



Green University of Bangladesh

Department of Computer Science & Engineering

Syllabus of

B.Sc. in Computer Science and Engineering

(To be enacted from Spring 2018, 24th Academic Council Meeting, 15 November, 2017)

A handwritten signature in black ink, appearing to read "Anirul Rahaman".

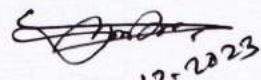
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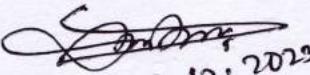
Chairperson, Dept. of CSE
Green University of Bangladesh

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Green University of Bangladesh

Department of Computer Science & Engineering

Syllabus of

B.Sc. in Computer Science and Engineering

(To be enacted from Spring 2018)

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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. We have designed syllabus for our Bachelor of Science in Computer Science and Engineering (B. Sc. in CSE) degree 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 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 ACM held on July 2012. This amendment brought some major changes in the areas of mark distribution system, basic science courses & 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 31st January 2017 approved the syllabus of B.Sc. in CSE with revised marks distribution.

This is 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 Nov 2017. This

syllabus 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.

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. 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 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 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, prerequisite 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 term(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 advisor. 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 Advisor.

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.

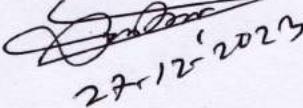
Degree Requirement

- 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	Credits	Percentage
Social Science (any 2) Engineering Economics (3) Sociology (3) Financial and Managerial Accounting (3)	6	
Business (any 1) Business Communication (3) Industrial and Operational Management (3) Technology Entrepreneurship (3)	3	13.89%
Mandatory Bangladesh Studies (2) Professional Ethics and Environmental Protection (2)	4	
Language English I (3) English II (2) Functional Bengali (2)	7	
Basic Science Physics I (3) Physics II (3) Physics Lab (1.5) Chemistry (3) Chemistry Lab (1)	11.5	7.99%
Mathematics Mathematics	12	8.33%
Other Engineering Introduction to Electrical Engineering (3) Introduction to Electrical Engineering Lab (1) Electronic Devices and Circuits & Pulse Techniques (3) Electronic Devices and Circuits & Pulse Techniques Lab (1) Electrical Drives and Instrumentation (3) Engineering Drawing (1.5)	12.5	8.68%
Core Subjects		


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Structured Programming (3) Structured Programming Lab (1.5) Object Oriented Programming (3) Object Oriented Programming lab (1.5) Web Programming (3) Web Programming Lab (1.5) Mobile Application Development (3) Mobile Application Development Lab(1.5)	18	
Computer Architecture (3) Digital Logic Design (3) Digital Logic Design Lab (1) Microprocessors & Microcontrollers (3) Microprocessors & Microcontrollers Lab (1)	11	
Discrete Mathematics (3) Data Structures (3) Data Structures Lab (1.5) Algorithms (3) Algorithms Lab (1.5)	12	50.35%
Database (3) Database Lab (1.5) Operating System (3) Operating System Lab (1.5) Computer Networking (3) Computer Networking Lab (1.5) Computer and Cyber Security (3)	16.5	
Software Engineering (3) Software Engineering Lab (1.5) Information System and Design (3) Information System and Design Lab (1.5)	9	
Project/Thesis	6	

