Search Engine Optimization, minification, obfuscation. Native and cross platform mobile application development. Desktop app development.

SWE 4638   **Web and Mobile Application**   **Credit 0.75**
                              Development Lab
Sessional works based on SWE 4637.

The students will incrementally deliver a web and a mobile front-end app that will consume the web service developed in SWE 4537 (Server Programming) course. Some of the features will be available in all platforms, some features will be exclusive to each platform. The

requirements of the app will be given week-by-week, the delivery will also be in a weekly interval.

Suggested Technologies: Web: HTML, CSS, Sass/Less, JavaScript, TypeScript. Native Mobile: Android. Cross-platform Mobile: Flatter/Xamarin/Ionic/PhoneGap/React Native. Desktop: Java/C#/Python/Node.

SWE 4635   **Computer Graphics and**   **Credit 3.0**
Multimedia Systems

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. Foley J D and others , *Introduction to Computer Graphics*, Addison-Wesley Professional; Edition Unstated edition, 1993.
2. Angel E*, Computer Graphics.*
3. Hearn D and Baker M P*, Computer Graphics with OpenGL*, Prentice Hall; 3 edition, 2003.
4. Steinmetz*, Multimedia systems*, Springer.

SWE 4636	**Computer Graphics and Multimedia Systems Lab**	**Credit 0.75**

Sessional works based on CSE 4635.

SWE 4631	**System Programming and Device Driver**	**Credit 3.0**

What is Systems Programming, Explanations of specific system features, Overview of high level programming languages; Operating system functions: Device management, Memory management, Process management, File system management, Accounting and security, User services; Machine Considerations for Assemblers: Instruction formats/types, Addressing modes and address spaces, Registers, Data representation, Pre-processor directives and portability , Macros, inline

assembly, Modularization and program assembly; Memory Management; Input/output at a systems level; File systems and directories; Process management; Object-Oriented extensions of a system programming language ; An Introduction to Device Drivers; Building and Running Modules; Char Drivers; Advanced Char Driver Operations; Communicating with Hardware; PCI Driver, USB Drivers; The Linux device model; network drivers; block drivers; TTY drivers.

Recommended Texts:

1. Stevens, R. W and Rago, R. A, *Advanced Programming in the UNIX environment*, 2nd Edition, Addison-Wesley, 2005.

2. W. Richard Stevens, Stephen A. Rago, *Advanced Programming in the Unix Environment*, Addison-Wesley Professional, 3rd. Edition, 2013.
3. Jonathan Corbet, Allessandro Rubini & Greg Kroah-Hartman, *Linux Device Drivers*, O'Reilly Media, 3rd Edition, 2005.

SWE 4632   System Programming and Device   Credit 0.75
Driver Lab

Sessional works based on CSE 4631.

SWE 4633   Network Security   Credit 3.00

Basic Concepts: Security goals - confidentiality, integrity and availability, network security threats, security mechanisms, basics of cryptography

Physical and Logical Access Control – Identification, Authentication and authorization - Windows and UNIX password system

Mutual Authentication- Authentication protocols, Trusted Intermediaries, Mediated Authentication (with KDC), Many to many authentication, Kerberos Authentication requirements, Authentication functions, Message authentication codes

Network Level Security Controls: Network layer security - IP security (IPSec), Transport Layer Security TLS/SSL, Electronic mail security – PGP, S/MIME, Web security, VPN and Real time Communication Security, Multimedia security (SRTP and MIKey)

System Level Security Controls: Intrusion detection, Password management, Malware, Anti malware, Firewall and its design principles, Intrusion Detection System, Trusted systems.

Recommended Texts:

1. Computer Network Security, Joseph Migga Kizza
2. Network Security Essentials: Applications and Standards, Stallings

SWE 4634   **Network Security Lab**   **Credit 0.75**

Sessional works based on SWE 4633.

Detailed Course Description

Seventh Semester

Hum 4747   **Legal Issues and Cyber law**   **Credit 3.0**

Introduction to legal aspects, Jurisdiction, Intellectual property laws (Copyright, patent, trademark, etc.), Contracts and licenses, Privacy in the workplace, Trade secrets and non-disclosure agreement;

Cyber laws and rights in today's digital age ICT Act; Information Warfare, computer crime and information terrorism;   Threats to

information resources, including military and economic espionage, communications eavesdropping, computer break-ins, denial-of-service, destruction and modification of data, distortion and fabrication of information, forgery, Digital Forensics, IT and the Legal Profession, Policing the Internet, Cyber Constitutionalism, Cyber Speech, Cyber Privacy, Cyber Defamation and Conflicts.

