Green University of Bangladesh

Department of Computer Science & Engineering

Syllabus of
B.Sc. in Computer Science and Engineering

(To be enacted from Spring 2020, 32nd Academic Council Meeting, 19 December, 2019)

Index

Ser.	Topic	Page No
1	Cover page	01
2	Preface	02
3	Mission of Program	03
4	Objective and Goal	03
5	Program Educational Objectives (PEOs)	03
6	Program Outcomes (POs)	04
7	Types of Courses	05
8	Course Category	05
9	Student Advising	05
10	Registration Procedure	06
11	Distribution of Marks	06
12	Grading System	06
13	Credit Hour	07
14	Degree Requirement	07
15	Credit Distribution	08
16	Semester wise Course Distribution (Tri-semester Course Distribution)	12
	Detail Syllabus	
	Programming Courses	
17	Structured Programming Language	18
18	Structured Programming Language Lab	18
19	Object Oriented Programming	18
20	Object Oriented Programming Lab	18
21	Web Programming	19
22	Web Programming Lab	19
	Logic and Algorithm Courses	
23	Discrete Mathematics	19
24	Data Structures	19
25	Data Structures Lab	20
26	Algorithms	20
27	Algorithms Lab	20
28	Artificial Intelligence	20
29	Artificial Intelligence Lab	20
	Hardware System Courses	
30	Digital Logic Design	21
31	Digital Logic Design Lab	21
32	Computer Architecture	21
33	Microprocessors & Microcontrollers	21
34	Microprocessors & Microcontrollers Lab	22
	System Courses	
35	Database System	22

36	Database System Lab	22
37	Operating System	22
38	Operating System Lab	23
39	Computer Networking	23
40	Computer Networking Lab	23
	Software Systems and Engineering Courses	
41	Software Engineering	23
42	Integrated Design Project I	24
43	Information System and Design	24
44	Integrated Design Project II	24
45	Industrial Training	25
	Technical Elective Courses	
46	Compiler	25
47	Compiler Lab	25
48	Data Communication	25
49	Data Communication Lab	26
50	Mathematical Analysis for Computer Science	26
51	Digital System Design	26
52	Human Computer Interaction	26
53	Computer and Cyber Security	27
54	Graph Theory	27
55	Graph Theory Lab	27
56	Algorithm Engineering	28
57	Algorithm Engineering Lab	28
58	Machine Learning	28
59	Machine Learning Lab	28
60	Natural Language processing	28
61	Natural Language processing Lab	29
62	Digital Image Processing	29
63	Digital Image Processing Lab	29
64	Wireless Networks	29
65	Wireless Networks Lab	30
66	Embedded Systems	30
67	Embedded Systems Lab	30
68	VLSI Design	30
69	VLSI Design Lab	31
70	Peripherals and Interfacing	31
71	Peripherals and Interfacing Lab	31
72	Mobile Application Development	31
73	Mobile Application Development Lab	32
74	Software Design Pattern	32
75	Software Design Pattern Lab	32
76	Bioinformatics	32
77	Bioinformatics Lab	32
78	Computational Geometry	33
79	Computational Geometry Lab	33
80	Computer Graphics	33
81	Computer Graphics Lab	33
82	Data Mining	33

83	Data Mining Lab	34
84	Information Retrieval	34
85	Information Retrieval Lab	34
86	Pattern Recognition	34
87	Pattern Recognition Lab	35
88	Big Data Analytics	35
89	Big Data Analytics Lab	35
90	Internet of Things	35
91	Internet of Things Lab	36
92	Cloud Computing	36
93	Cloud Computing Lab	36
94	Simulation and Modeling	36
95	Simulation and Modeling Lab	37
96	Robotics	37
97	Robotics Lab	37
98	Blockchain	37
99	Blockchain Lab	37
100	Software Testing and Quality Assurance	38
101	Software Testing and Quality Assurance Lab	38
102	Software Maintenance and Management	38
103	Software Maintenance and Management Lab	38
	Other Engineering Courses	
104	Introduction to Electrical Engineering	39
105	Introduction to Electrical Engineering Lab	39
106	Electronic Devices and Circuits & Pulse Techniques	39
107	Electronic Devices and Circuits & Pulse Techniques Lab	40
108	Electronic Device and Instrumentation	40
109	Engineering Drawing	40
	Physics Courses	
110	Physics I	41
111	Physics II	41
112	Physics Lab	42
	Chemistry Courses	
113	Chemistry	42
114	Chemistry Lab	42
	Mathematics Courses	
115	Differential and Integral Calculus	42
116	Ordinary and Partial Differential Equations and Coordinate Geometry	43
117	Linear Algebra & Vector Analysis	43
118	Statistics and Complex Variables	44
	Social Science Courses	
119	Engineering Economics	44
120	Sociology	45
121	Financial & Managerial Accounting	45
	Arts and Humanities Courses	
122	Bangladesh Studies	46
123	Professional Ethics and Environmental Protection	46
	Business Courses	
124	Business Communication	47

125	Industrial and Operational Management	47
126	Technology Entrepreneurship	48
	Language Courses	
127	English For Academic Purposes I	48
128	English For Academic Purposes II	48
129	Functional Bengali	49
130	**Equivalence Table**	50

Green University of Bangladesh

Department of Computer Science & Engineering

Syllabus of
B.Sc. in Computer Science and Engineering

(To be enacted from Spring 2020)

Bachelor of Science in Computer Science and Engineering (CSE)

The exponential growth of computing devices and their applications across the world has created a vast demand of high quality graduates in Computer Science and Engineering (CSE). It is an ever-growing field, and a Bachelor degree in CSE brings an amazing range of prospects for the students. But it is very challenging job to produce high quality graduates. If we want to take the challenge, it is necessary to introduce such a system where out-comes of the graduates will be measured in every single steps. Outcome-based education (OBE) is a model that can satisfy the needs. We have designed syllabus for our Bachelor of Science in Computer Science and Engineering (B. Sc. in CSE) degree maintaining OBE and UGC standard to meet the specific needs and desired career goals of our students. Our graduates are expected to earn sufficient competencies both in technical and general areas required for quality employment in industries and academia at home and abroad.

Preface

An engineering degree program must be carefully crafted to prepare engineering students for immediate entry into the work place or to pursue advanced graduate study. Mass of our students' further success highly depends on the quality of the education they received. With the aim of ensuring quality higher education, University Grant Commission (UGC) of Bangladesh has recommended a number of guidelines for CSE curriculum. These guidelines are aligned with the requirements of national and international professional associations. This syllabus has been designed following the UGC guidelines along with the OBE based requirements and the mission of Green University of Bangladesh.

The syllabus for B.Sc. in Computer Science and Engineering was first approved in 2008, consisting of 141 credits. The 1st amendment of the syllabus came through the approval in the 4th Academic Council Meeting held on July 2012. This amendment brought some major changes in the areas of mark distribution system, basic science courses and increased the degree requirement to 144 credits. The 2nd amendment of the syllabus was approved in the 15th academic council meeting on 19 September 2015, brought some changes in credits of some of the courses, and introduced a number of new courses in the syllabus without changing the total credits (144). The 3rd amendment was made in the 20th Academic Council Meeting, held on 6 December 2016, enacted from batch 171. A number of new courses (both core and optional) were introduced including Introduction to Cloud Computing, Introduction to Internet of Things and Ethics, keeping the total number of credits (144) unchanged. All the updates, modifications and inclusion were done aiming to enrich the syllabus for the welfare of the students of the department. The 21st academic council meeting held on 31 January 2017 approved the syllabus of B.Sc. in CSE with revised marks distribution.

The 5th amendment of the syllabus, revised following the guidelines of UGC, recommended by curriculum committee of the Department of Computer Science and Engineering and approved by the academic council, in its' 24th meeting on 15 November 2017. This amendment made Web Programming and Mobile Application Development courses mandatory. In addition, Functional Bengali, Professional Ethics and Environmental Protection and Business Communication were accommodated as mandatory courses. The required total credits (144) and the mark distribution were kept unaltered.

This is the 6th amendment of the syllabus, revised following the requirements of OBE keeping UGC guidelines as stable, recommended by curriculum committee of the Department of Computer Science and Engineering, Faculty of Science and Engineering and approved by the academic council, in its' 32nd meeting on 19 December 2019. This syllabus made Artificial Intelligence, Industrial training and Integrated Design Project I & II mandatory. In addition, it rearranged the Optional III and IV courses in four specialized tracks namely Theoretical Computer Science, Machine Learning and Data Science, Network and Systems, and Software Systems. However, the required total credits (144) and the mark distribution were kept unaltered.

Mission of the Program

The mission of the B.Sc. in Computer Science and Engineering program is to produce graduates who, trained in the design, analysis and implementation of computing systems and skilled in technical communication.

Objective and Goal

Founded in 2003, the Computer Science and Engineering (CSE) Department of Green University of Bangladesh (GUB) continues to lead the nation in research and education with a clear objective. A combination of highly qualified faculty members and state-of-the-art facilities are in the process of establishing the department as one of the leading and prestigious CSE departments of the country. The competency of the department should be evident from the achievements of the alumni. The CSE department is working heart and soul to create a brand value both in industrial and academic sectors at home and abroad.

The main objective of the CSE Department is to facilitate a sound leading to a B.Sc. degree in Computer Science and Engineering maintaining OBE standard. It is also the aim of the department to provide general computer science courses required in other disciplines. It is intended that upon completion of the program the graduate should be able to identify and apply mathematics, science and engineering knowledge effectively. Also, a CSE graduate will be able to design and conduct scientific research and experiments. He/she will develop skills on interpretation and analysis of data. A CSE graduate will achieve adequate skills to design and implement suitable computer applications, both software and hardware, and advice on such applications. The CSE department aims to focus on student's understanding of professional and ethical responsibilities along with their ability to identify, formulate and solve complex engineering problems.

Program Educational Objectives (PEOs)

1. Graduates will establish themselves as leading computational professionals and continue to learn and address evolving challenges in Computer Science and Engineering.
2. Graduates will engage in lifelong pursuit of knowledge and interdisciplinary learning for industrial, research, and academic careers.

3. Graduates will contribute to sustainable development and the well-being of society through the use of Computer Science and Engineering principles, practices and tools in an ethical and responsible manner.

Program Outcomes (POs)

1. **Engineering Knowledge (Cognitive):** Apply the knowledge of mathematics, science, engineering fundamentals and an engineering specialization to the solution of complex engineering problems.
2. **Problem Analysis (Cognitive):** Identify, formulate, research the literature and analyse complex engineering problems and reach substantiated conclusions using first principles of mathematics, the natural sciences and the engineering sciences.
3. **Design/Development of Solutions (Cognitive, Affective):** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for public health and safety as well as cultural, societal and environmental concerns.
4. **Investigation (Cognitive, Psychomotor):** Conduct investigations of complex problems, considering design of experiments, analysis and interpretation of data and synthesis of information to provide valid conclusions.
5. **Modern Tool Usage (Psychomotor, Cognitive):** Create, select and apply appropriate techniques, resources and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
6. **The Engineer and Society (Affective):** Apply reasoning informed by contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to professional engineering practice.
7. **Environment and Sustainability (Affective, Cognitive):** Understand the impact of professional engineering solutions in societal and environmental contexts and demonstrate the knowledge of, and need for sustainable development.
8. **Ethics (Affective):** Apply ethical principles and commit to professional ethics, responsibilities and the norms of the engineering practice.
9. **Individual Work and Teamwork (Psychomotor, Affective):** Function effectively as an individual and as a member or leader of diverse teams as well as in multidisciplinary settings.
10. **Communication (Psychomotor, Affective):** Communicate effectively about complex engineering activities with the engineering community and with society at large. Be able to comprehend and write effective reports, design documentation, make effective presentations and give and receive clear instructions.
11. **Project Management and Finance (Cognitive, Psychomotor):** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work as a member or a leader of a team to manage projects in multidisciplinary environments.
12. **Life-Long Learning (Affective, Psychomotor):** Recognize the need for and have the preparation and ability to engage in independent, life-long learning in the broadest context of technological change.

Types of Courses

Three types of courses are included in the undergraduate curricula. These are core course, pre-requisite course and optional course.

Core Course: A number of courses are identified as core courses, which form the nucleus of the bachelor's degree program in Computer Science and Engineering. A student has to complete the all core courses.

Prerequisite Course: Some of the core courses are identified as prerequisite courses for other courses. A prerequisite course is the one that is required to be completed before taking some other course(s).

Optional Course: Apart from the core courses, the students can choose from a set of optional courses following their area of interests.

Course Category

The letter prefix in any course number indicates the discipline/subject offering the course. Letter symbols for course categories are:

EAP-English for Academic Purpose
EEE-Electrical and Electronic engineering
CSE-Computer Science and Engineering
MAT-Mathematics
PHY-Physics
GED-General Education
CHE-Chemistry

Student Advising

One faculty is usually appointed as "Student Adviser" for a group of students by the departmental academic committee. The adviser advises each student about the courses to be taken in each term. However, it is also the student's responsibility to keep regular contact with his/her adviser who will review and eventually approve the student's specific plan of study and monitor subsequent progress of the student. Based on the academic performance of the previous terms(s), the adviser decides the number and nature of courses the student can register. The adviser may suggest the student to drop/add one or more courses based on previous academic performance.

Registration Procedure

Before the commencement of each semester, a student has to complete pre-registration in consultation with and under the guidance of his/her adviser. The date, time and venue of such registration are announced in advance by the office of the registrar. Much counselling and advising are accomplished at this time. It is essential that all the students be present for pre-registration at the specified time. Based on pre-registration, faculty assignment and final registration will be done. The maximum or minimum number of credits that a student can register in a semester is determined by the course registration policy of the university.

Distribution of Marks

Theory Courses

Name of Examination	Marks
Class Attendance	5%
Group Assignment/Project	5%
Individual Presentation	5%
Class Test	15%
Mid Term	30%
Final Exam	40%
Total Marks	**100%**

Lab Courses

Name of Examination	Marks
Class Attendance	10%
Lab Report and Performance	10%
Lab Viva Voce	15%
Lab Project/ Experiment/Quiz/Simulation Test	25%
Presentation on Lab Project/Experiment	10%
Lab Final Exam	30%
Total Marks	**100%**

Grading System

Letter grading will be made to assess students' performance. The grade will be assigned on the overall evaluation of a student's performance on the basis of semester final examination, midterm exam, case studies, tutorial test, term papers, assignment and class attendance in aggregate and whatever is applicable for an individual program. The teachers responsible for the course will determine Grades/GPA. The final result will be prepared by cumulating the grade

point average over the courses. The UGC approved uniform grading system is adopted for assigning a letter grade and grade point. This is given in the following table:

Numerical grade	Letter Grade	Grade point
80 % or Above	A+	4.00
75 % to 79%	A	3.75
70% to 74%	A-	3.50
65% to 69%	B+	3.25
60% to 64%	B	3.00
55% to 59%	B-	2.75
50% to 54%	C+	2.50
45% to 49%	C	2.25
40% to 44%	D	2.00
Less than 40%	F	0.00
	I	Incomplete
	W	Withdrawn

1. "F" means failure. Credits for courses with this grade do not apply towards graduation.
2. "I" grade is given to students who have fulfilled the majority of the course requirements but have been unable to complete the rest.
3. "W" means withdrawal. A student may decide to withdraw from a course by the deadline with the consent of the instructor and the Academic Adviser.