<p>Elective</p> <p>4 Theory Courses</p> <p>Option I (Any 1 with corresponding Lab)</p> <p>Compiler (3) Data Communication (3)</p> <p>Option II (Any 1)</p> <p>Mathematical Analysis for Computer Science (3) Digital System Design (3) Embedded Systems (3) Human Computer Interaction (3)</p> <p>Option III (Any 1 with corresponding Lab)</p> <p>Artificial Intelligence (3) Machine Learning (3) Graph Theory (3) Algorithm Engineering (3)</p> <p>Option IV (Any 1 with corresponding Lab)</p> <p>Simulation and Modeling (3) VLSI Design (3) Robotics (3) Digital Image Processing (3) Pattern Recognition (3) Data Mining (3) Big Data Analysis (3) Wireless Networks (3) Cloud Computing (3) Bioinformatics (3) Software Testing and Quality Assurance (3) Computer Graphics (3)</p>	15.5	10.76%
<p>3 Laboratory Courses</p> <p>Option I (1 Lab)</p> <p>Compiler Lab (1) Data Communication Lab (1)</p> <p>Option III (1 Lab)</p> <p>Artificial Intelligence Lab (1.5) Machine Learning Lab (1.5) Graph Theory Lab (1.5) Algorithm Engineering Lab (1.5)</p> <p>Option IV (1 Lab)</p> <p>Simulation and Modeling Lab (1) VLSI Design Lab (1)</p>		

Robotics Lab (1)		
Digital Image Processing Lab (1)		
Pattern Recognition Lab (1)		
Data Mining Lab (1)		
Big Data Analysis Lab (1)		
Wireless Networks Lab (1)		
Cloud Computing Lab (1)		
Bioinformatics Lab (1)		
Software Testing and Quality Assurance Lab (1)		
Total	144	

Semester-wise Course Distribution

Tri-semester Course Distribution

For Fresher

Level-1, Term-1

Course Code	Course Title	Credit	Prerequisite
EAP 101	English for Academic Purpose I	3	
PHY 101	Physics I	3	
CSE 101	Discrete Mathematics	3	
MAT 101	Differential and Integral Calculus	3	
		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	
PHY 104	Physics II Lab	1.5	
CSE 103	Structured Programming	3	
CSE 104	Structured Programming Lab	1.5	
MAT 103	Ordinary and Partial Differential Equations and Coordinate Geometry	3	MAT 101
		12.0	

Level-1, Term-3

Course Code	Course Title	Credit	Prerequisite
EAP 103	English for Academic Purpose II	2	
CHE 101	Chemistry	3	
CHE 102	Chemistry Lab	1	
CSE 105	Data Structures	3	CSE 103
CSE 106	Data Structures Lab	1.5	
MAT 105	Linear Algebra and Vector Analysis	3	MAT 101
		13.5	

Sophomore

Level-2, Term-1

Course Code	Course Title	Credit	Prerequisite
CSE 201	Object Oriented Programming	3	CSE 103
CSE 202	Object Oriented Programming lab	1.5	
CSE 203	Digital Logic Design	3	
CSE 204	Digital Logic Design Lab	1	
EEE 201	Introduction to Electrical Engineering	3	
EEE 202	Introduction to Electrical Engineering Lab	1	
		12.5	

Level-2, Term-2

Course Code	Course Title	Credit	Prerequisite
GED 201	Functional Bengali	2	
CSE 205	Algorithms	3	CSE 105
CSE 206	Algorithms Lab	1.5	
CSE 208	Engineering Drawing	1.5	
EEE 203	Electronic Devices and Circuits & Pulse Techniques	3	EEE 201
EEE 204	Electronic Devices and Circuits & Pulse Techniques Lab	1	
		12.0	

Level-2, Term-3

Course Code	Course Title	Credit	Prerequisite
CSE 209	Database System	3	CSE 105
CSE 210	Database System Lab	1.5	
CSE 211	Computer Architecture	3	CSE 203
EEE 205	Electrical Drives and Instrumentation	3	EEE 203
MAT 201	Statistics and Complex Variables	3	
		13.5	

Junior

Level-3, Term-1

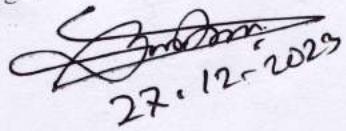
Course Code	Course Title	Credit	Prerequisite
CSE 301	Web Programming	3	CSE 209
CSE 302	Web Programming Lab	1.5	
CSE 303	Microprocessors & Microcontrollers	3	CSE 203
CSE 304	Microprocessors & Microcontrollers Lab	1	
	Optional I (Any one course with corresponding lab)	3	
CSE 305	Compiler		
CSE 307	Data Communication		
	Optional I Lab	1	
CSE 306	Compiler Lab		
CSE 308	Data Communication Lab		
		12.5	