Recommended Texts:

1. Chris Reed & John Angel, *Computer Law*, OUP, 5th edition, 2004.

2. Akdeniz, Y., Walker, C. and Wall, D., *The Internet: Law and Society*, Longman, 1st edition, 2001.

3. Bainbridge, D., *Introduction to Computer Law*, Longman Pub Group, 5th Edition, 2004.

CSE 4714   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. Eunson B, John, *Writing and presenting reports*, Wiley 3rd Edition, 1994.
2. Roy Peter Clark*, Writing Tools: 50 Essential Strategies for Every*, Little, Brown and Company; 1st edition, 2008.
3. Lutz Hering, Heike Hering, *How to Write Technical Reports: Understandable Structure, Good Design, Convincing Presentation*, Springer, 2010th Edition, 2010.
4. Leslie Lamport*, LaTeX: A Document Preparation Syste,* Addison-Wesley Professional; 2 edition, 1994.

SWE 4701   Software Metrics and Process   Credit 3.0

Definition of software measurement and metrics; The basics of measurement: Property-oriented measurement, Meaningfulness in measurement, Measurement quality, Measurement process, Scale, Measurement validation, Object-oriented measurement, Subject-domain-oriented measurement; Goal-based framework for software measurement: Software measure classification, Goal-based paradigms, Case studies, Empirical investigation, Measuring internal product attributes: size, Structure: Software structural measurement, Control-flow structure, Cyclomatic complexity, Data flow and data structure attributes, Architectural measurement; Software Process Metrics, Testing Metrics, Quality Metrics, Usability Metrics, Software Maintainability Metrics, Software cost model, COCOMO and COCOMO II, Measuring external product attributes: quality; Measuring software reliability: Software reliability models and metrics.

Recommended Texts:

1. N.E. Fenton and S.L.Pfleeger*, Software Metrics: A Rigorous and Practical Approach*, PWS Publishing, 2nd edition, 1998.
2. BA Kitchenham, *Software Metrics: Measurement for Software Process Improvement,* Blackwell Pub, 1996.

SWE 4790   **Internship**   **Credit 9.00**

The student will work full-time as an Intern in a particular company for a period of 5/6 months. The students will join the company for Internship just after the 6th Semester final examination and will resume their classes after the Mid Semester Examination of the Winter Semester of the next academic year.

SWE 4700   **Project/Thesis**   **Credit 1.50**

SWE 4741   Computer and Information Security   Credit 3.00

Computer and data security goals, Challenges of protecting computer and information.

Access Control: Access control models; , Discretionary Access Control (DAC), Mandatory Access Control (MAC), Commercial Security Policies, Role-based access control, Credentials and Delegation, dynamic access control.

Threats and Attacks landscape : Types and examples of computer and information security threats; Methods of attack; malware, social engineering and TCP/IP based attacks

Vulnerabilities : Design and application vulnerabilities, Common vulnerability exposure

Attackers: Attackers type, skill and motivation

Information Flow: Program analysis techniques, Quantitative information flow, Covert channels

Perimeter and host Defenses: Perimeter attacks, security zones and devices, configuring a DMZ, NAT router, VPNs, protections against web threats, Malware protection, password attacks, hardening a Windows system, managing file system security, security of a Linux system.

Data Defenses: Redundancy through RAID, proper management of backups and restores, file encryption, implementing secure protocols, and cloud computing.

Web security: Basic concepts of securing web applications, fortifying the internet browser, securing e-mail from e-mail attacks, security considerations about networking software.

Internet security controls

Law and Ethics: Digital Security Act, Data protection, Copyright, Trade Mark and Patent, Computer misuse act, Ethics in computer security

Recommended Texts:

1. Security in Computing, Pfleeger, C. P. and Pfleeger, S. L., Prentice hall.
2. Security engineering: a guide to building dependable distributed systems, Ross Anderson.

SWE 4742   Computer and Information Security   Credit 0.75
Lab

Sessional works based on CSE 4741.

SWE 4731   Advanced Network Protocols   Credit 3.0

Review of networking protocols; Router and Switch architectures, Packet Classification, Packet scheduling and fair queuing, Protocol Processing; Overview of Linux Network kernel programming; Network Congestion control, Data Centre Networking, Traffic analysis, Software Defined Networks.