Credit-Hour

Three credit hours are assigned to a theory course if there are three hours lecture in a week. A class period for theory course will have duration of 90 minutes. One credit of lab course will have a minimum of 2 hours of actual lab works in a week.

Degree Requirement

a) Completion of minimum 144 credit hours.
b) Passing of all courses individually and maintaining a minimum CGPA of 2.50.

Language and General Education Courses	20.0	Credits
Basic Science Courses	11.5	Credits
Mathematics Courses	12.0	Credits
Other Engineering Courses	12.5	Credits
Core Courses	72.5	Credits
Optional Courses	15.5	Credits

Credit Distribution

Type	Credit	Percentage
Social Science (any 2) Engineering Economics (3.0) Sociology (3.0) Financial and Managerial Accounting (3.0)	6.0	13.89%
Business (any 1) Business Communication (3.0) Industrial and Operational Management (3.0) Technology Entrepreneurship (3.0)	3.0	
Arts and Humanities Courses Bangladesh Studies (2.0) Professional Ethics and Environmental Protection (2.0)	4.0	
Language EAP I (3.0) EAP II (2.0) Functional Bengali (2.0)	7.0	
Basic Science Physics I (3.0) Physics II (3.0) Physics Lab (1.5) Chemistry (3.0) Chemistry Lab (1.0)	11.5	7.99%
Mathematics Mathematics	12.0	8.33%
Other Engineering Introduction to Electrical Engineering (3.0) Introduction to Electrical Engineering Lab (1.0) Electronic Devices and Circuits & Pulse Techniques (3.0) Electronic Devices and Circuits & Pulse Techniques Lab (1.0) Electrical Drives and Instrumentation (3.0) Engineering Drawing (1.5)	12.5	8.68%
Core Subjects		

Structured Programming (3.0) Structured Programming Lab (1.5) Object Oriented Programming (3.0) Object Oriented Programming lab (1.5) Web Programming (3.0) Web Programming Lab (1.5)	13.5	50.35%
Computer Architecture(3.0) Digital Logic Design (3.0) Digital Logic Design Lab(1.0) Microprocessors & Microcontrollers (3.0) Microprocessors & Microcontrollers Lab(1.0)	11.0	
Discrete Mathematics (3.0) Data Structures (3.0) Data Structures Lab (1.5) Algorithms (3.0) Algorithms Lab (1.5) Artificial Intelligence (3.0) Artificial Intelligence Lab (1.5)	16.5	
Database (3.0) Database Lab (1.5) Operating System (3.0) Operating System Lab (1.5) Computer Networking (3.0) Computer Networking Lab (1.5)	13.5	
Software Engineering (3.0) Information System and Design (3.0) Industrial Training (3.0)	9.0	
Capstone Project/Thesis	6.0	
Integrated Design Project I (1.5) Integrated Design Project II (1.5)	3.0	

Elective Subjects **Option I (Any 1 with corresponding Lab)** Compiler (3.0) Compiler Lab (1.0) Data Communication (3.0) Data Communication Lab (1.0) **Option II (Any 1)** Mathematical Analysis for Computer Science (3.0) Digital System Design (3.0) Human Computer Interaction (3.0) Computer and Cyber Security (3.0) **Specialization (Any one course from any of the following four Specialized Groups with corresponding lab)** **Theoretical Computer Science** Graph Theory (3.0) Graph Theory Lab (1.5) Algorithm Engineering (3.0) Algorithm Engineering Lab (1.5) **Machine Learning and Data Science** Machine Learning (3.0) Machine Learning Lab (1.5) Natural Language Processing (3.0) Natural Language Processing Lab (1.5) Digital Image Processing (3.0) Digital Image Processing Lab (1.5) **Network and Systems** Embedded Systems (3.0) Embedded Systems Lab (1.5) Wireless Networks (3.0) Wireless Networks Lab (1.5) VLSI Design (3.0) VLSI Design Lab (1.5) Peripherals and Interfacing (3.0) Peripherals and Interfacing Lab(1.5) **Software Systems** Mobile Application Development (3.0) Mobile Application Development Lab (1.5) Software Design Pattern (3.0) Software Design Pattern Lab (1.5)	15.5	10.76%

Specialization (Any one course from any of the following four Specialized Groups with corresponding lab) **Theoretical Computer Science** Bioinformatics (3.0) Bioinformatics Lab (1.0) Computational Geometry (3.0) Computational Geometry Lab (1.0) Computer Graphics (3.0) Computer Graphics Lab (1.0) **Machine Learning and Data Science** Data Mining (3.0) Data Mining Lab (1.0) Information Retrieval (3.0) Information Retrieval Lab (1.0) Pattern Recognition (3.0) Pattern Recognition Lab (1.0) Big Data Analytics (3.0) Big Data Analytics Lab (1.0) **Network and Systems** Internet of Things (3.0) Internet of Things Lab (1.0) Cloud Computing (3.0) Cloud Computing Lab (1.0) Simulation and Modeling (3.0) Simulation and Modeling Lab (1.0) Robotics (3.0) Robotics Lab (1.0) Blockchain (3.0) Blockchain Lab(1.0) **Software Systems** Software Testing and Quality Assurance (3.0) Software Testing and Quality Assurance Lab (1.0) Software Maintenance and Management (3.0) Software Maintenance and Management Lab (1.0)		
Total	**144.0**	

Semester-wise Course Distribution

Tri-semester Course Distribution

Fresher

Level-1, Term-1

Course Code	Course Title	Credit	Prerequisite
EAP 101	English for Academic Purpose I	3.0	
PHY 101	Physics I	3.0	
CSE 101	Discrete Mathematics	3.0	
MAT 101	Differential and Integral Calculus	3.0	
		12.0	

Note: A newly admitted student needs to take "**EAP 009: English for Academic Purpose**" if he/she scores below margin in English section of admission test of GUB.

Level-1, Term-2

Course Code	Course Title	Credit	Prerequisite
PHY 103	Physics II	3.0	
PHY 104	Physics Lab	1.5	
CSE 103	Structured Programming	3.0	
CSE 104	Structured Programming Lab	1.5	
MAT 103	Ordinary and Partial Differential Equations and Coordinate Geometry	3.0	MAT 101
		12.0	

Level-1, Term-3

Course Code	Course Title	Credit	Prerequisite
EAP 103	English for Academic Purpose II	2.0	
CHE 101	Chemistry	3.0	
CHE 102	Chemistry Lab	1.0	
CSE 105	Data Structures	3.0	CSE 103
CSE 106	Data Structures Lab	1.5	
MAT 105	Linear Algebra and Vector Analysis	3.0	MAT 101
		13.5	

Sophomore

Level-2, Term-1

Course Code	Course Title	Credit	Prerequisite
CSE 201	Object Oriented Programming	3.0	CSE 103
CSE 202	Object Oriented Programming lab	1.5	
CSE 203	Digital Logic Design	3.0	
CSE 204	Digital Logic Design Lab	1.0	
EEE 201	Introduction to Electrical Engineering	3.0	
EEE 202	Introduction to Electrical Engineering Lab	1.0	
		12.5	

Level-2, Term-2

Course Code	Course Title	Credit	Prerequisite
GED 201	Functional Bengali	2.0	
CSE 205	Algorithms	3.0	CSE 105
CSE 206	Algorithms Lab	1.5	
CSE 208	Engineering Drawing	1.5	
EEE 203	Electronic Devices and Circuits & Pulse Techniques	3.0	EEE 201
EEE 204	Electronic Devices and Circuits & Pulse Techniques Lab	1.0	
		12.0	

Level-2, Term-3

Course Code	Course Title	Credit	Prerequisite
CSE 209	Database System	3.0	CSE 105
CSE 210	Database System Lab	1.5	
CSE 211	Computer Architecture	3.0	CSE 203
EEE 205	Electrical Drives and Instrumentation	3.0	EEE 203
MAT 201	Statistics and Complex Variables	3.0	
		13.5	

Junior

Level-3, Term-1

Course Code	Course Title	Credit	Prerequisite
CSE 301	Web Programming	3.0	CSE 209
CSE 302	Web Programming Lab	1.5	
CSE 303	Microprocessors & Microcontrollers	3.0	CSE 203
CSE 304	Microprocessors & Microcontrollers Lab	1.0	
	Optional I (Any one course with corresponding lab)	4.0	**Theory: 3.0 Lab: 1.0**
CSE 305	Compiler		
CSE 306	Compiler Lab		
CSE 307	Data Communication		
CSE 308	Data Communication Lab		
		12.5	

Level-3, Term-2

Course Code	Course Title	Credit	Prerequisite
CSE 309	Operating System	3.0	
CSE 310	Operating System Lab	1.5	
CSE 311	Computer Networking	3.0	
CSE 312	Computer Networking Lab	1.5	
	Social Science I (Any one of the following two courses)	3.0	
GED 301	Engineering Economics		
GED 303	Sociology		
		12.0	

Level-3, Term-3

Course Code	Course Title	Credit	Prerequisite
CSE 313	Software Engineering	3.0	
CSE 315	Artificial Intelligence	3.0	CSE 201
CSE 316	Artificial Intelligence Lab	1.5	
CSE 324	Integrated Design Project I	1.5	
	Optional II (Any one of the following four courses)	3.0	
CSE 317	Mathematical Analysis for Computer Science		
CSE 319	Digital System Design		
CSE 321	Human Computer Interaction		
CSE 323	Computer and Cyber Security		
		12.0	

Senior

Level-4, Term-1

Course Code	Course Title	Credit	Prerequisite
CSE 403	Information System and Design	3.0	
CSE 406	Integrated Design Project II	1.5	
CSE 400A	Capstone Project/Thesis	2.0	
	Social Science II		
GED 401	Financial and Managerial Accounting	3.0	
	Specialization (Any one course from any of the following four Specialized Groups with corresponding lab)	**4.5**	**Theory: 3.0 Lab: 1.5**
	Theoretical Computer Science		
CSE 407	Graph Theory		
CSE 408	Graph Theory Lab		
CSE 409	Algorithm Engineering		
CSE 410	Algorithm Engineering Lab		
	Machine Learning and Data Science		
CSE 411	Machine Learning		
CSE 412	Machine Learning Lab		
CSE 413	Natural Language Processing		
CSE 414	Natural Language Processing Lab		
CSE 415	Digital Image Processing		
CSE 416	Digital Image Processing Lab		
	Network and Systems		
CSE 417	Wireless Networks		
CSE 418	Wireless Networks Lab		
CSE 419	Embedded Systems		
CSE 420	Embedded Systems Lab		
CSE 421	VLSI Design		
CSE 422	VLSI Design Lab		
CSE 423	Peripherals and Interfacing		
CSE 424	Peripherals and Interfacing Lab		
	Software Systems		
CSE 425	Mobile Application Development		
CSE 426	Mobile Application Development Lab		
CSE 427	Software Design Pattern		
CSE 428	Software Design Pattern Lab		
		14.0	

Level-4, Term-2

Course Code	Course Title	Credit	Prerequisite
GED 409	Professional Ethics and Environmental Protection	2.0	
GED 411	Bangladesh Studies	2.0	
CSE 400B	Capstone Project/Thesis	2.0	
	Business (Any one of the following three courses)	3.0	
GED 403	Business Communication		
GED 405	Industrial and Operational Management		
GED 407	Technology Entrepreneurship		
	Specialization (Any one course from any of the following four Specialized Groups with corresponding lab)	4.0	**Theory: 3.0 Lab: 1.0**
	Theoretical Computer Science		
CSE 429	Bioinformatics		
CSE 430	Bioinformatics Lab		
CSE 431	Computational Geometry		
CSE 432	Computational Geometry Lab		
CSE 433	Computer Graphics		
CSE 434	Computer Graphics Lab		
	Machine Learning and Data Science		
CSE 435	Data Mining		
CSE 436	Data Mining Lab		
CSE 437	Information Retrieval		
CSE 438	Information Retrieval Lab		
CSE 439	Pattern Recognition		
CSE 440	Pattern Recognition Lab		
CSE 441	Big Data Analytics		
CSE 442	Big Data Analytics Lab		
	Network and Systems		
CSE 443	Internet of Things		
CSE 444	Internet of Things Lab		
CSE 445	Cloud Computing		
CSE 446	Cloud Computing Lab		
CSE 447	Simulation and Modeling		
CSE 448	Simulation and Modeling Lab		
CSE 449	Robotics		
CSE 450	Robotics Lab		

CSE 451	Blockchain		
CSE 452	Blockchain Lab		
	Software Systems		
CSE 453	Software Testing and Quality Assurance		
CSE 454	Software Testing and Quality Assurance Lab		
CSE 455	Software Maintenance and Management		
CSE 456	Software Maintenance and Management Lab		
		13.0	

Level-4, Term-3

Course Code	Course Title	Credit	Prerequisite
CSE 400C	Capstone Project/Thesis	2.0	
CSE 458	Industrial Training	3.0	
		5.0	

Detail Syllabus

Programming Courses

Course Code: CSE 103 **Credit:** 3.0
Course Title: Structured Programming Language
Course Brief: Overview: data types, operators and expression; control structure: decision making and branching, decision making and looping, jumping statements; array and strings: linear array, multidimensional array and strings; managing input and output operations; user defined functions: defining, calling, declaring functions; user defined data types: structure and union; pointer, dynamic memory allocation and file handling; sound and graphics.

Prerequisite Course: None
Reference Book:

1. Kernighan, B. W., & Ritchie, D. M. (2006). The C Programming Language. Prentice Hall, 2nd Edition.
2. Schildt, Herbert (2000). The Complete Reference C, McGraw-Hill, 4th Edition.

Course Code: CSE 104 **Credit:** 1.5
Course Title: Structured Programming Language Lab
Course Brief: Laboratory works based on CSE 103
Prerequisite Course: None

Course Code: CSE 201 **Credit:** 3.0
Course Title: Object Oriented Programming
Course Brief: Object oriented programming (OOP) principles: advantages of OOP over structured programming, encapsulation, classes and objects, access specifiers, static and non- static members; constructors: destructors and copy constructors; array of objects: object pointers, object references; inheritance: single and multiple inheritance; polymorphism: overloading, abstract classes, virtual functions and overriding; exceptions: object oriented I/O; template functions and classes; multi-threaded programming; GUI: abstract window toolkit (AWT), swing, event handling; animation: graphical content drawing, moving object.

Prerequisite Course: CSE 103
Reference Book:

1. Schildt, H. (2003). C++: The Complete Reference, McGraw-Hill, 4th Edition.
2. McLaughlin, B., Pollice, G., & West, D. (2006). Head First Object-Oriented Analysis and Design: A Brain Friendly Guide to OOA&D. O'Reilly Media, Inc, 1st Edition.
3. Bruegge, B., & Dutoit, A. H. (2004). Object-Oriented Software Engineering Using UML, Patterns and Java, Prentice Hall, 3rd Edition.