Level-3, Term-2

Course Code	Course Title	Credit	Prerequisite
CSE 309	Operating System	3	
CSE 310	Operating System Lab	1.5	
	Social Science I (Any one of the following two courses)	3	
GED 301	Engineering Economics		
GED 303	Sociology		
CSE 311	Computer Networking	3	
CSE 312	Computer Networking Lab	1.5	
		12.0	

Level-3, Term-3

Course Code	Course Title	Credit	Prerequisite
CSE 313	Software Engineering	3	
CSE 314	Software Engineering Lab	1.5	
GED 305	Bangladesh Studies	2	
	Social Science II	3	
GED 307	Financial and Managerial Accounting		
	Optional II (Any one of the following four courses)	3	
CSE 315	Mathematical Analysis for Computer Science		
CSE 317	Digital System Design		
CSE 319	Embedded Systems		
CSE 321	Human Computer Interaction		
		12.5	


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Senior

Level-4, Term-1

Course Code	Course Title	Credit	Prerequisite
	Business (Any one of the following three courses)	3	
GED 401	Business Communication		
GED 403	Industrial and Operational Management		
GED 405	Technology Entrepreneurship		
CSE 401	Mobile Application Development	3	CSE 201
CSE 402	Mobile Application Development Lab	1.5	
	<i>Optional IIIa</i> (Any one course with corresponding lab)	3	
CSE 403	Artificial Intelligence		
CSE 405	Machine Learning		
CSE 407	Graph Theory		
CSE 409	Algorithm Engineering		
	<i>Optional IIIb</i>	1.5	
CSE 404	Artificial Intelligence Lab		
CSE 406	Machine Learning Lab		
CSE 408	Graph Theory Lab		
CSE 410	Algorithm Engineering Lab		
		12.0	

Level-4, Term-2

Course Code	Course Title	Credit	Prerequisite
CSE 411	Computer and Cyber Security	3	
GED 407	Professional Ethics and Environmental Protection	2	
CSE 400	Project/Thesis	3	
	<i>Optional IVa</i> (Any one with corresponding lab)	3	
CSE413	Simulation and Modelling		
CSE415	VLSI Design		
CSE417	Robotics		
CSE419	Digital Image Processing		
CSE421	Pattern Recognition		
CSE423	Data Mining		
CSE425	Big Data Analytics		
CSE427	Wireless Networks		
CSE429	Cloud Computing		
CSE431	Bioinformatics		
CSE433	Software Testing and Quality Assurance		
CSE 435	Computer Graphics		
	<i>Optional IV b</i> (Lab)	1	
CSE414	Simulation and Modelling Lab		
CSE416	VLSI Design Lab		

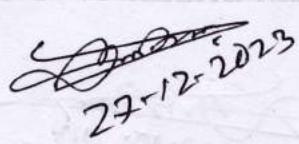
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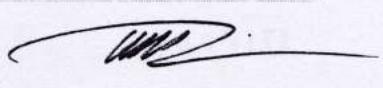
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CSE418	Robotics Lab		
CSE420	Digital Image Processing Lab		
CSE422	Pattern Recognition Lab		
CSE424	Data Mining Lab		
CSE426	Big Data Analytics Lab		
CSE428	Wireless Networks Lab		
CSE430	Cloud Computing Lab		
CSE432	Bioinformatics Lab		
CSE434	Software Testing and Quality Assurance Lab		
CSE436	Computer Graphics Lab		
		12.0	

Level-4, Term-3

Course Code	Course Title	Credit	Prerequisite
CSE 437	Information System and Design	3	CSE 313
CSE 438	Information System and Design Lab	1.5	
CSE 400	Project/Thesis	3	
		7.5	


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Detail Syllabus

Programming Courses

Course Code: CSE 103

Credit: 3

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

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

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

Course Code: CSE 401

Credit: 3

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.