Recommended Texts:

3. George Varghese*, Network Algorithmics*, Morgan Kaufmann, 1st edition, 2004.
4. Christian Benvenuti, *Understanding Linux Network Internals*, O'Reilly, 1st edition, 2005.
5. W. Richard Stevens and Kevin R. Fall, *TCP/IP Illustrated Vol I, II, III*, Addison-Wesley Professional, 2nd edition, 2011.

SWE 4732   Advanced Network Protocols Lab   Credit 0.75

Sessional works based on SWE 4731.

SWE 4739   Embedded Software Development   Credit 3.0

This course covers computing elements, structures in embedded software, resource access protocols, uniprocessor scheduling, programming-language support, languages for model-driven development, worst-case execution time analysis, and overview of embedded distributed systems. Other topics include specification and design of embedded systems, specification languages, hardware/software co-design, performance estimation, co-simulation, embedded architectures, processor architectures and software synthesis, system-on-a-chip paradigm, retargetable code generation and optimization, verification and validation, environmental issues and considerations.

SWE 4740   Embedded Software Development   Credit 0.75
Lab
Sessional works based on SWE 4739.

SWE 4737   Computer Animation   Credit 3.0

Introduction to computer animation, Technical background for computer animation,, Technical background for computer animation, Introduction to computer animation software, Interpolation and Basic Techniques, Skeletal animation (Motion capture),, Skeletal animation (Motion capture), Physically based animation, Group behavior and crowed animation, Fluids: Clouds, Water, Fire; Figures, Facial, and Behavior.

Recommended Texts:

1. R. Parent, *Computer Animation: Algorithms and Techniques*, Morgan-Kaufmann, San Francisco, 2nd Edition, 2008.

2. M. O'Rourke, *Principles of Three-Dimensional Computer Animation*, W. W. Norton and Company, 3rd editon, 2003.
3. Lynn Pocock, Judsun Rosebush, *The Computer Animator's Technical Handbook*, Morgan Kaufmann, 1st edition, 2001.

SWE 4738   **Computer Animation Lab**   **Credit 0.75**

Sessional works based on SWE 4737.

Detailed Course Description

Eighth Semester

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. T. Cormen et al., *Introduction to Algorithms*, McGraw-Hill Co, 3rd edition, 2009.
2. Anany Levitin, *The Design and Analysis of Algorithms*, Pearson, Third Edition, 2012.

3. J. McConnell, *Analysis of Algorithms: An Active Learning Approach,* Jones & B, 2nd edition, 2007.

CSE 4810   **Algorithm Engineering Lab**   **Credit 0.75**

Sessional works based on CSE 4809.

SWE 4801   **Software Maintenance**   **Credit 3.0**

The nature of Software maintenance, Software Maintenance types, Characteristics of maintainable software, Software Maintenance Process Models: Quick-and-Fix Model , Bohem's Model, Osborne Model , Iterative Model,   State of the art tools for supporting software developers and maintenance engineers, Program Comprehension, Legacy Information Systems,   Software Clone Detection and Analysis, Mining Software Repositories, Design Recovery, Traceability, Refactoring, Reuse and Domain Engineering, Locating features in source code, concept analysis, Program Transformation and Migration, Software Evolution Process Models, Software Testing during Maintenance and Evolution, Software Metrics for Maintenance, Software Reuse, Maintenance and Evolution of Services Systems, Maintenance Cost Estimation by COCOMO II, Bohem's Maintenance Cost Model I, mpact Analysis, Big Data Analytics, Reverse engineering.

Recommended Texts:

1. Stanislaw Jarzabek*, Effective Software Maintenance and Evolution: A Reuse-Based Approach*, Auerbach Publications; 1 edition, 2007.

2. Penny Grubb, Armstrong A. Takang*, Software Maintenance: Concepts and Practice*, World Scientific USA, 2nd edition, 2003.

SWE 4802   **Software Maintenance Lab**   **Credit 0.75**

Sessional works based on SWE 4801.

SWE 4803   **Software Project Management**   **Credit 3.0**

Project Management Basics, Role of a Project Manager, Project Resources, Phases of Software Project; Introduction to PERT/CPM, Software Project Planning: Management, Risk, Configuration, Quality Assurance, Induction, Schedule, Cost Estimation; People and Project Organization; Change Management Monitoring and Control; Productivity Aspects: Productivity Basics, Productivity Measurement & Metrics; Human Factors and Leadership: Motivation, Communication, Handling Difficult People,
Leadership, Team Dynamics; Progress Tracking & Control: Progress Assessment & Reporting, Scope Management; Organizational Support for Effective Project Management; dispute and error tracking, RMMM charts Industry scenarios: Domain analysis, Business case analysis, Dynamicity, Success and failure factors, case studies.