Course Code: CSE 202 **Credit:** 1.5
Course Title: Object Oriented Programming Lab
Course Brief: Laboratory works based on CSE 201
Prerequisite Course: None

Course Code: CSE 301 **Credit:** 3.0
Course Title: Web Programming
Course Brief: HTML basics: tags, formatting text, creating links, adding images, lists, tables, frames, forms, Cascading Style Sheets (CSS), graphics; JavaScript: introduction to JavaScript, JavaScript syntax, variables, functions; PHP: generating HTML dynamically, processing forms, sessions, cookies, data ties, back-end database support, SQL primer, database interface in PHP, searching in web applications, regular expressions and matching, Audio and video in web; advanced tools: AJAX, flash and flex.

Prerequisite Course: CSE 209
Reference:

1. Robbins, J. N. (2012). Learning web design: A beginner's guide to HTML, CSS, JavaScript, and web graphics, O'Reilly Media, Inc, 4th Edition.
2. Duckett, J. (2011). Beginning html, xhtml, css, and javascript. John Wiley & Sons, 1st Edition.

Course Code: CSE 302 **Credit:** 1.5
Course Title: Web Programming Lab
Course Brief: Laboratory works based on CSE 301
Prerequisite Course: None

Logic and Algorithm Courses

Course Code: CSE 101 **Credit:** 3.0
Course Title: Discrete Mathematics
Course Brief: Mathematical logic: propositional logic, predicate logic, mathematical reasoning and proof techniques; set theory: sets, relations, partial ordered sets, functions; counting: permutations, combinations, principles of inclusion and exclusion; discrete probability; functions: recurrence relations and recursive algorithms; growth of functions; graph theory: graphs, paths, trees; algebraic structures: rings and groups.

Prerequisite Course: None
Reference Book:

1. Rosen, K. H. (2007). Discrete mathematics and its applications. AMC, 7th Edition.
2. Goodaire, E. G., & Parmenter, M. M. (1997). Discrete mathematics with graph theory. Prentice Hall PTR.
3. Biswal, P. C. (2015). Discrete mathematics and graph theory. PHI Learning Pvt. Ltd.

Course Code: CSE 105 **Credit:** 3.0
Course Title: Data Structures
Course Brief: Internal data representation; Abstract data types; elementary data structures: arrays, linked lists, stacks, queues, trees and graphs; basic data structures operations: traversal, insertion, deletion, searching, merging, sorting, tree; tree traversal and graph traversal; recursion and recursive algorithm, pattern matching; advanced data structures: heaps, Fibonacci heaps; search trees: binary search trees, AVL trees, multi-way search trees, sorting, hashing.

Prerequisite Course: CSE 103
Reference Book:

1. Mehlhorn, K. (2013). Data structures and algorithms 1: Sorting and searching (Vol. 1). Springer Science & Business Media. 1st Edition.
2. Chang, S. K. (Ed.). (2003). Data structures and algorithms (Vol. 13). World Scientific. 3rd Edition.
3. Goodrich, M. T., & Tamassia, R. (2008). Data structures and algorithms in Java. John Wiley & Sons, 4th Edition.
4. Cormen, T. H. (2009). Introduction to algorithms. MIT press, 3rd Edition.

Course Code: CSE 106 **Credit:** 1.5
Course Title: Data Structures Lab
Course Brief: Laboratory works based on CSE 105
Prerequisite Course: None

Course Code: CSE 205 **Credit:** 3.0
Course Title: Algorithms
Course Brief: 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; topological sorting; connected components, spanning trees, shortest paths; Flow algorithms; Approximation algorithms; Parallel algorithms, Lower bound theory; NP-completeness, NP-hard and NP-complete problems.

Prerequisite Course: CSE 105
Reference Book:
1. Cormen, T. H. (2009). Introduction to algorithms. MIT press, 3rd Edition.
2. Kleinberg, J., & Tardos, E. (2006). Algorithm design. Pearson Education India. 1st Edition.

Course Code: CSE 206 **Credit:** 1.5
Course Title: Algorithms Lab
Course Brief: Laboratory works based on CSE 205
Prerequisite Course: None

Course Code: CSE 315 **Credit:** 3.0
Course Title: Artificial Intelligence
Course Brief: Introduction to artificial intelligence; foundation and history of artificial intelligence; intelligent agents; solving problem by searching; adversarial searching; logical agents; first-order logic; knowledge representation; probabilistic reasoning; planning; making decisions; perception; robotics.

Prerequisite Course: CSE 205
Reference Book:
1. Russell, S. J., & Norvig, P. (2002). Artificial intelligence: a modern approach, Prentice Hall, 3rd Edition.
2. Frankish, K., & Ramsey, W. M. (Eds.). (2014). The Cambridge handbook of artificial intelligence. Cambridge University Press. 3rd Edition.

Course Code: CSE 316 **Credit:** 1.5
Course Title: Artificial Intelligence Lab
Course Brief: Laboratory works based on CSE 315
Prerequisite Course: None

Hardware System Courses

Course Code: CSE 203 **Credit:** 3.0
Course Title: Digital Logic Design
Course Brief: Digital logic: Boolean algebra, De Morgan's theorems, logic gates and their truth tables, canonical forms, combinational logic circuits; minimization techniques: arithmetic and data handling logic circuits, decoders and encoders, multiplexers and demultiplexers; combinational circuit design: Flip-flops, race around problems; counters: asynchronous counters, synchronous counters and their applications; PLA design; synchronous and asynchronous logic design; state diagram; Mealy and Moore machines; state minimizations and assignments; pulse mode logic; fundamental mode design.

Prerequisite Course: None
Reference Book:

1. Mano, M. M. (2017). Digital logic and computer design. Pearson Education India, 2nd Edition.
2. Holdsworth, B., & Woods, C. (2002). Digital logic design. Newnes, 4th Edition.

Course Code: CSE 204 **Credit:** 1.0
Course Title: Digital Logic Design Lab
Course Brief: Laboratory works based on CSE 203
Prerequisite Course: None

Course Code: CSE 211 **Credit:** 3.0
Course Title: Computer Architecture
Course Brief: Information representation; measuring performance; instructions and data access methods: operations and operands of computer hardware, representing instruction, addressing styles; Arithmetic Logic Unit (ALU) operations: floating point operations, designing ALU; processor design: datapaths single cycle and multicycle implementations, control unit design - hardwared and microprogrammed, hazards, exceptions; pipeline: pipelined datapath and control, superscalar and dynamic pipelining; memory organization: cache, virtual memory, channels; DMA and interrupts; buses; multiprocessors: types of multiprocessors, performance, single bus multiprocessors, multiprocessors connected by network, clusters.

Prerequisite Course: CSE 203
Reference Book:

1. Mano, M. M. (2006). Computer systems architecture. Prentice Hall, 3rd Edition.
2. David, A., & John, H. (2005). Computer organization and design: the hardware/software interface. San mateo, CA: M organ Kaufmann Publishers, 1998. 5th Edition.

Course Code: CSE 303 **Credit:** 3.0
Course Title: Microprocessors & Microcontrollers
Course Brief: Microprocessor: microcontroller & microcomputer, evaluation of microprocessor & application, **i**ntroduction to 8-bit, 16-bit, and 32-bit microprocessors; addressing modes: absolute addressing, 8086 internal architecture, PIN diagram of 8086, Max-Min mode, register structure; memory read write cycle; Instruction set; pipeline concept: interrupts, programmed I/O, memory mapped I/O, interrupt driven I/O, direct memory access; block transfer; cycle stealing; interleaved; multi-tasking and virtual memory; memory interface; bus interface; arithmetic co-processor; assembly language programming of 8086 microprocessors.

Prerequisite Course: CSE 203
Reference Book:

1. Mazidi, M. A., Naimi, S., & Naimi, S. (2011). The AVR Microcontroller and Embedded Systems. August. 1st Edition.
2. Hall, D. V., & Rood, A. L. (1986). Microprocessors and interfacing: programming and hardware (pp. 442-487). McGraw-Hill. 2nd Edition.

Course Code: CSE 304 **Credit:** 1.0
Course Title: Microprocessors and Microcontrollers Lab
Course Brief: Laboratory works based on CSE 303
Prerequisite Course: None

System Courses

Course Code: CSE 209 **Credit:** 3.0
Course Title: Database System
Course Brief: Concepts of database systems: different types of databases, application, models; database architecture: client-server architecture, parallel architecture, distributed databases, relational databases, E-R design, strong entity set and weak entity set, specialization, generalizations; integrity constraint: DDL, DML, DTL; introduction to SQL: syntax, aggregation function, relational operators, logical operators, string operations, join functions; query processing; hashing and indexing; query optimization; database optimization: normalization, 1NF, 2NF, 3NF, BCNF; database transactions: transaction model, ACID, serializability, transaction as SQL statements; database concurrency control: lock based protocol, dead lock handling, multiple granularity; database triggers: row level triggers based on update, insert, delete; basic of data mining and data warehousing.

Prerequisite Course: CSE 105 Reference Book:

1. Silberschatz, A., Korth, H. F., & Sudarshan, S. (2010). Database System Concepts. McGraw-Hill Education. 7th Edition.
2. Elmasri, R. (2008). Fundamentals of database systems. Pearson Education India. 6th Edition.

Course Code: CSE 210 **Credit:** 1.5
Course Title: Database System Lab
Course Brief: Laboratory works based on CSE 209
Prerequisite Course: None

Course Code: CSE 309 **Credit:** 3.0
Course Title: Operating System
Course Brief: Operating system: its role in computer systems, operating system concepts, operating system structure; process: process model and implementation, inter-process communication (IPC), classical IPC problems, thread, process scheduling, multiprocessing and time-sharing; memory management: swapping, paging, segmentation, virtual memory; Input/Output: hardware, software, disk, terminals, clocks; deadlock: resource allocation and deadlock, deadlock detection, prevention and recovery; file systems: files, directories, security, protection; case study of some operating systems.

Prerequisite Course: None
Reference Book:

1. Silberschatz, A., Galvin, P. B., & Gagne, G. (2014). Operating system concepts essentials. John

Wiley & Sons, Inc. 8th Edition.
2. Stallings, W. (2005). Operating Systems: Internals and Design Principles. Pearson. 5th Edition.

Course Code: CSE 310 **Credit:** 1.5
Course Title: Operating System Lab
Course Brief: Laboratory works based on CSE 309
Prerequisite Course: None

Course Code: CSE 311 **Credit:** 3.0
Course Title: Computer Networking
Course Brief: Introduction to computer networks: protocol layers, network performance Metrics-Delay, loss, throughput, jitter; circuit and packet switching; application layer: protocol overview of HTTP, FTP, SMTP, DNS, SNMP, P2P, client server and hybrid applications of the Internet; transport layer: protocol overview of TCP and UDP, principles of reliable data transfer, flow control, congestion control, TCP Reno, TCP Tahoe, socket programming; network layer: overview of IPv4 and IPv6, IP addressing, components of a router, routing and forwarding functions of a router, routing algorithms: link state and distance vector, OSPF and BGP; wireless networks: definition and types of wireless networks, MAC and routing in wireless networks, mobility and mobile IPv6.

Prerequisite Course: None
Reference Book:
1. Kurose, J. F., & Ross, K. W. (2009). Computer networking: a top-down approach (Vol. 4). Boston, USA: Addison Wesley. 6th Edition.
2. Foruzan, B. A. (2013). Data communication and Networking. Science Engineering& Math Publications. 5th Edition.

Course Code: CSE 312 **Credit:** 1.5
Course Title: Computer Networking Lab
Course Brief: Laboratory works based on CSE 311
Prerequisite Course: None

Software Systems and Engineering Courses

Course Code: CSE 313 **Credit:** 3.0
Course Title: Software Engineering
Course Brief: Introduction: concepts/paradigms/phases of software engineering/life cycle, recurring and fundamental principles, requirement analysis/engineering/specification, concepts of feasibility analysis and techniques of cost benefit analysis, role, tasks and attributes of system analysts, software architectures; design: architectural design, module design, interfaces and fundamental principles; User Interface (UI) design: UI design principles, user interaction, information presentation, user support, interface evaluation; implementation issues; introduction to software testing; quality assurance; configuration management: version management and tools; maintenance and evolution; project management: software process and project metrics, software project planning, risk analysis and management, project scheduling and tracking; use case model for requirement writing; elaboration using system sequence diagram; UML diagrams; interaction and collaboration diagram for designing

software; GRASP patterns.

Prerequisite Course: None

Reference:

1. Sommerville, I. (2004). Software Engineering. International computer science series. ed: Addison Wesley. 9th Edition.
2. Pressman, R. S. (2005). Software engineering: a practitioner's approach. Palgrave Macmillan. 7th Edition.

Course Code: CSE 324 **Credit:** 1.5

Course Title: Integrated Design Project I

Course Brief: This course simulates a real world integrated design environment through a capstone project (CP). Considering current industry requirement, this course particularly aims at complex engineering problem solving, requirement specification, problem analysis and modern tool usage. Based on the knowledge of previous courses, students will be trained to develop professional practitioner guided applications as an essential part to meet the challenges especially in the era of Industry 4.0 in Bangladesh.

Prerequisite Course: **CSE 210**

Reference:

1. Software engineering a practitioner's approach, 7ªed. Roger Pressman. McGraw Hill Higher Education, 2010. INF/681.3.06/PRE. Available in Spanish.
2. Software engineering, 9ª ed. Addison Wesley. Ian Sommerville. INF/681.3.06/SOM.

Course Code: CSE 403 **Credit:** 3.0

Course Title: Information System and Design

Course Brief: Introduction: Introduction to information system, tools of information system development, information systems development life cycle, tools for analysis; planning phase: systems planning, preliminary planning and investigation, determining IS development requirements, project management; analysis phase: analysing requirements, evaluating alternatives, information systems analysis principles; design phase: structured information systems design, input design and control, output system design; development phase: information systems development, computer-aided software engineering; implementation phase: systems implementation, systems evaluation and optimization, information systems documentation.

Prerequisite Course: None

Reference:

1. Kendall, K. E., & Kendall, J. E. Systems analysis and design. Prentice Hall Press. 9th Edition.
2. Valacich, J. S., & George, J. (2016). Modern systems analysis and design. Pearson. 7th Edition.

Course Code: CSE 406 **Credit:** 1.5

Course Title: Integrated Design Project II

Course Brief: This course will enable students to undertake a "design, build and test" exercise to enhance their skills in product reengineering and improve their understanding of the project implementation phase. In addition to the engagement in life-long learning in the broadest context of technological change, students will be able to gather sustainable experience on individual and teamwork along with project management and finance.

Prerequisite Course: CSE 324
Reference:

1. Software engineering a practitioner's approach, 7ªed. Roger Pressman. McGraw Hill Higher Education, 2010. INF/681.3.06/PRE. Available in Spanish.
2. Software engineering, 9ª ed. Addison Wesley. Ian Sommerville. INF/681.3.06/SOM. Available in Spanish.

Course Code: CSE 458 **Credit:** 3.0
Course Title: Industrial Training
Course Brief: 12-16 weeks hands on experience in Software Industries.
Prerequisite Course: CSE 406

*__Note__: This course is mandatory. Evaluation report from industry is to be submitted at the end of the training.

Technical Elective Courses

Course Code: CSE 305 **Credit:** 3.0
Course Title: Compiler
Course Brief: Language theory; finite automata: deterministic finite automata, nondeterministic finite automata, equivalence and conversion of deterministic and nondeterministic finite automata, pushdown automata; context free grammars; introduction to compiling; basic issues; lexical analysis; syntax analysis; syntax-directed translation; semantic analysis; type-checking; run-time environments; intermediate code generation; code generation; code optimization.