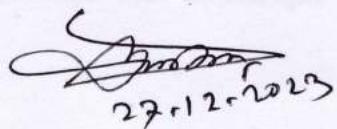
Course Code: CSE 402

Credit: 1.5

Course Title: Mobile Application Development Lab

Course Brief: Contents related to the coursework CSE-4101 (Mobile Application Development).

Prerequisite Course: None



27.12.2023

Logic and Algorithm Courses

Course Code: CSE 101

Credit: 3

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

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

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.

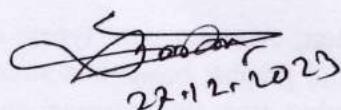
Course Code: CSE 206

Credit: 1.5

Course Title: Algorithms Lab

Course Brief: Laboratory works based on CSE 205

Prerequisite Course: None



27.12.2023

Hardware System Courses

Course Code: CSE 203

Credit: 3

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

Course Title: Digital Logic Design Lab

Course Brief: Laboratory works based on CSE 203

Prerequisite Course: None

Course Code: CSE 211

Credit: 3

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 - hardwired 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.
3. Hamacher, V. C., Vranesic, Z. G., Zaky, S. G., Vrancic, Z., & Zakay, S. (1984). Computer organization (Vol. 3). New York et al.: McGraw-Hill. 5th Edition.

Course Code: CSE 303

Credit: 3

Course Title: Microprocessors & Microcontrollers

Course Brief: Microprocessor: microcontroller & microcomputer, evaluation of microprocessor & application, introduction 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.
3. Yu, Y. Y., & Marut, C. (1992). Assembly Language Programming and Organization IBM PC. McGraw-Hill Higher Education. 1st Edition.
4. Irvine, K. R. (1990). Assembly Language for the IBM-PC. Prentice Hall PTR. International Edition.

Course Code: CSE 304

Credit: 1

Course Title: Microprocessors and Microcontrollers Lab

Course Brief: Laboratory works based on CSE 303

Prerequisite Course: None


27.12.2023

System Courses

Course Code: CSE 209

Credit: 3

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.
3. Garcia-Molina, H. (2008). Database systems: the complete book. Pearson Education India. 2nd 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

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
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.
3. Tanenbaum, A. S., & Wetherall, D. J. (2011). Computer networks. Pearson. 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

Course Code: CSE 411 **Credit:** 3
Course Title: Computer and Cyber Security

Course Brief:

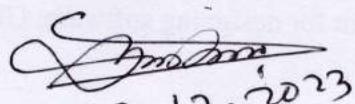
The security environment: threats, vulnerabilities, and consequences, advanced persistent threats, the state of security today; concepts of information security: security principles, access control mechanisms, authentication schemes; operating system security: classic security models, common vulnerabilities, 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.



27.12.2023

Software Systems and Engineering Courses

Course Code: CSE 313

Credit: 3

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 314

Credit: 1.5

Course Title: Software Engineering Lab

Course Brief: Laboratory works based on CSE 313

Prerequisite Course: None

Course Code: CSE 437

Credit: 3

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. (2010). Systems analysis and design. Prentice Hall Press. 9th Edition.
2. Valacich, J. S., & George, J. (2016). Modern systems analysis and design. Pearson. 7th Edition.