Recommended Texts:

1. Stellman, Andrew, and Jennifer Greene, *Applied Software project management*. O'Reilly Media Inc., 1st edition, 2005.
2. Phillips, Joseph. *IT project management: on track from start to finish*. McGraw-Hill, Inc., 1st edition, 2002.

SWE 4805   **Software Verification and**   **Credit 3.0**
                                Validation

Introduction: Terminology, Evolving Nature of Area; V&V Limitations: Theoretical Foundations, Impracticality of Testing All Data, Impracticality of Testing All Paths, No Absolute Proof of Correctness, The Role of V&V in Software Evolution, . V&V Objectives, Software V&V Approaches and their Applicability, Software V&V Planning, Organizational Responsibilities, Integrating V&V Approaches.

Recommended Texts:

1. Marcus S. Fisher*, Software Verification and Validation: An Engineering and Scientific Approach*, Springer, 2007 edition, 2006.

SWE 4806   **Software Verification and**   **Credit 0.75**
                                Validation Lab

Sessional works based on SWE 4805.

SWE 4800   **Project/Thesis**   **Credit 3.0**

SWE 4831   **OS Optimization and Real-Time OS**   **Credit 3.0**

OS Concepts, Kernel, Micro Kernel vs Monolithic Kernel, Difference between OS and Real-Time(RT) OS, Relations and Differences of Embedded Systems with RT Systems, Introduction to concepts, techniques, and standards related to design of RT systems, Motivation,

Specification of RT systems, Verification of RT systems, Optimizations in the Kernel, RT kernel architectures, Performance analysis of particular types of RT kernels, POSIX 1003.1b interface for RT operating systems (RTOS), Case Studies, RT task scheduling algorithms.

Recommended Texts:

1. Abbott, D., *Linux for Embedded and Real-Time Applications*, Newnes, 3rd edition, 2012.
2. Cheng, A. M. K., *Real-Time Systems: Scheduling, Analysis, and Verification*, Wiley, 1st edition, 2002.
3. Laplante, P. A., *Real-Time Systems Design and Analysis,* Wiley-IEEE Press, 4th edition, 2012.

SWE 4832   OS Optimization and Real-Time OS   Credit 0.75
Lab
Sessional works based on SWE 4831.

SWE 4833   UI/UX Interface Design   Credit 3.0

Understanding User Experience (UX) & User Interface (UI) Design, Principles of good, Hicks law, Fitts's Law, General UI design workflow, and iterative design; Foundation of UX: Information Architecture, Elements of information architecture, Iconography,

mapping user interaction, navigation structure; User interface design guidelines: Golden rules of design, principles of consistency and standards, visibility of the system status, error and slips control, recognition Vs. recall, Aesthetic and Minimalist Design, Informative Feedback, Reduce Short-Term Memory Load, The Psychological Basis for UI Design Rules; Usability considerations: Simplicity in design, consistency in design, Don Norman design principles, User attention, chunking of information, understanding usability goals, measuring usability goals; HCI design models: Cognitive models, Workload models, Human information processing models, Distributed cognition models, Human Task Performance Measures. User experience modeling: Use case scenarios, writing scenarios, storytelling, building personas, mental model diagrams; UX and UI design: User-Centered Design (UCD), The Mobile, Web (And Desktop) Convergence, Responsive Design; Visual Elements: Understanding color psychology in design, color models, screen planning, sketching, wire-framing, prototyping, Icon and branding; Usability testing and evaluation: Usability evaluation, importance of user testing, Usability inspection methods, evaluating user interfaces.

Recommended Texts:

1. Jeff Johnson, *Designing with the Mind in Mind: Simple Guide to Understanding User Interface Design Guidelines,* Morgan Kaufmann, 2nd Edition, 2014.
2. Jenifer Tidwell, *Designing Interfaces: Patterns for Effective Interaction Design,* O'Reilly, 2nd Edition, 2011.

SWE 4834   **UI/UX Design Lab**   **Credit 0.75**

Sessional works based on SWE 4833.

SWE 4847 **Security Management** **Credit 3.0**

Information Security Management System Principles and concepts, Information Security Policy, The Integrated approach to security management, Asset Management, Strategic information security planning and management, Information security risk assessment and management framework, Information security management system - Requirements, model, process and continual improvement following ISO 27001, Information security management system audit and assurance, Disaster Recovery and Business Continuity, Legal aspect of information security

Recommended Texts:

1. Management of Information Security, Whitman, M. and Mattord, H., Cengage Learning
2. Information Security Management System Standard- ISO27001

SWE 4836 **System Security Lab** **Credit 0.75**

Sessional works based on SWE 4835.