Prerequisite Course: None
Reference Book:

1. Hopcroft, J. E., Motwani, R., & Ullman, J. D. (2006). Automata theory, languages, and computation. Pearson, 24th International Edition.
2. Aho, A. V., Sethi, R., & Ullman, J. D. (2007). Compilers: principles, techniques, and tools (Vol. 2). Addison-wesley. 2nd Edition.
3. Puntambekar, A. A. (2009). Principles of compiler design. Technical Publications. 1st Edition.

Course Code: CSE 306 **Credit:** 1.0
Course Title: Compiler Lab
Course Brief: Laboratory works based on CSE 305
Prerequisite Course: None

Course Code: CSE 307 **Credit:** 3.0
Course Title: Data Communication
Course Brief:
Signal and random processes; review of Fourier transform; Hilbert transform; continuous wave modulation: AM, PM, FM, sampling theorem; pulse modulation: PAM, PDM, PPM, PCM, companding, delta modulation, differential PCM; multiple access techniques: TDM, FDM; digital modulation: ASK, PSK, BPSK, QPSK, FSK, MSK, constellation, bit error rate (BER); noise; echo cancellation; intersymbol Interference; concept of channel coding and capacity.

Prerequisite Course: None
Reference Book:

1. Foruzan, B. A. (2013). Data communication and Networking. McGrill - Hall. 5th Edition.
2. Tanenbaum, A. S., & Wetherall, D. J. (2011). Computer networks. Pearson. 5th Edition.

Course Code: CSE 308 **Credit:** 1.0
Course Title: Data Communication Lab
Course Brief: Laboratory works based on CSE 307
Prerequisite Course: None

Course Code: CSE 317 **Credit:** 3.0
Course Title: Mathematical Analysis for Computer Science
Course Brief: Recurrent problems; manipulation of sums; number theory; special numbers; generating functions; random variables; Stochastic process; Markov chains: discrete parameter, continuous parameter, birth-death process; queuing models: birth-death model, Markovian model, open and closed queuing network; application of queuing models.

Prerequisite Course: None
Reference:

1. Graham, R. L. (1994). Concrete mathematics: a foundation for computer science. Pearson Education India. 2nd Edition.
2. Ross, S. M. (2014). Introduction to probability models. Academic press. 11th Edition.

Course Code: CSE 319 **Credit:** 3.0
Course Title: Digital System Design
Course Brief: Overview of digital systems; combinational logic circuits and design; FPGA & CPLD VHDL; description of digital systems: behavioural modelling, VHDL description of digital systems: structural modelling, VHDL description of arithmetic functions: sequential circuits, sequential system design, processor datapath and control unit, memory and timing issues, computer design, basic instruction set, architecture pipeline design, Verilog basics, (optional) I/O, bus design, D/A, A/D, power issues.

Prerequisite Course: None
Reference:

1. Charles H. R., Jr. & Lizy K. J., Digital Systems Design Using VHDL, Thomson , 2nd Edition.
2. Peter J. A., The Student's Guide to VHDL, Morgan Kaufmann, 2nd Edition.

Course Code: CSE 321 **Credit: 3.0**
Course Title: Human Computer Interaction
Course Brief:
Overview of human-computer interaction strategies from a number of perspectives including that of the engineer; cognitive psychologist and end-user; major themes include the design and evaluation of usable interfaces; matching computer systems with the cognitive capabilities of users and an investigation of novel paradigms in human-computer interaction; A team-based project, dealing with the design, development, and evaluation of a computer-based device to support distributed human communication.

Prerequisite Course: None

Recommended Books:

1. Human Computer Interaction by A. Dix and J. E. Finlay., Prentice Hall, 2006. ISBN- 13: 978-0130461094, 4th Edition.
2. Preece J., Rogers Y., Sharp H., Baniyon D., Holland S. and Carey T. *Human Computer Interaction*, Addison-Wesley, 1994. 1st Edition.

Course Code: CSE 323 **Credit: 3.0**

Course Title: Computer and Cyber Security

Course Brief:

The security environment: threats, vulnerabilities, and consequences, advanced persistent threats, the state of security today; concepts of information security: security principles, access control mechanisms, authentication schemes; operating system security: classic security models, common vulnerabilities, Linux and Windows security; cyber-attacks: examples, tools, and methodologies, principles of software and hardware reverse engineering; network security: firewall, intrusion detection system, network monitoring tools; cloud & web security: mobile computing security, distributed computing security, cyber defence techniques; cyber forensics: tools, mechanisms, challenges; cyber-ethics: cybercrimes, intellectual properties, privacy; security conference: DefCon, etc.

Prerequisite Course: None

Reference:

1. Kaplan, J. M., Bailey, T., O'Halloran, D., Marcus, A., & Rezek, C. (2015). Beyond Cybersecurity: Protecting Your Digital Business. John Wiley & Sons. 1st Edition.
2. Singer, P. W., & Friedman, A. (2014). Cybersecurity: What Everyone Needs to Know. Oxford University Press. 1st Edition.
3. Dua, S., & Du, X. (2016). Data mining and machine learning in cybersecurity. CRC press. 1st Edition.

Course Code: CSE 407 **Credit**: 3.0

Course Title: Graph Theory

Course Brief: Graphs: simple graphs, digraphs, sub graphs, vertex-degrees, walks, paths & cycles; Trees: spanning trees in graphs, distance in graphs; complementary graphs; cut-vertices; bridges and blocks; k-connected graphs; Euler tours; Hamiltonian cycles; Chinese Postman Problem; Traveling Salesman Problem; Chromatic number; chromatic polynomials; chromatic index; Vizing's theorem; planar graphs; perfect graphs.

Prerequisite Course: None

Reference Book:

1. Introduction to Graph Theory By Douglas B. West, Prentice Hall, 2nd Edition
2. Introduction to Graph Theory By Richard J. Trudeau, Dover Publications, 1st edition

Course Code: CSE 408 **Credit:** 1.5

Course Title: Graph Theory Lab

Course Brief: Laboratory works based on CSE 407

Prerequisite Course: None

Course Code: CSE 409 **Credit**: 3.0
Course Algorithm Engineering
Course Brief:
Computationalcomplexity; parameterized complexity; algorithms for combinatorial optimization; practical computing and heuristics; approximation algorithms; LP based approximation algorithms; randomized algorithms; experimental algorithmic; algorithms in state- of-the-art fields like bioinformatics, grid computing, VLSI design etc.

Prerequisite Course: None
Recommended Books:

1. Introduction to Algorithms by Thomas Cormen , 3rd edition, MIT press, 2017. ISBN- 13: 978-0072970548.
2. Algorithms by Robert Sedgewick, 4th Edition, Addison-Wesley Professional, 2011. ISBN-10: 032157351X

Course Code: CSE 410 **Credit:** 1.5
Course Title: Algorithm Engineering Lab
Course Brief: Laboratory works based on CSE 409
Prerequisite Course: None

Course Code: CSE 411 **Credit:** 3.0
Course Title: Machine Learning
Course Brief:
Supervised and unsupervised learning; issues in machine learning: parametric and non- parametric models, curse of dimensionality, overfitting, and model selection; linear models for regression: maximum likelihood and least squares, regularized least squares, bias variance decomposition, Bayesian linear regression; linear models for classification: Fisher's linear discriminant, probabilistic generative models -parametric (maximum likelihood and Bayesian) and non-parametric density estimation; probabilistic discriminative models: logistic regression, log-linear models, Kernel methods and Sparse Kernel Machines; Clustering; mixture models and expectation; maximization algorithm; sequential data and Markov models.

Prerequisite Course: None
Recommended Books:

1. Pattern Recognition and Machine Learning by Christopher Bishop, Springer, 2006. ISBN-13: 978-0387310732. 1st Edition.
2. Robert W., Machine Learning: For Complete Beginners, Tech Publishing, 2017. ASIN: B0741RVXV9. 1st Edition.

Course Code: CSE 412 **Credit:** 1.5
Course Title: Machine Learning Lab
Course Brief: Laboratory works based on CSE 411
Prerequisite Course: None

Course Code: CSE 413 **Credit:** 3.0
Course Title: Natural Language processing
Course Brief:
Role of syntax, semantics, and pragmatics in human language processing by computers. Natural language generators and parsers, inference, and conceptual analysis. Modeling conceptual processes and

representing semantic knowledge by means of computer problems.
Prerequisite Course: CSE 315
Reference:

1. Natural Language Processing with PyTorch: Build Intelligent Language Applications Using Deep Learning
   By Brian McMahan, Edition: 1st , Publisher: O'Reilly Media.
2. Foundations of Statistical Natural Language Processing
   By Christopher D. Manninge, Edition: 1st , Publisher: MIT Press.

Course Code: CSE 414 **Credit:** 1.5
Course Title: Natural Language processing Lab
Course Brief: Laboratory works based on CSE 413
Prerequisite Course: None

Course Code: CSE 415 **Credit**: 3.0
Course Title: Digital Image Processing
Course Brief:
Introduction to image processing: differences between image processing, image analysis, and computer vision, image representation, color space, image sampling and quantization, image quality measurement; image quality enhancement: intensity transformations, contrast stretching, histogram equalization; spatial domain filtering: mean and median filters, Sharpening filters - Laplacian and Sobel, discrete Fourier transform; frequency-domain filtering: Gaussian and Butterworth low pass and High pass filters; image transform: discrete Cosine transform, wavelet transform, Mutiresolution analysis and discrete wavelet transform; introduction to image restoration: noise models, spatial and frequency filters, Weiner filter, Morphological Image Processing; image feature extraction and representation: edge and line, region segmentation and representation, image and video compression.
Prerequisite Course: None
Recommended Books:

1. Digital Image Processing by Rafael C. Gonzalez, 4th edition, Pearson Education, 2009. ISBN-13: 978-0131687288.
2. Digital Image Processing: PIKS Scientific Inside by William K. Pratt, 3rd edition, Wiley, 2010.

Course Code: CSE 416 **Credit:** 1.0
Course Title: Digital Image Processing Lab
Course Brief: Laboratory works based on CSE 415
Prerequisite Course: None

Course Code: CSE 417 **Credit:** 3.0
Course Title: Wireless Networks
Course Brief: Cellular concepts: frequency reuse, handoff strategies, interference and system capacity, grade of service, improving capacity and coverage, call blocking probability; Propagation effects: outdoor propagation models, indoor propagation models, power control, Doppler's effect, small and large scale fades; Wireless LAN Technology; IEEE 802.11: standard, protocol architecture, physical layer and media access control; Mobile IP; Wireless Application Protocol; IEEE 802.16 Broadband Wireless Access; Brief review of 2nd and 3rd generation wireless: GSM, GPRS, CDMA; Cordless system; Wireless local loop; Bluetooth: overview and baseband specifications.

Prerequisite Course: CSE 311

Reference Book:

1. Wireless Networks
   By P. Nicopolitidis, M.S. Obaidat, G.I. Papadimitriou, A.S. Pomportsis
2. 802.11 Wireless Networks: The Definitive Guide
   By Matthew S. Gast

Course Code: CSE 418 **Credit:** 1.0
Course Title: Wireless Networks Lab
Course Brief: Laboratory works based on CSE 417
Prerequisite Course: None

Course Code: CSE 419 **Credit:** 3.0
Course Title: Embedded Systems
Course Brief: History & need of embedded system; basic components of embedded system; programming language classification of embedded system; advantage & disadvantage; development environments for embedded software; resource aware programming; hardware programming; developing multi-threaded software; inter-process communication with shared memory and message passing; programming using real time operating systems; fault detection and testing; fault tolerance and fault recovery.

Prerequisite Course: None
Reference:

1. Simon, David E.(1999),An embedded software primer, Mass.: Addison-Wesley, cop., 1st Edition.
2. Marwedel, Peter (2006), Embedded system design Updated and corr. version: Dordrecht: Springer, cop. 1st Edition.

Course Code: CSE 420 **Credit:** 1.0
Course Title: Embedded Systems Lab
Course Brief: Laboratory works based on CSE 419
Prerequisite Course: None

Course Code: CSE 421 **Credit:** 3.0
Course Title: VLSI Design
Course Brief: VLSI design methodology: top-down design approach, technology trends and design automation algorithms, introduction to CMOS inverters and basic gates; brief overview of CMOS fabrication process: layout and design rules, basic CMOS circuit characteristics and performance estimation, buffer circuit design, complex CMOS gates; CMOS building blocks: adder, multiplier, data path and memory structures; hardware modelling: hardware modelling languages, logic networks, state diagrams, data-flow and sequencing graphs, behavioural optimization; architectural synthesis: circuit specification, strategies for architectural optimization, data-path synthesis, control unit synthesis and synthesis of pipelined circuits; ASIC design using FPGA and PLDs.

Prerequisite Course: None
Reference:

1. Principles of CMOS VLSI Design : A Systems Perspective
   By N. H. E. Weste and K. Eshraghian, Addision-Wesley, 2nd Edition

2. Digital Integrated Circuits: A Design Perspective By J. Rabaey, A. Chandrakasan and B. Nikolic, 2nd Edition

Course Code: CSE 422 **Credit:** 1.0
Course Title: VLSI Design Lab
Course Brief: Laboratory works based on CSE 421
Prerequisite Course: None

Course Code: CSE 423 **Credit:** 3.0
Course Title: Peripherals and Interfacing
Course Brief:
Introduction to peripherals and real world interfacing, Serial communication interface; Computer BUS standards and their interfaces: ISA, PCI, AGP, PS/2 and USB; Interfacing with hard-disk and Printer; Interfacing ADCs and DACs with a microcomputer; Barcodes reader and interfacing with them; Sound card and MIDI interface; Introduction to stepper motors and their interfacing; Interfacing with semiconductor power switches: BJT, MOSFET, SCR and Triac.
Prerequisite Course: None
Recommended Books:
1. Introduction to Robotics: Analysis, Control, Applications by Saeed B.Niku, 2nd Edition, Wiley, 2011
2. Robot Modelling and Control, by M. W. Spong, Wiley 2006. ISBN : 978-0-471-64990-8, 1st Edition

Course Code: CSE 424 **Credit:** 1.5
Course Title: Peripherals and Interfacing Lab
Course Brief: Laboratory works based on CSE 423
Prerequisite Course: None

Course Code: CSE 425 **Credit:** 3.0
Course Title: Mobile Application Development
Course Brief: Introduction to mobile computing: Android development environment; factors in developing mobile applications: mobile software engineering, frameworks and tools, model, Android storing and retrieving data, working with a content provider; communications via network and the web: state machine, correct communications model, Android networking and web; telephony : scope of an App, wireless connectivity and mobile apps, Android telephony; performance, best practices, Android field service app, security and hacking, active transactions, platforms and additional Issues, development process, architecture, design, technology selection , mobile app development hurdles , testing.

Prerequisite Course: CSE 201 Reference:
1. Stark, J. (2010). Building Android Apps with HTML, CSS, and JavaScript. O'Reilly Media, Inc. 2nd Edition.
2. Meier, R. (2012). Professional Android 4 application development. John Wiley & Sons. 3rd Edition.