SWE 4837 **Advanced Game Development** **Credit 3.0**

Advanced Scripting: Blueprints, Construction Scripts, Event Graphs, Material Graphs; Level Design: Environments & Terrain, Open World Tools, Encounters; Audio: Sound Cues, Ambient Sound Actors, Distance Model Attenuation; Animation: Rag-doll physics, Skeleton Retargeting, Inverse Kinematics, State Machines, Cut-Scenes with Matinee; 2D Games: Spritesheets, Flipbooks, Graphical User Interfaces; Networking: Client-Server Models, Replication; Artificial

Intelligence: Pathfinding, Behaviour Trees, Rule-based / Needs-based AI; Interaction: Control & Touch Devices, Depth Sensors, Virtual / Augmented Reality.

Recommended Texts:

1. Sanjay Madhav*, Game Programming Algorithms and Techniques*, Addison-Wesley Professional; 1 edition, 2013.
2. Tom Miller and Dean Johnson*, XNA Game Studio 4.0 Programming*, Addison-Wesley Professional; 1 edition, 2010.

SWE 4838   Advanced Game Development Lab   Credit 0.75

Sessional works based on SWE 4837.

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:

3. Edwin Kah Pin Chong, *An Introduction to Optimization*, Wiley-Interscience; 1 edition, 1996.

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, And 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: Group wave systems, Meeting and Decision support systems, Framework for Grouware.

CSCW Issues 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, Janet Finlay*, Human-Computer Interaction*, Prentice Hall, 3 edition, 2003.

SWE 4839   **Big Data Analysis**   **Credit 3.0**

Transition from relational database to big data & from data-mining to big data, Business aspect of big data, Characteristics of big data, Distributed File Systems, Map Reduce, Finding Similar items, Link Analysis algorithms, Similarity measure algorithms, Data Filtering algorithms, Introduction to NoSQL databases, Introduction to Hadoop platform

Recommended Texts:

1. Anand Rajaraman and Jeffrey Ullman, *Mining of Massive Datasets,* Cambridge University Press; 1 edition, 2011.
2. Tom White, *Hadoop: The Definitive Guide: Storage and Analysis at Internet Scale,* O'Reilly Media; 4 edition, 2015.

SWE 4841   **Natural Language Processing**   **Credit 3.0**

Classical Approaches to Natural Language Processing, Text Preprocessing, Lexical Analysis, Syntactic Parsing, Semantic Analysis, Natural Language Generation, Corpus Creation, Part-of-Speech Tagging, Information Extraction, Statistical Parsing, Multiword Expression, Normalized Web Distance and Word Similarity, Word Sense Disambiguation, Machine Translation, Applications of NLP, Deep Learning for NLP.

Recommended Texts:

1. Jurafsky and Martin, *Speech and Language Processing*, Prentice Hall, 2nd edition, 2008.
2. Manning and Schutze, *Statistical Natural Language Processing*, MIT Press, 1st edition, 1999.

SWE 4843   **Concurrent and Parallel**   **Credit 3.0**
Programming

This course introduces the design, development and debugging of parallel programs. It will build on the concurrency concepts gained from the Operating Systems module. It covers concepts and modeling tools for specifying and reasoning (about the properties of) concurrent systems and parallel programs. It also covers principles of performance analysis, synchronous and asynchronous parallel programming, and engineering concurrent systems and parallel programs. The topics includes: Concurrency Basics; From Concurrency to Concurrent Programming; Basic exposure to Multi-threaded Java; Threads and concurrent execution; Managing concurrency via locks and shared objects; Monitors as a concurrency control mechanism; Deadlocks in concurrent systems; Parallel programming using MPI (point-to-point communication, collective communication, management of communicators).

Recommended Texts:

1. Jeff Magee and Jeff Kramer, *Concurrency: State Models and Java Programming*, Wiley, Second Edition, 2006.
2. Lin and Snyder, *Parallel Programming*, Pearson, 1st Edition, 2008.

SWE 4845   **E-Commerce**   **Credit 3.0**

E-commerce Business Models and Concepts: Identify the key components of e-commerce business models, B2C business models, and 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 Laudon , Carol Guercio Traver, *E-Commerce*, Pearson, 13th edition, 2017.

2. Jason Andress, Steve Winterfeld, *Cyber Warfare: Techniques, Tactics and Tools for Security Practitioners,* Syngress; 2 edition, 2013.