Course Code: CSE 426 **Credit:** 1.5

Course Title: Mobile Application Development Lab
Course Brief: Laboratory works based on CSE 425
Prerequisite Course: None

Course Code: CSE 427 **Credit:** 3.0

Course Title: Software Design Pattern
Course Brief:

Introduction to design patterns, object oriented design and UML; Class diagram in UML: Class notation, attributes, operations, relationship such as association, generalization, dependency, realization, constraints, static UML diagram and dynamic UML diagram; Patterns: Iterator, Composite, Command, Singleton, Façade, Adapter, Template, Observer, Visitor, Proxy design, Curiously recurring template pattern (CRT), Bridge, Flyweightand Restful service patterns; Patterns combination in practice; Refactoring to patterns.

Prerequisite Course: None Reference:

1. "Software Architecture: Foundations, Theory, and Practice", Richard N. Taylor, Nenad Medvidović, and Eric M. Dashofy, John Wiley and Sons, 2009.
2. "Software Architecture in Practice" (3rd Edition), Len Bass, Paul Clements, Rick Kazman, Addison Wesley, 2012.

Course Code: CSE 428 **Credit:** 1.5

Course Title: Software Design Pattern Lab
Course Brief: Laboratory works based on CSE 427
Prerequisite Course: None

Course Code: CSE 429 **Credit**: 3.0

Course Title: Bioinformatics
Course Brief: Basics of molecular biology; Genome rearrangements; sequence alignments and motif discovery; Gene prediction; Dynamic Programming, Local and Global Alignment; DNA sequencing, genome sequencing, protein sequencing, spectrum graphs; Combinatorial pattern matching: Database search, Rapid string matching, BLAST, FASTA; Genome Assembly: Consensus-alignment-overlap, Graph-based assembly; Gene expression analysis, biological network analysis; Evolutionary trees and Phylogenetics; Machine learning methods in bioinformatics.

Prerequisite Course: None
Reference:

1. Bioinformatics and Functional Genomics by Jonathan Pevsner, 2nd edition, Wiley-Liss. ISBN: 978-0-470-08585-1.
2. Bioinformatics Basics: Applications in Biological Science and Medicine by Hooman Rashidi, Lukas K. Buehler, 2nd Edition, CRC Press/Taylor & Francis Group, 2005. ISBN: 0849312833.

Course Code: CSE 430 **Credit:** 1.0

Course Title: Bioinformatics Lab
Course Brief: Laboratory works based on CSE 429
Prerequisite Course: None

Course Code: CSE 431 **Credit**: 3.0
Course Title: Computational Geometry
Course Brief: Linear programming in two and three dimensions, Geometric primitives, Line intersection, Algorithm and complexity of fundamental geometric objects, Voronoi diagrams and Delaunary triangulations, Graph drawing styles and applications, drawing of rooted trees, straight line drawing of planar graphs, Non-orthogonal range searching, Convex hulls, Point location and Binary Space Partitions, Linear programming in two and three dimensions, Triangulation and visibility.

Prerequisite Course:
Reference:
1. An introduction to computational geometry for curves and surfaces by Alan J. Davies.
2. Computational Geometry Algorithms and Applications By de Berg, M.

Course Code: CSE 432 **Credit:** 1.0
Course Title: Computational Geometry Lab
Course Brief: Laboratory works based on CSE 431
Prerequisite Course: None

Course Code: CSE 433 **Credit:** 3.0
Course Title: Computer Graphics
Course Brief: Graphics hardware: Display devices, Input devices, Basic raster graphics algorithms for drawing 2D primitives; Two-dimensional viewing; Clipping and transformations; Three-dimensional viewing; 3D object representation: B-spline curves and surfaces, Visible surface detection methods, Surface rendering methods, BSP trees, Octrees; Data Compression Techniques: JPEG; H.261 (px64); MPEG; Intel's DVI; Microsoft AVI; Audio compression; Fractal compression.

Prerequisite Course: None
Reference Book:
1. Foley, J. D., Van Dam, A., Feiner, S. K., Hughes, J. F., & Phillips, R. L. (1994). Introduction to computer graphics (Vol. 55). Reading: Addison-Wesley.
2. Hearn, D. D., Baker, M. P., & Carithers, W. (2010). Computer graphics with open GL. Prentice Hall Press.

Course Code: CSE 434 **Credit:** 1.0
Course Title: Computer Graphics Lab
Course Brief: Laboratory works based on CSE 433
Prerequisite Course: None

Course Code: CSE 435 **Credit:** 3.0
Course Title: Data Mining
Course Brief: Mining frequent patterns: Definitions and background, Market basket analysis, Methods for mining frequent patterns: Apriori, FP-growth, Mining frequent itemsets using vertical data format; Mining closed and maximal frequent itemsets. Mining association rules and correlation: generating association rules from frequent itemsets; mining correlations from association rules, various correlation measures: lift, chi-square, all_conf, max_conf, cosine and Kulc; their performance and applicability analysis. Classification: Basic concepts of supervised learning; Classification Methods: Decision tree, Naïve Bayes, k-NN, Rule-Based, Neural Network; Metrics for evaluating classifier performance: accuracy, precision, recall, F-measure; Cross-validation, Bootstrap, Model selection using Statistical

Tests of significance, ROC-curves; Introducing ensemble methods: bagging, boosting and adaboost, random forests; handling imbalanced data, semi-supervised learning, transfer learning. Clustering: Basic concepts of unsupervised learning; Requirements of cluster analysis; Overview of clustering methods:- Partitioning methods: k-Means, k-Medoids; Hierarchical methods: Agglomerative and Divisive, BIRCH, Chameleon; Density-Based Methods: DBSCAN, OPTICS; Evaluation of Clustering; Outlier analysis.

Prerequisite Course: CSE 209, CSE 205

Reference:

1. **Data Mining: Concepts and Techniques**
   By Jiawei Han, Micheline Kamber and Jian Pei
2. **Data Mining and Analysis: Fundamental Concepts and Algorithms**
   By Mohammed J. Zaki, Wagner Meira, Jr and Wagner Meira

Course Code: CSE 436 **Credit:** 1.0

Course Title: Data Mining Lab

Course Brief: Laboratory works based on CSE 435

Prerequisite Course: None

Course Code: CSE 437 **Credit:** 3.0

Course Title: Information Retrieval

Course Brief: Boolean Retrieval, Term Vocabulary and Postings lists, Dropping common terms: Dictionaries and tolerant retrieval, Index Construction, Scoring and Ranking, Computing scores in a complete search system, Evaluation in information retrieval, Relevance feedback and query expansion, Language models for information retrieval, Enterprise Information Retrieval, Link Analysis, Search Applications, Probabilistic Retrieval Models, Text Clustering, Federated Search.

Prerequisite Course: CSE 205

Reference:

1. **Introduction to Information Retrieval**
   By Christopher D. Manning, Edition: 1st , Publisher: Cambridge University Press
2. **Information storage and retrieval**
   By Robert R. Korfhage, Edition: 1st , Publisher: John Wiley & Sons

Course Code: CSE 438 **Credit:** 1.0

Course Title: Information Retrieval Lab

Course Brief: Laboratory works based on CSE 437

Prerequisite Course: None

Course Code: CSE 439 **Credit:** 3.0

Course Title: Pattern Recognition

Course Brief: Pattern Recognition: introduction, importance; statistical and neural pattern recognition: Bayesian classifier, Bayes decision theory, discriminant functions and decision surfaces, Bayesian classifier for normal distributions; Linear classifiers: discriminant functions and decision hyper planes, perception algorithm and its variants, Kessler's construction; nonlinear classifiers: two and three layer perceptions, back propagation algorithm and its variants; template matching: optimal path searching techniques, dynamic programming methods, correlation based matching and 2D log search algorithm for image matching; context dependent classification: Viterbi algorithm, channel equalization, observable and hidden Markov models, three problems of HMM and their application in speech recognition; syntactic pattern recognition: introduction to syntactic pattern recognition, grammar-based

approach, parsing, graph-based approach; unsupervised classification: basic concepts of clustering, proximity measures, categories of clustering algorithms, sequential clustering algorithms.

Prerequisite Course: None
Reference:

i. Pattern Classification by Richard O. Duda, Peter E. Hart and David G. Stork, 2nd Edition
ii. Pattern Recognition by William Gibson, 1st Edition
iii. Image Processing and Pattern Recognition: Fundamentals and Techniques by Frank Y. Shih, 2nd Edition

Course Code: CSE 440 **Credit:** 1.0
Course Title: Pattern Recognition Lab
Course Brief: Laboratory works based on CSE 439
Prerequisite Course: None

Course Code: CSE 441 **Credit:** 3.0
Course Title: Big Data Analytics
Course Brief:
Fundamentals of Big Data Analysis, the Big Data landscape including examples of real world big data problems including the three key sources of Big Data: people, organizations, and sensors; Introduction to the V's of Big Data (volume, velocity, variety, veracity, valence, and value) and why each impacts data collection, monitoring, storage, analysis and reporting; Identify what are and what are not big data problems and be able to recast big data problems as data science questions; Provide an explanation of the architectural components and programming models used for scalable big data analysis; Summarize the features and value of core Hadoop stack components including the YARN resource and job management system, the HDFS file system and the MapReduce programming model.

Prerequisite Course: None
Recommended Books:

1. Data Science & Big Data Analytics: Discovering, Analyzing, Visualizing and Presenting Data by D Dietrich. USA: Wiley, 2015. ISBN: 978-1-118-87613-8.
2. Big data by Viktor Mayer-Schönberger, Eamon Dolan/Mariner Books, 2014. ISBN- 10: 0544227751

Course Code: CSE 442 **Credit:** 1.0
Course Title: Big Data Analytics Lab
Course Brief: Laboratory works based on CSE 441
Prerequisite Course: None

Course Code: CSE 443 **Credit:** 3.0
Course Title: Internet of Things
Course Brief: Internet of Things: Definition, applications, the IoT paradigm, Smart objects, IoT components and diversities, convergence of technologies, Industry domains: IoT Service design and analysis in various industrial applications - IoT in Transport, Health, Sports, Smart Cities, Home, Retail Market, etc.; IoT Platforms: Hardware, SoC, sensors, device drivers, IoT standards, Cloud computing for IoT, Bluetooth, Bluetooth Low Energy, beacons, IoT Communication Protocols: NFC, RFID, Zigbee, MIPI, M-PHY, UniPro, SPMI, SPI, M-PCIe, Wired vs. Wireless communication, GSM, CDMA, LTE, GPRS, small cell, etc. Quality of Service issues for IoT Data Collection, Integration of IoT Data and Cloud Computing Systems.

Prerequisite Course: CSE 311
Reference:

1. IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things
   By Qusay F. Hassan, Edition: 1st , Publisher: Wiley-IEEE Press
2. Internet of Things (IoT): Systems and Applications
   By Jamil Y. Khan, Edition: 1st , Publisher: Jenny Stanford Publishing

Course Code: CSE 444 **Credit:** 1.0
Course Title: Internet of Things Lab
Course Brief: Laboratory works based on CSE 443
Prerequisite Course: None

Course Code: CSE 445 **Credit:** 3.0
Course Title: Cloud Computing
Course Brief: Definition, applications including benefits, challenges, and risks, Enabling Technologies and System Models for Cloud Computing, Cloud Computing Models: IaaS, PaaS, SaaS and emerging XaaS, Types of Cloud Computing: Public cloud, private cloud and hybrid clouds, Architectural design of Cloud computing, Interaction among providers, customers, and cloud broker; VM Resource Provisioning: Static and dynamic resource provisioning approaches, HARMONY architecture, Capacity provisioning approaches, Scalability and Fault Tolerant Issues; Principles of Virtualization platforms: VMWare ESX Memory Management, Security and Privacy issues in the Cloud.

Prerequisite Course: CSE 205, CSE 311
Reference:

1. Cloud Computing: Methodology, Systems, and Applications
   By Lizhe Wang, Rajiv Ranjan, Jinjun Chen, Boualem Benatallah
2. Cloud Computing SaaS, PaaS, IaaS, Virtualization, Business Models, Mobile, Security and More, By Dr. Kris Jamsa

Course Code: CSE 446 **Credit:** 1.0
Course Title: Cloud Computing Lab
Course Brief: Laboratory works based on CSE 445
Prerequisite Course: None

Course Code: CSE 447 **Credit:** 3.0
Course Title: Simulation and Modeling
Course Brief: Simulation modeling basics: systems, models and simulation, classification of simulation models, steps in a simulation study; concepts in discrete-event simulation: event- scheduling vs. process-interaction approaches, time-advance mechanism, organization of a discrete-event simulation model, continuous simulation models, combined discreet-continuous models, Monte Carlo simulation, simulation of queuing systems; building valid and credible simulation models: validation principles and techniques, statistical procedures for comparing real-world observations and simulated outputs, input modeling; generating random numbers and random variants; output analysis; simulation languages; analysis and modeling of some practical systems.

Prerequisite Course: None
Reference:

1. **Handbook of Simulation: Principles, Methodology, Advances, Applications, and Practice,** By John Wiley & Sons, New York, NY.
2. **Discrete-Event System Simulation, Fourth Edition,** By Prentice-Hall

Course Code: CSE 448 **Credit:** 1.0
Course Title: Simulation and Modeling Lab
Course Brief: Laboratory works based on CSE 447
Prerequisite Course: None

Course Code: CSE 449 **Credit:** 3.0
Course Title: Robotics
Course Brief:
Very fast review of 3D kinematics: representation of kinematic chains, Denatit-Hartenberg frame assignment convention; forward and inverse kinematics: Jacobeans, static force/torque relationships, and manoeuvrability; Independent joint control: path and trajectory planning, and dynamics (time permuting).

Prerequisite Course: None
Recommended Books:
1. Introduction to Robotics: Analysis, Control, Applications by Saeed B.Niku, 2nd Edition, Wiley, 2011
2. Robot Modelling and Control, by M. W. Spong, Wiley 2006. ISBN : 978-0-471-64990-8, 1st Edition

Course Code: CSE 450 **Credit:** 1.0
Course Title: Robotics Lab
Course Brief: Laboratory works based on CSE 449
Prerequisite Course: None

Course Code: CSE 451 **Credit:** 3.0
Course Title: Blockchain
Course Brief:
Overview, blockchain technology: Transactions, Blocks, Hashes, Consensus, Verify and confirm blocks; Consensus building: Distributed consensus, Byzantine generals problem, Proof of work, Writing to the blockchain; Mining and incentivizing blockchain: Game theory behind competitive mining, Race to beat the others (including hackers), Incentives; Cryptography: Symmetric-key cryptography, Public-key cryptography, Digital signatures and Hash functions; Security and safeguards: Protecting blockchain from attackers, Forks – soft and hard.
Prerequisite Course: None
Recommended Books:
1. Blockchain Revolution: How the Technology Behind Bitcoin Is Changing Money, Business, and the World by Don Tapscott and Alex Tapscott
2. The Business Blockchain: Promise, Practice, and Application of the Next Internet Technology by William Mougayar and Vitalik Buterin

Course Code: CSE 452 **Credit:** 1.0
Course Title: Blockchain Lab
Course Brief: Laboratory works based on CSE 451
Prerequisite Course: None

Course Code: CSE 453 **Credit:** 3.0

Course Title: Software Testing and Quality Assurance

Course Brief: Definition and concept of software quality assurance (SQA); quality models; specification of quality requirements; product development & delivery issues; software development processes & maturity; software quality management process: total quality management, improvement cycle, SQA planning & management, organizing the SQA effort; software verification & validation; typical software development errors; Fagan inspections; software audit; software testing: testing objectives & testing fundamentals, testing theory, coverage criteria, equivalence class testing, value-based testing, decision table, syntax & state transition testing, statement & path testing, branch & condition testing, data flow testing, thread- based testing, integration & integration testing, system testing; testing in object-oriented systems; test tools & test automation; test management; problem reporting & corrective action.

Prerequisite Course: None

Reference:

1. Mastering Software Quality Assurance: Best Practices, Tools and Techniques for Software Developers

By Murali Chemuturi

2. Testing Computer Software

By Cem Kaner, Jack Falk and Hung Q. Nguyen

Course Code: CSE 454 **Credit:** 1.0

Course Title: Software Testing and Quality Assurance Lab

Course Brief: Laboratory works based on CSE 453

Prerequisite Course: None

Course Code: CSE 455 **Credit:** 3.0

Course Title: Software Maintenance and Management

Course Brief: Introduction to the techniques of software maintenance and evolution, software change management, software quality, mining software repositories, software refactoring, defect prediction and effort estimation, software re-documentation, Describing the role of the software manager, the organizational structure, and key personnel positions associated with planning and managing software development and maintenance activities; Software Reengineering – Economic and Technical feasibility analysis, planning, reengineering from function/procedural to Object Oriented design, Uncertainty and failure/risk analysis of reengineering, various issues of implementation, Auto Code translation – Opportunities and problems.

Prerequisite Course: CSE 435

Reference:

1. Stanislaw Jarzabek (2007). Effective Software Maintenance and Evolution: A Reuse-Based Approach. Auerbach Publications, 1st Edition.
2. Andy Oram, Greg Wilson (2010). Making Software: What Really Works, and Why We Believe It. Publisher: O'Reilly Media, 1st Edition.

Course Code: CSE 456 **Credit:** 1.0

Course Title: Software Maintenance and Management Lab

Course Brief: Laboratory works based on CSE 455

Prerequisite Course: None

Other Engineering Courses

Course Code: EEE 201 **Credit:** 3.0
Course Title: Introduction to Electrical Engineering
Course Brief: Circuit variables: voltage, current, power and energy, Voltage and current independent and dependent sources, Circuit elements: resistance, inductance and capacitance. Modelling of practical circuits, Ohm's law and Kirchhoff's laws, Solution of simple circuits with both dependent and independent sources, Series-parallel resistance circuits and their equivalents, Delta-Wye equivalent circuits, Techniques of general DC circuit analysis (containing both independent and dependent sources): Node-voltage method, Mesh-current method, Source transformations. Thevenin and Norton equivalents, Maximum power transfer. Superposition technique. Properties of Inductances and capacitances. Series-parallel combinations of inductances and capacitances; Concepts of transient and steady state response with dc source. Introduction to sinusoidal steady state analysis: Sinusoidal sources, impedance, admittance, reactance; Norton Equivalents, Phase diagrams. Sinusoidal steady state power calculations, RMS values, Real and reactive power. Maximum power transfer, impedance matching. Steady state voltage, current. Resonance in AC circuits: Series and parallel resonance and Q factors. Magnetically coupled circuits.

Prerequisite Course: None
Reference:

1. Floyd, T. L. (2006). Electric Circuit Fundamentals (Floyd Electronics Fundamentals Series). Prentice-Hall, Inc.
2. Alexander, C. K., & no Sadiku, M. (2000). Electric circuits. Transformation, 135, 4-5.
3. Kerchner, R. M., & Corcoran, G. F. (1951). Alternating-current circuits.

Course Code: EEE 202 **Credit:** 1.0
Course Title: Introduction to Electrical Engineering Lab
Course Brief: Laboratory works based on EEE 201
Prerequisite Course: None

Course Code: EEE 203 **Credit:** 3.0
Course Title: Electronic Devices and Circuits & Pulse Techniques
Course Brief: Diode logic gates, transistor switches, transistor gates, MOS gates; Logic Families: TTL, ECL, IIL and CMOS logic with operation details; Propagation delay, product and noise immunity; Open collector and high impedance gates; Electronic circuits for flip-flops, counters and register, memory systems, PLA's; A/D and D/A converters with applications; S/H circuits, LED, LCD and optically coupled oscillators; Non-linear applications of OP AMPs; Analog switches. Linear wave shaping: diode wave shaping techniques, clipping and clamping circuits, comparator circuits, switching circuits; Pulse transformers, pulse transmission, pulse generation; monostable, bi-stable and stable multi-vibrators, Schmitt trigger, blocking oscillators and time-base circuit; Timing circuits; Simple voltage sweeps, linear current sweeps. Device Problems including BJT, FET, MOSFETS, CMOS, TUBES, Digital interfaces including D/A, A/D, S/H. Digital Filters, Modern Sampling Techniques.

Prerequisite Course: EEE 201
Reference Book:

1. Millman, J., & Grabel, A. (1987). Microelectronics. McGraw-Hill.
2. Stanley, W. D. (2002). Operational amplifiers with linear integrated circuits. Pearson Education India.
3. Coughlin, R. F., & Driscoll, F. F. (1987). Operational amplifiers and linear integrated circuits. Prentice-Hall, Inc.

Course Code: EEE 204 **Credit:** 1.0
Course Title: Electronic Devices and Circuits & Pulse Techniques Lab
Course Brief: Laboratory work based on EEE 203
Prerequisite Course: None

Course Code: EEE 205 **Credit:** 3.0
Course Title: Electrical Drives and Instrumentation
Course Brief: Introduction to three phase circuits, Alternators and transformers; Principles of operation of DC, Synchronous, induction, universal, and stepper motors; thyristor and microprocessor based speed control of motors. Instrumentation amplifiers: differential, logarithmic and chopper amplifiers; Frequency and voltage measurements using digital techniques; Recorders and display devices, spectrum analyzers and logic analyzers; Data acquisition and interfacing to microprocessor based systems; Transducers: terminology, types, principles and application of photovoltaic, piezoelectric, thermoelectric, variable reactance and opto electronic transducers; Noise Design Techniques. Noise reduction in instrumentation. Audio Power Amplifiers: Review of Power Amplifiers; Output Transformer less Power Amplifiers; Quasi-Complementary Methods; Directly Coupled Circuits; Pulse-width and Other Switching Methods; Innovative Circuit Design.

Prerequisite Course: EEE 203
Reference Book:
1. Gupta, J. B. (2003). A course in Electrical and Electronic Measurement and Instrumentation. Katson Publishing House.
2. Rashid, M. H. (2010). Power electronics handbook: devices, circuits and applications. Academic press.
3. Anand, M. M. S. (2004). Electronic Instruments and Instrumentation Technology. PHI Learning Pvt. Ltd.
4. Helfrick, A. D., & Cooper, W. D. (1990). Modern electronic instrumentation and measurement techniques. Prentice Hall.

Course Code: CSE 208 **Credit:** 1.5
Course Title: Engineering Drawing
Course Brief: 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. Lines and lettering; Plane geometry: drawing of linear and curved geometric figures, e.g. pentagon, hexagon, octagon, ellipse, parabola, hyperbola; Solid geometry: concept of isometric view and oblique view, theory of projections; First and third angle projections; Orthographic drawings; Isometric views; Missing lines and views; Plan, elevation and section of multi-storied buildings; drawings of building services; Use of CAD packages;

Prerequisite Course: None
Reference Book:
1. Mandal, Dr. Amalesh Chandra., & Islam, Dr. Md. Quamrul. (2007) Mechanical Engineering Drawing. Bangladesh Engineering University and Technology

Physics Courses

Course Code: PHY 101 **Credit:** 3.0
Course Title: Physics I
Course Brief:
Waves and Oscillations: Differential equation of a simple harmonic oscillator, total energy and average energy, Lissajous' figures, spring-mass-system, calculation of time period of torsional pendulum, damped oscillation, determination of damping co-efficient, forced oscillation, resonance, two-body oscillations, Reduced mass, differential equation of a progressive wave, power and intensity of wave motion, stationary wave, group velocity and phase velocity, reverberation and Sabine's formula.

Physical Optics: Interference of light, Young's double slit experiment, Displacements of fringes and its uses, Newton's rings, Diffraction of light, Fresnel and Fraunh offer diffraction, diffraction by single slit, resolving power of optical instruments, diffraction grating, production and analysis of polarized light, Brewster's law, Malus law, Polarization by double refraction, retardation plates, Nicol prism, optical activity, polarimeters, polaroid.

Heat and Thermodynamics: Platinum resistance thermometer, thermo-electric thermometer, Kinetic theory of gases, Maxwell's distribution of molecular speeds, mean free path, equipartition of energy, Brownian motion, Vander Waal's equation of state, First Law of thermodynamics and its application, reversible and irreversible processes, Second Law of thermodynamics, Carnot cycle, Efficiency of heat engines, Carnot's Theorem, entropy and disorder, thermodynamic functions, Maxwell relations, Third Law of thermodynamics.

Prerequisite Course: None
Reference Book:

1. Subrahmanyam, N., Lal, B., & Avadhanulu, M. N. (2015). A Text Book of Optics (me). S. Chand.
2. Ahmed, G., Physics for Engineering (part-1). Revised and enlarged edition.
3. Hossain, T., Text Book of Heat. 2nd Edition.

Course Code: PHY 103 **Credit:** 3.0
Course Title: Physics II
Course Brief:
Structure of Matter: Crystalline and non-crystalline solids, Single crystal and polycrystal solids, Unit cell, Crystal systems, Co-ordinations number, Crystal planes and directions, NaCl and CsCl structure, Packing factor, Miller indices, Relation between interplanar spacing and Miller indices, Bragg's Law, Methods of determination of interplanar spacing from diffraction patterns, Defects in solids: Point defects, Line defects, Bonds in solids, Interatomic distances, Calculation of cohesive and bonding energy, Introduction to band theory: Distinction between me, Semiconductor and insulator.

Electricity and Magnetism: Coulomb's Law, Electric field (E), Gauss's Law and its application, Electric potential (V), Capacitors and capacitance, Capacitors with dielectrics, Dielectrics an atomic view, Charging and discharging of a capacitor, Ohm's Law, Kirchoff's Law, Magnetism, Magnetic induction, Magnetic force on a current carrying conductor, Torque on a current carrying loop, Hall effect, Faradays Law of electromagnetic induction, Lenz's Law, Self- induction, Mutual induction, Magnetic properties of matter, Hysteresis curve; Electromagnetic oscillation: L-C oscillations and its

analogy to simple harmonic motion.
Modern Physics: Michelson-Morley's experiment, Galilean transformation, Special theory of relativity and its consequences, Quantum theory of radiation, Photo-electric effect, Compton effect, Wave particle duality, Interpretation of Bohr's postulates; Radioactive disintegration, Properties of nucleus, Nuclear reactions, Fission, Fusion, Chain reaction, Nuclear reactor.

Prerequisite Course: Physics I
Reference Book:

1. Ahmed, G., Physics for Engineering (part-2). Revised and enlarged edition.
2. Kittel, C. (2005). Introduction to solid state physics. Wiley.
3. Walker, J., Halliday, D., & Resnick, R. (2008). Fundamentals of physics. Hoboken, NJ: Wiley.
4. Beiser, A. Concept of Modern Physics, 1999.

Course Code: PHY 104 **Credit:** 1.5
Course Title: Physics Lab
Course Brief: Laboratory works based on PHY 101 & PHY 103

Chemistry Course

Course Code: CHE 101 **Credit:** 3.0
Course Title: Chemistry
Course Brief: Atomic structure, quantum numbers, electronic configuration, periodic table; Properties and uses of noble gases; Different types of chemical bonds and their properties; Molecular structure of compounds; Selective organic reactions; Different types of solutions and their compositions; Phase rule, phase diagram of mono component system; Properties of dilute solutions; Thermo chemistry, chemical kinetics, chemical equilibria; Ionization of water and pH concept; Electrical properties of Solution.

Prerequisite Course: None
Reference Book:

1. Bahl, B. S., & Tuli, G. D. (1960). Essentials of physical chemistry. S Chand And Co.; Delhi; Jullundur; Lucknow.
2. Cotton, A. F., Wilkinson, G., Bochmann, M., & Murillo, C. A. (1999). Advanced inorganic chemistry. Wiley.
3. Morrison, R. T., Boyd, R. N., & Rajora, S. (1992). Organic Chemistry for the JEE. Pearson Education India.

Course Code: CHE 102 **Credit:** 1.0
Course Title: Chemistry Lab
Course Brief: Laboratory works based on CHE 101
Prerequisite Course: None

Mathematics Courses

Course Code: MAT 101 **Credit:** 3.0
Course Title: Differential and Integral Calculus
Course Brief:
Differential Calculus: Functions; Limit; Continuity and differentiability; Successive differentiations of various functions and Leibnitz's theorem; Rolle's theorem; Mean value theorem; Taylor's and Maclaurin's theorem in finite and infinite forms; Indeterminate form; Partial differentiation; Euler's

theorem; Maxima and minima; Concavity; Tangent and normal; Asymptotes; Application of differentiation.

Integral Calculus: Indefinite integral; Method of substitution; Integration by parts; Integration of rational fraction; Integration of special trigonometric function; Definite integral; General properties of definite integral; Gamma and Beta function; Multiple Integrals; Application of integration.

Prerequisite Course: None

Reference Book:

1. Anton, H., Bivens, I., & Davis, S. (2002). Calculus (Vol. 2). Hoboken: Wiley.
2. Courant, R. (2011). Differential and integral calculus (Vol. 2). John Wiley & Sons.
3. William Anthony Granville. (1911). Elements of the Differential and Integral Calculus. Revised Edition.

Course Code: MAT 103 **Credit:** 3.0

Course Title: Ordinary and Partial Differential Equations and Coordinate Geometry

Course Brief:

Ordinary Differential Equation**:** Formation of differential equations; Separation of variables; Homogenous linear equations; Exact equations; Linear and Bernoulli equations; Higher order differential equations; Linear differential equation with constant coefficients; Application of first and higher order differential equations; Variation of parameter; Series solution of linear differential equations; System of linear differential equations.

Partial Differential Equation**:** Formation of partial differential equation; Linear and non-linear partial differential equation of order one; Lagrange's method for one or more than two independent variables; linear partial differential equation of second order with variable coefficients.

Coordinate Geometry**:** Transformation of co-ordinates axes and its uses; Direction cosines and direction ratios; Pair of straight line and 2^{nd} degree general equation; Shortest distance; Angle between a pair of straight lines; Circles; Equations of parabola, ellipse and hyperbola in Cartesian and polar co-ordinates; Plane; Straight line; Sphere.

Prerequisite Course: MAT 101

Reference Book:

1. Ross, S. L. (1980). Introduction to ordinary differential equations. John Wiley & Sons.
2. Coddington, E. A. (2012). An introduction to ordinary differential equations. Courier Corporation.
3. Dennis G. Zill. A First Course in Differential Equations with Modeling Application. 10^{th} Edition.
4. S. L. Loney. The Elements of Coordinate Geometry. 2^{nd} Edition.

Course Code: MAT 105 **Credit:** 3.0

Course Title: Linear Algebra and Vector Analysis

Course Brief:

Linear Algebra: Algebra of matrices; Multiplication of matrices; Adjoint and inverse of a matrix; Rank of a matrix; Application of determinants; Solutions of the system of linear equations; Application of system of linear equations; Vector space; Linear dependence and independence; Basis and dimension; Eigenvalues and eigenvectors; Linear transformation with uses of rank and nullity; Caley-Hamilton theory.

Vector Analysis: Scalars and vectors; Equality of vectors; Addition, subtraction and multiplication of

vectors; Position vector of a point; Scalar and vector product of two vectors and their geometrical interpretation; Triple products and multiple products of vectors; Definition of line, surface and volume integral; Gradient, divergence and curl of point functions; Gauss's theorem; Stoke's theorem; Green's theorem and their applications.

Prerequisite Course: MAT 101
Reference Book:

1. Gilbert Strang. Introduction to Linear Algebra. 4th Edition.
2. Howard Anton (1988). Elementary Linear Algebra. 10th Edition.
3. Rahman & Bhattacharjee (2005). Co-ordinate Geometry with Vector Analysis.

Course Code: MAT 201 **Credit:** 3.0
Course Title: Statistics and Complex Variables
Course Brief:
Statistics**:** Types and sources of data; Uses and limitations of statistics; Presentation of data and exploratory data analysis tools; Histograms; Characteristics of data; Measures of location - mean, median and mode; Range; Standard deviation and other measures of dispersion; Moments; Skewness and kurtosis; Correlation and regression analysis; Experiments; Events; Set theory; Axioms of probability and counting methods for computing probability; Conditional probability; Discrete and continuous probability distribution; Mathematical expectation; Population and sample variance; Binomial distribution; Normal distribution; Cauchy distribution.
Complex Variable**:** Complex number system; General functions of a complex variable; Curve sketching; Limits and continuity of a function of complex variable and related theorems; Complex differentiation; Cauchy Riemann equations; Cauchy's integral formula; Taylor's Theorem and Laurent's Theorem; Singular points; Contour integration.

Prerequisite Course: None
Reference Book:

1. Walpole and Myers. Probability and Statistics for Engineers & Scientists. 9th Edition.
2. James Ward Brown and Ruel V. Churchill. Complex Variables and Applications. 7th Edition.

Social Science Courses

Course Code: GED 301 **Credit**: 3.0
Course Title: Engineering Economics
Course Brief:
Definition of Economics; Economics and engineering; Principles of economics. Micro-Economics: Introduction to several economic systems: capitalist, command and mixed economy etc.; Fundamental economic problems and the mechanism through which these problems are solved; Theory of demand and supply and their elasticity; Theory of consumer behaviour; Cardinal and ordinal approaches of utility analysis; Price determination; Nature of an economic theory; Applicability of economic theories to the problems of developing countries; Indifference curve techniques; Theory of production, production function, types of productivity; Rational region of production of an engineering firm; Concepts of market and market structure; Cost analysis and cost function; Small scale production and large scale production and its optimization; Theory of distribution; Uses of derivative in

economics: maximization and minimization of economic functions, relationship among total, marginal and average concepts. Macro-economics: Savings; investment and employment; National Income Analysis; Inflation; Monetary policy; Fiscal policy and trade policy with reference to Bangladesh; Economics of development and planning.

Micro-Economics: Introduction to several economic systems: capitalist, command and mixed economy etc.; Fundamental economic problems and the mechanism through which these problems are solved; Theory of demand and supply and their elasticity; Theory of consumer behaviour; Cardinal and ordinal approaches of utility analysis; Price determination; Nature of an economic theory; Applicability of economic theories to the problems of developing countries; Indifference curve techniques; Theory of production, production function, types of productivity; Rational region of production of an engineering firm; Concepts of market and market structure; Cost analysis and cost function; Small scale production and large scale production and its optimization; Theory of distribution; Uses of derivative in economics: maximization and minimization of economic functions, relationship among total, marginal and average concepts. Macro-economics: Savings; investment and employment; National Income Analysis; Inflation; Monetary policy; Fiscal policy and trade policy with reference to Bangladesh; Economics of development and planning.

Prerequisite Course: None Reference Books:

1. Park, C. S., Kim, G., & Choi, S. (2007). Engineering economics. Pearson Prentice Hall, New Jersey.

Course Code: GED 303 **Credit**: 3.0

Course Title: Sociology

Course Brief:

Introduction: Society, Science and Technology- an overview; Scientific Study of Society; Social Elements, Society, Community, Association and Institution; Mode of Production and Society Industrial Revolution, Development of Capitalism. Culture and Socialization: Culture; Elements of Culture; Technology and Culture; Cultural Lag; Socialization and Personality; Family; Crime and Deviance; Social Control. Technology, Society and Development; Industrialization and Development; Development and Dependency Theory; Sustainable Development; Development and Foreign Borrowing; Technology Transfer and Globalization, Modernity and Environment; Problems and Prospects. Pre-industrial, Industrial and Post-industrial Society: Common Features of Industrial Society; Development and Types of Social Inequality in Industrial Society; Poverty, Technology and Society; Social Stratification and Social Mobility; Rural and Urban Life, and their Evaluation. Population and Society: Society and Population; Fertility. Mortality and Migration; Science, Technology and Human Migration; Theories of Population Growth- Demographic Transition Theory, Malthusian Population Theory; Optimum Population Theory; Population Policy.

Prerequisite Course: None Reference Book:

1. Introduction to Sociology. OpenStax College. 21 June 2012.

Course Code: GED 401 **Credit**: 3.0

Course Title: Financial and Managerial Accounting

Course Brief: Financial Accounting: Objectives and significance of accounting; Accounting as an information system; computerized system and applications in accounting; Recording system: double entry mechanism; Accounts and their classification; Accounting equation; Accounting cycle: journal, ledger, trial balance; Preparation of financial statements considering adjusting and closing entries; Accounting concepts (principles) and conventions. Financial statement analysis and interpretation: ratio analysis. Cost and Management Accounting: Cost concepts and classification; Overhead cost: meaning

and classification; Distribution of overhead cost; Overhead recovery method/rate; Job order costing: preparation of job cost sheet and quotation price; Inventory valuation: absorption costing and marginal/variable costing technique; Cost- Volume-Profit analysis: meaning, breakeven analysis, contribution margin approach, sensitivity analysis. Short-term investment decisions: relevant and differential cost analysis. Long-term investment decisions: capital budgeting, various techniques of evaluation of capital investments.

Prerequisite Course: None Reference Books:

1. Fundamental financial accounting concepts / Thomas P. Edmonds, Frances M. McNair, Philip R. Olds; Edward E. Milam, 8th ed.
2. Financial Accounting: Meaning, Nature and Role of Accounting, Link: http://www.ddegjust.ac.in/studymaterial/mba/cp-104.pdf

Arts and Humanities Courses

Course Code: GED 411 **Credit**: 2.0

Course Title: Bangladesh Studies

Course Brief: Society and Culture: The sociological perspective, primary concepts, factors of social life, social structure and process, social institutions, culture and civilization, city and country, social change, problems of society, social problems of Bangladesh, Urbanization Process and its impact on Bangladesh Society. Bangladesh History: introduction, sources of History, History in nation building; ancient Bengal, ancient geography and trade links with other world-Pal and Sen Dynasty; Medieval Bengal, Muslim conquest of Bengal, Socio-economic and cultural changes, unification of Bengal, the development of Bengali language and literature. The Independent Sultanate in Bengal-Bengal under the Mughal, the Nawabi Rule in Bengal (1700- 1765). Modern Period: British colonial rule, introduction of Zarnindari system and decline of socio-economic condition, resistance movements, English education and its impact, revival of statehood in Bengal, the growth of Indian National Congress, the creation of new province of East Bengal and Assam, Muslim League (1906), Bengal Pact (1923). Autonomous Bengal (1937
-1947): East Pakistan as a province of Pakistan, establishment of Awami League, Language Movement of 1952, United Front and Fall of Muslim League, the Military Rule of Ayub Khan, Economic disparity between the two regions, Cultural suppression of West Pakistan, 6-point Movement, Mass upsurge in 1969, the Rule of Yahya Khan, Election of 1970, the War of Independence and the Emergence of Bangladesh.

Prerequisite Course: None

Reference Books:

1. Majumdar, R. C. The History of Bengal
2. Rashid, Harun er, (2005) Economic Geography of Bangladesh.

Course Code: GED 409 **Credit**: 2.0

Course Title: Professional Ethics and Environmental Protection

Course Brief: Definition and scopes of Ethics. Different branches of Ethics. Social change and the emergence of new technologies. History and development of Engineering Ethics. Science and Technology- necessity and application. Study of Ethics in Engineering. Applied Ethics in engineering. Human qualities of an engineer. Obligation of an engineer to the clients. Attitude of an engineer to other engineers. Measures to be taken in order to improve the quality of engineering profession. Ethical Expectations: Employers and Employees; inter-professional relationship: Professional Organization-

maintaining a commitment of Ethical standards. Desired characteristics of a professional code. Institutionalization of Ethical conduct.

Prerequisite Course: None

Reference Books:

1. Jose A. Cruz-Cruz , William Frey, Professional Ethics in Engineering, Rice University, Huston, Texas.

Business Courses

Course Code: GED 403 **Credit**: 3.0

Course Title: **Business Communication**

Course Brief: Introduction: Meaning, Scope, Nature, Importance, Principles of Communication; Business and Social Communication; Factors affecting Communication; Hierarchy of Communication Levels; Cultural Orientation in Communication. Types of Communication, Major Media of written and oral Communication. Fundamentals of Business writings: Basic introductory words, adaptation and the selection of words, construction of clear sentences and paragraphs; Writing for effect. Pattern of Business Letter: Directness in initiating routine letters; answering routine letters; indirectness for bad news and persuasion; office order, circular, notes and memo. Application to Specific Letter: Situations and Persuasion in purchase and sales writings; pattern variations in collections; work order and customer complaints; Filing and Indexing; Strategy in job applications. Fundamentals of Business report writing: Characteristics, importance and types of reports, Main body and back matters, preparatory steps to writing reports; purposes and scope of reports, determining the audience, collecting data, organizing materials, basic of report writing, report structure, the shorter form, and long formal reports. Standard and Physical Aspects of Communication: Graphic aids to communication; physical presentation of reports and letters; correctness of communication, symbols, gestures, nods, body language. Organizational Communication: Tools of internal communication- office order, Office circular, office notes, office memo, Inter-organizational communication-business and job letters, forwarding letter and preparation of CV or resume.

Prerequisite Course: None Reference books:

1. Raymond V. Lesiker, Basic, Business Communication
2. Rajendra Pal & J.S.Korlahali, Essentials of Business Communication
3. William C, Himstreet & Wagne Murlin Baty, Business Communication Principles and Methods.
4. M.Mario, Kenneth Stewart and R.Lyn Clark, Business English and Communication
5. L.A.Woolcott & W.R.Macmillan, Communication for Business & Secretarial Students

Course Code: GED 405 **Credit**: 3.0

Course Title: Industrial and Operational Management

Course Brief:

Introduction, evolution, management function, organization and environment. Organization: Theory and structure; Coordination; Span of control; Authority delegation; Groups; Committee and task force; Manpower planning. Personnel Management: Scope; Importance; Need hierarchy; Motivation; Job redesign; Leadership; Participative management; Training; Performance appraisal; Wages and incentives; Informal groups; Organizational change and conflict. Cost and Financial Management: Elements of costs of products depreciation; Break-even analysis; Investment analysis; Benefit cost analysis. Management Accounting: Cost planning and control; Budget and budgetary control; Development planning process. Marketing Management: Concepts; Strategy; Sales promotion; Patent laws. Technology Management: Management of innovation and changes; Technology life cycle; Case

studies.

Prerequisite Course: None Reference Books:

1. Lugmayr, A., Stojmenova, E., Stanoevska, K., & Wellington, R. (2017). Information Systems and Management in Media and Entertainment Industries. Springer.

Course Code: GED 407 **Credit**: 3.0

Course Title: Technology Entrepreneurship

Course Brief:

Entrepreneurial motivation, Entrepreneurial creativity, Entrepreneurial opportunities and the "inevitabilities", Silicon Valley and Entrepreneurship Frameworks, Business models, Platform standards, Intellectual property search techniques, Mobile and Web Programming, Entrepreneurial role and identity, Entrepreneurial journeys, Licensing agreements, Business Model Review.

Prerequisite Course: None Reference Books:

1. Byers, Dorf, & Nelson. (2010). "Technology Ventures: From Ideas to Enterprise." McGraw Hill. ISBN-13: 978-0073380186.
2. Introduction to Technology Entrepreneurship ISBN: 9781308725741

Language Courses

Course Code: EAP 101 **Credit**: 3.0

Course Title: English for Academic Purpose I

Course Brief:

Grammar: Tense: along with SVA; Modal Verbs; Nouns: Countable and Uncountable; Tag Questions; Voice Change; Adjectives and Adverbs; Conditionals; Paired Conjunctions; Relative Clause; Narration; Word Choice. Reading Comprehension: selective texts from The Daily Star (Pages are specified for each course). Speaking: Presentation from the book assigned for British Council Book Reading Competition; Writing: Prewriting Tasks: mind-mapping, brain-storming, topic sentence, 10-sentence Accordion Paragraph, Descriptive Paragraph; Listening: Selective Audio Clips along with respective Questionnaires.

Additional Programme:

1. British Council Book Reading Competition.
2. Book: Five Canterbury Tales- Geoffrey Chaucer

Prerequisite Course: None Reference:

1. Course-pack prepared by the team of faculty members of Green University Language Center.

Course Code: EAP 103 **Credit**: 2.0

Course Title: English for Academic Purpose II

Course Brief:

Grammar (with contextual exercises): Modifier, Parallel Structure, Fragments, Comma Splice & Fused Sentences, Punctuation Marks, Use of Contrasting Words & Connectors Reading Comprehension: There are selective texts from The Daily Star. (Pages are specified for each course); Writing: Compare and Contrast Essay, News Article, Letter to the Editor of a daily Speaking: Presentation from the book assigned for British Council Book Reading Competition.

Listening: Selective Audio and video Clips along with respective Questionnaires.

Additional Program:

1. British Council Book Reading Competition.

2. Book: Twenty Thousand Leagues Under the Sea – Jules Verne

Prerequisite Course: EAP 101 Reference:

1. Course-pack prepared by the team of faculty members of Green University Language Center.

Course Code: GED 201 **Credit: 2.0**

Course Title: Functional Bengali

Course Brief:

প্রথম খন্ড- ভাষাঃ বাংলা ধ্বনি/বাগ ধ্বনি(Phone/Speech Sound), বর্ণ (Letter), অক্ষর (Syllable); বাংলা ধ্বনির উচ্চারণ স্থান ও রীতি (Point of Articulation & Manner of Articulation); বাংলা উচ্চারণ- প্রমিত (Standard), আঞ্চলিক (Dialectal), বৈচিত্র (Variation); অপিনিহিত, অভিশ্রুতি, স্বরসঙ্গতি, শ্বাসাঘাত (Stress accent), স্বরভঙ্গি/স্বরতরঙ্গ (Intonation); বাংলা ও ইংরেজির তুলনা; বাংলা লিখন দক্ষতাঃ সাধু/চলিত রীতি, বিরাম চিহ্ন প্রয়োগ; প্রমিত বাংলা বানানের নিয়ম (বাংলা একাডেমি); ব্যবহারিক বাংলাঃ সংক্ষিপ্ত আলোচনা-একুশে ফেব্রুয়ারি, মুক্তিযুদ্ধ, বাংলাভাষা, বিশ্বায়ন, বাংলার উৎসব, ষড়ঋতু, বাংলা নববর্ষ, আধুনিক তথ্য-প্রযুক্তি, বাংলার লোক সংস্কৃতি, মানবতা ও নৈতিকতা।

দ্বিতীয় খন্ড-সাহিত্যঃ নির্বাচিত কবিতা - আবদুল হাকিম-নূরনামা, মাইকেল মধুসূদন দত্ত-বঙ্গভাষা, লালন সাঁই-খাঁচার ভেতর অচিন পাখি, রবীন্দ্রনাথ ঠাকুর- নির্ঝরের স্বপ্নভঙ্গ, কাজী নজরুল ইসলাম- আজ সৃষ্টি-সুখের উল্লাসে, জীবনানন্দ দাস-রুপসী বাংলা, হাসান হাফিজুর রহমান- অমর একুশে, আলাউদ্দিন আল আজাদ-স্মৃতি স্তম্ভ, শামসুর রাহমান-তোমাকে পাওয়ার জন্য হে স্বাধীনতা,সৈয়দ শামসুল হক-পরিচয়। **নির্বাচিত প্রবন্ধ** - বঙ্কিম চন্দ্র চট্রোপাধ্যায়-বাঙ্গলা ভাষা, রবীন্দ্রনাথ ঠাকুর- সভ্যতার সংকট, হরপ্রসাদ শাস্ত্রী-তৈল, প্রমথ চৌধুরী-যৌবনে দাও রাজটিকা,কাজী নজরুল ইসলাম-বর্তমান বিশ্বসাহিত্য, মুহম্মদ আব্দুল হাই-আমাদের বাংলা উচ্চারন ,কবীর চৌধুরী-আমাদের আত্ম পরিচয়। **ছোটগল্প অন্যান রচনা** - রবীন্দ্রনাথ ঠাকুর- পোস্ট মাস্টার, রোকেয়া সাখাওয়াত হোসেন-অবরোধ বাসিনী, বিভূতিভূষণ বন্দোপাধ্যায়-পুঁইমাচা, সৈয়দ ওয়ালীউল্লাহ-নয়নচারা, জাহানারা ইমাম-একাত্তরের দিনগুলি, হাসান আজিজুল হক-ঘরগেরস্থি, আখতারুজ্জামান ইলিয়াস-অপঘাত। **নির্বাচিত নাটক** - কবর-মুনির চৌধুরী ।

রেফারেন্স বইঃ বাংলা বানান - আহমদ শরীফ ও অন্যান্য : বাংলা ভাষার প্রয়োগ ও অপপ্রয়োগ (বাংলা একাডেমি); উচ্চারণের নিয়ম - নরেন বিশ্বাস : বাংলা উচ্চারণ অভিধান (বাংলা একাডেমি); বিরামচিহ্ন - সুভাষ ভট্টাচার্য : তিষ্ঠ ক্ষণকাল (আনন্দবাজার পত্রিকা লিমিটেড, কলকাতা); ব্যাকরণ ও অন্যান্য - গিয়াস শামীম : বাংলা ব্যাকরণ ও রচনাশৈলী (জুপিটার পাবলিকেশন্স, ঢাকা); ধ্বনিবিজ্ঞান - জীনাত ইমতিয়াজ আলী : ধ্বনিবিজ্ঞানের ভূমিকা (মাওলা ব্রাদার্স, ঢাকা)।

EQUIVALENCE TABLE

Old Course (SPRING 2018)			New Course (SPRING 2020)		
Course Code	**Course Title**	**Cr.**	**Course Code**	**Course Title**	**Cr.**
EAP 101	English for Academic Purpose I	3.0	EAP 101	English for Academic Purpose I	3.0
PHY 101	Physics I	3.0	PHY 101	Physics I	3.0
CSE 101	Discrete Mathematics	3.0	CSE 101	Discrete Mathematics	3.0
MAT 101	Differential and Integral Calculus	3.0	MAT 101	Differential and Integral Calculus	3.0
PHY 103	Physics II	3.0	PHY 103	Physics II	3.0
PHY 104	Physics II Lab	1.5	PHY 104	Physics II Lab	1.5
CSE 103	Structured Programming	3.0	CSE 103	Structured Programming	3.0
CSE 104	Structured Programming Lab	1.5	CSE 104	Structured Programming Lab	1.5
MAT 103	Ordinary and Partial Differential Equations and Coordinate Geometry	3.0	MAT 103	Ordinary and Partial Differential Equations and Coordinate Geometry	3.0
EAP 103	English for Academic Purpose II	2.0	EAP 103	English for Academic Purpose II	2.0
CHE 101	Chemistry	3.0	CHE 101	Chemistry	3.0
CHE 102	Chemistry Lab	1.0	CHE 102	Chemistry Lab	1.0
CSE 105	Data Structures	3.0	CSE 105	Data Structures	3.0
CSE 106	Data Structures Lab	1.5	CSE 106	Data Structures Lab	1.5
MAT 105	Linear Algebra and Vector Analysis	3.0	MAT 105	Linear Algebra and Vector Analysis	3.0
CSE 201	Object Oriented Programming	3.0	CSE 201	Object Oriented Programming	3.0
CSE 202	Object Oriented Programming lab	1.5	CSE 202	Object Oriented Programming lab	1.5
CSE 203	Digital Logic Design	3.0	CSE 203	Digital Logic Design	3.0
CSE 204	Digital Logic Design Lab	1.0	CSE 204	Digital Logic Design Lab	1.0
EEE 201	Introduction to Electrical Engineering	3.0	EEE 201	Introduction to Electrical Engineering	3.0
EEE 202	Introduction to Electrical Engineering Lab	1.0	EEE 202	Introduction to Electrical Engineering Lab	1.0
GED 201	Functional Bengali	2.0	GED 201	Functional Bengali	2.0
CSE 205	Algorithms	3.0	CSE 205	Algorithms	3.0
CSE 206	Algorithms Lab	1.5	CSE 206	Algorithms Lab	1.5
CSE 208	Engineering Drawing	1.5	CSE 208	Engineering Drawing	1.5
EEE 203	Electronic Devices and Circuits & Pulse Techniques	3.0	EEE 203	Electronic Devices and Circuits & Pulse Techniques	3.0
EEE 204	Electronic Devices and Circuits & Pulse Techniques Lab	1.0	EEE 204	Electronic Devices and Circuits & Pulse Techniques Lab	1.0
CSE 209	Database System	3.0	CSE 209	Database System	3.0
CSE 210	Database System Lab	1.5	CSE 210	Database System Lab	1.5
CSE 211	Computer Architecture	3.0	CSE 211	Computer Architecture	3.0
EEE 205	Electrical Drives and Instrumentation	3.0	EEE 205	Electrical Drives and Instrumentation	3.0
MAT 201	Statistics and Complex Variables	3.0	MAT 201	Statistics and Complex Variables	3.0
CSE 301	Web Programming	3.0	CSE 301	Web Programming	3.0
CSE 302	Web Programming Lab	1.5	CSE 302	Web Programming Lab	1.5
CSE 303	Microprocessors & Microcontrollers	3.0	CSE 303	Microprocessors & Microcontrollers	3.0
CSE 304	Microprocessors & Microcontrollers Lab	1.0	CSE 304	Microprocessors & Microcontrollers Lab	1.0

CSE 305	Compiler	3.0	CSE 305	Compiler	3.0
CSE 307	Data Communication	3.0	CSE 307	Data Communication	3.0
CSE 306	Compiler Lab	1.0	CSE 306	Compiler Lab	1.0
CSE 308	Data Communication Lab	1.0	CSE 308	Data Communication Lab	1.0
CSE 309	Operating System	3.0	CSE 309	Operating System	3.0
CSE 310	Operating System Lab	1.5	CSE 310	Operating System Lab	1.5
GED 301	Engineering Economics	3.0	GED 301	Engineering Economics	3.0
GED 303	Sociology	3.0	GED 303	Sociology	3.0
CSE 311	Computer Networking	3.0	CSE 311	Computer Networking	3.0
CSE 312	Computer Networking Lab	1.5	CSE 312	Computer Networking Lab	1.5
CSE 313	Software Engineering	3.0	CSE 313	Software Engineering	3.0
CSE 314	Software Engineering Lab	1.5	_	_	_
GED 305	Bangladesh Studies	2.0	GED 411	Bangladesh Studies	2.0
GED 307	Financial and Managerial Accounting	3.0	GED 401	Financial and Managerial Accounting	3.0
CSE 315	Mathematical Analysis for Computer Science	3.0	CSE 317	Mathematical Analysis for Computer Science	3.0
CSE 317	Digital System Design	3.0	CSE 319	Digital System Design	3.0
CSE 319	Embedded Systems	3.0	CSE 419	Embedded Systems	3.0
_	_	_	CSE 420	Embedded Systems Lab	1.5
CSE 321	Human Computer Interaction	3.0	CSE 321	Human Computer Interaction	3.0
CSE 403	Artificial Intelligence	3.0	CSE 315	Artificial Intelligence	3.0
CSE 404	Artificial Intelligence Lab	1.5	CSE 316	Artificial Intelligence Lab	1.5
_	_	_	CSE 324	Integrated Design Project I	1.5
_	_	_	CSE 406	Integrated Design Project II	1.5
GED 401	Business Communication	3.0	GED 403	Business Communication	3.0
GED 403	Industrial and Operational Management	3.0	GED 405	Industrial and Operational Management	3.0
GED 405	Technology Entrepreneurship	3.0	GED 407	Technology Entrepreneurship	3.0
CSE 401	Mobile Application Development	3.0	CSE 425	Mobile Application Development	3.0
CSE 402	Mobile Application Development Lab	1.5	CSE 426	Mobile Application Development Lab	1.5
CSE 405	Machine Learning	3.0	CSE 411	Machine Learning	3.0
CSE 407	Graph Theory	3.0	CSE 407	Graph Theory	3.0
CSE 409	Algorithm Engineering	3.0	CSE 409	Algorithm Engineering	3.0
CSE 406	Machine Learning Lab	1.5	CSE 412	Machine Learning Lab	1.5
CSE 408	Graph Theory Lab	1.5	CSE 408	Graph Theory Lab	1.5
CSE 410	Algorithm Engineering Lab	1.5	CSE 410	Algorithm Engineering Lab	1.5
CSE 437	Information System and Design	3.0	CSE 403	Information System and Design	3.0
CSE 438	Information System and Design Lab	1.5	_	_	_
CSE 400	Project/Thesis	3.0	CSE 400A	Capstone Project/Thesis	2.0
CSE 400	Project/Thesis	3.0	CSE 400B	Capstone Project/Thesis	2.0
_	_	_	CSE 400C	Capstone Project/Thesis	2.0
_	_	_	CSE 413	Natural Language Processing	3.0
_	_	_	CSE 414	Natural Language Processing Lab	1.5
CSE427	Wireless Networks	3.0	CSE 417	Wireless Networks	3.0

CSE428	Wireless Networks Lab	1.5	CSE 418	Wireless Networks Lab	1.5
_	_	_	CSE 427	Software Design Pattern	3.0
_	_	_	CSE 428	Software Design Pattern Lab	1.5
CSE 411	Computer and Cyber Security	3.0	CSE 323	Computer and Cyber Security	3.0
GED 407	Professional Ethics and Environmental Protection	2.0	GED 409	Professional Ethics and Environmental Protection	2.0
CSE423	Data Mining	3.0	CSE 435	Data Mining	3.0
CSE429	Cloud Computing	3.0	CSE 445	Cloud Computing	3.0
CSE431	Bioinformatics	3.0	CSE 429	Bioinformatics	3.0
CSE433	Software Testing and Quality Assurance	3.0	CSE 453	Software Testing and Quality Assurance	3.0
CSE424	Data Mining Lab	1.5	CSE 436	Data Mining Lab	1.5
CSE430	Cloud Computing Lab	1.5	CSE 446	Cloud Computing Lab	1.5
CSE432	Bioinformatics Lab	1.5	CSE 430	Bioinformatics Lab	1.5
CSE434	Software Testing and Quality Assurance Lab	1.5	CSE 454	Software Testing and Quality Assurance Lab	1.5
_	_	_	CSE 423	Peripherals and Interfacing	3.0
_	_	_	CSE 424	Peripherals and Interfacing Lab	1.5
			CSE 451	Blockchain	3.0
			CSE 452	Blockchain Lab	1.0
_	_	_	CSE 431	Computational Geometry	3.0
_	_	_	CSE 432	Computational Geometry Lab	1.5
_	_	_	CSE 437	Information Retrieval	3.0
_	_	_	CSE 438	Information Retrieval Lab	1.5
_	_	_	CSE 443	Internet of Things	3.0
_	_	_	CSE 444	Internet of Things Lab	1.5
_	_	_	CSE 455	Software Maintenance and Management	3.0
_	_	_	CSE 456	Software Maintenance and Management Lab	1.5
_	_	_	CSE 458	Industrial Training	3.0
CSE 419	Digital Image Processing	3.0	CSE 415	Digital Image Processing	3.0
CSE 420	Digital Image Processing Lab	1.5	CSE 416	Digital Image Processing Lab	1.5
CSE415	VLSI Design	3.0	CSE 421	VLSI Design	3.0
CSE 416	VLSI Design Lab	1.0	CSE 422	VLSI Design Lab	1.5
CSE 435	Computer Graphics	3.0	CSE 433	Computer Graphics	3.0
CSE 436	Computer Graphics Lab	1.0	CSE 434	Computer Graphics Lab	1.0
CSE 421	Pattern Recognition	3.0	CSE 439	Pattern Recognition	3.0
CSE 422	Pattern Recognition Lab	1.0	CSE 440	Pattern Recognition Lab	1.0
CSE 425	Big Data Analytics	3.0	CSE 441	Big Data Analytics	3.0
CSE 426	Big Data Analytics Lab	1.0	CSE 442	Big Data Analytics Lab	1.0
CSE 413	Simulation and Modeling	3.0	CSE 447	Simulation and Modeling	3.0
CSE 414	Simulation and Modeling Lab	1.0	CSE 448	Simulation and Modeling Lab	1.0
CSE 417	Robotics	3.0	CSE 449	Robotics	3.0
CSE 418	Robotics Lab	1.0	CSE 450	Robotics Lab	1.0
Total Credit Requirement		**144.0**	**Total Credit Requirement**		**144.0**

Note:

- Red Mark – Courses offered in Syllabus of Spring 2018 but dropped from Proposed Syllabus of Spring 2020.
- Green Mark – Courses weren't offered in Syllabus of Spring 2018 but added to Proposed Syllabus of Spring 2020.
- Blue Mark – Courses that have their Course Code changed in Proposed Syllabus of Spring 2020.