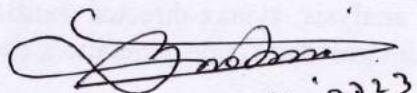
Course Code: CSE 438

Credit: 1.5

Course Title: Information System and Design Lab

Course Brief: Sessional works based on CSE 437

Prerequisite Course: None



27.12.2023

Technical Elective Courses

Course Code: CSE 305

Credit: 3

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

Course Title: Compiler Lab

Course Brief: Laboratory works based on CSE 305

Prerequisite Course: None

Course Code: CSE 307

Credit: 3

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. McGraw - Hill. 5th Edition.
2. Tanenbaum, A. S., & Wetherall, D. J. (2011). Computer networks. Pearson. 5th Edition.

Course Code: CSE 308

Credit: 1

Course Title: Data Communication Lab

Course Brief: Laboratory works based on CSE 307

Prerequisite Course: None

Course Code: CSE 315

Credit: 3

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 317

Credit: 3

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:

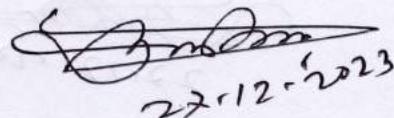
1. Charles H. R., Jr. & Lizy K. J., Digital Systems Design Using VHDL, Thomson , 2nd Edition.
2. Peter J. A., The Student's Guide to VHDL, Morgan Kaufmann, 2nd Edition.

Course Code: CSE 319

Credit: 3

Course Title: Embedded System

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.



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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 321

Credit: 3

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., Banerji D., Holland S. and Carey T. Human Computer Interaction*, Addison-Wesley, 1994. 1st Edition.

Course Code: CSE 403

Credit: 3

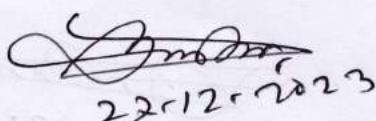
Course Title: Artificial Intelligence

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: None

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.


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Course Code: CSE 404 **Credit:** 1.5
Course Title: Artificial Intelligence Lab
Course Brief: Laboratory works based on CSE 403
Prerequisite Course: None

Course Code: CSE 405 **Credit:** 3
Course 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 406 **Credit:** 1.5
Course Title: Machine Learning Lab
Course Brief: Laboratory works based on CSE 405
Prerequisite Course: None

Course Code: CSE 407 **Credit:** 3
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
Course Algorithm Engineering
Course Brief: Computational complexity; 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 413 **Credit:** 3
Course Title: Simulation and Modelling
Course Brief: Simulation modelling 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 modelling; generating random numbers and random variants; output analysis; simulation languages; analysis and modelling 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 414 **Credit:** 1
Course Title: Simulation and Modelling Lab
Course Brief: Laboratory works based on CSE 413
Prerequisite Course: None

Course Code: CSE 415 **Credit:** 3
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, Addison-Wesley, 2nd Edition
2. **Digital Integrated Circuits: A Design Perspective**
By J. Rabaey, A. Chandrakasan and B. Nikolic, 2nd Edition

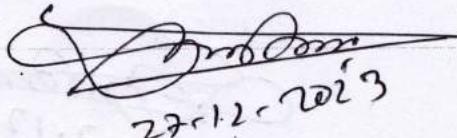
Course Code: CSE 416 **Credit:** 1
Course Title: VLSI Design Lab
Course Brief: Laboratory works based on CSE 415
Prerequisite Course: None

Course Code: CSE 417 **Credit:** 3
Course Title: Robotics
Course Brief:
Very fast review of 3D kinematics: representation of kinematic chains, Denavit-Hartenberg frame assignment convention; forward and inverse kinematics: Jacobians, 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



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Course Code: CSE 418 **Credit:** 1
Course Title: Robotics Lab
Course Brief: Laboratory works based on CSE 417
Prerequisite Course: None

Course Code: CSE 419 **Credit:** 3
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, Multiresolution 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 420 **Credit:** 1
Course Title: Digital Image Processing Lab
Course Brief: Laboratory works based on CSE 419
Prerequisite Course: None

Course Code: CSE 421 **Credit:** 3
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, perceptron 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:

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

Course Code: CSE 422

Credit: 1

Course Title: Pattern Recognition Lab

Course Brief: Laboratory works based on CSE 421

Prerequisite Course: None

Course Code: CSE 423

Credit: 3

Course Title: Data Mining

Course Brief: Introduction, classification, clustering, association rules, Data mining tools and applications, Data visualization; Mining frequent patterns: Definitions and background, Market basket analysis, Methods for mining frequent patterns, priory & FP-growth algorithm, Mining frequent item sets using vertical data format; Mining closed and maximal frequent item sets; Mining frequent patterns in data streams; Mining association rules and correlation: Mining association rules, generating association rules from frequent item sets, Mining correlations from association rules, Significance of correlation mining in presence of association rules, Pattern evaluation methods; correlation measures: lift, chi-square, all_conf, max_conf, cosine and Kulc; performance and applicability analysis; Mining sequential patterns: Concepts and primitives, applications, domains; mining methods in transactional databases-GSP, SPADE, Prefix Span; closed and maximal sequential patterns; Mining sequential patterns in biological, web access and time series databases.

Prerequisite Course: CSE 207

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

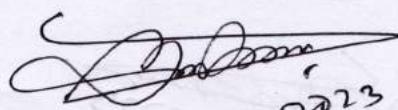
Course Code: CSE 424

Credit: 1

Course Title: Data Mining Lab

Course Brief: Laboratory works based on CSE 423

Prerequisite Course: None



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Course Code: CSE 425

Credit: 3

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 426

Credit: 1

Course Title: Big Data Analytics Lab

Course Brief: Laboratory works based on CSE 425

Prerequisite Course: None

Course Code: CSE 427

Credit: 3

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

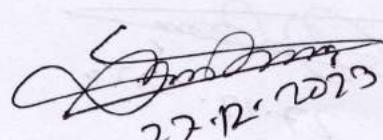
Reference Book:

1. **Wireless Networks**

By P. Nicopolidis, M.S. Obaidat, G.I. Papadimitriou, A.S. Pomportsis

2. **802.11 Wireless Networks: The Definitive Guide**

By Matthew S. Gast


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Course Code: CSE 428
Course Title: Wireless Networks Lab
Course Brief: Laboratory works based on CSE 427
Prerequisite Course: None

Credit: 1

Course Code: CSE 429
Course Title: Cloud Computing

Credit: 3

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 207, 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 430
Course Title: Cloud Computing Lab
Course Brief: Laboratory works based on CSE 429
Prerequisite Course: None

Credit: 1

Course Code: CSE 431
Course Title: Bioinformatics
Course Brief:

Credit: 3

This course introduces fundamental concepts and methods for structural bioinformatics and the advanced applications. Topics covered include sequence, structure and function databases of DNA and protein molecules, advanced sequence and structure alignment methods, methods of protein folding and protein structure prediction (homologous modelling, threading and ab initio folding), basics of molecular dynamics and Monte Carlo simulation, principle and application of machine learning, and techniques of protein structure determination (X-ray crystallography, NMR and cryo-EM). Emphasis is on the understanding of the concepts taught and the practical utilization, with the objective to help students to use the cutting-edge bioinformatics tools/methods to solve problems in their own research. For this term, four world's top experts are invited to give lectures on mass spectrometry and proteomics (Prof. Philip Andrews), NMR spectroscopy (Prof. Tomek Cierpicki), Cryo-electron microscopy (Prof. Melanie Ohi), and X-ray crystallography (Prof. Mark Saper).

Prerequisite Course: None

Recommended Books:

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 432

Credit: 1

Course Title: Bioinformatics Lab

Course Brief: Laboratory works based on CSE 431

Prerequisite Course: None

Course Code: CSE 433

Credit: 3

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 434

Credit: 1

Course Title: Software Testing and Quality Assurance Lab

Course Brief: Laboratory works based on CSE 433

Prerequisite Course: None

Course Code: CSE 435

Credit: 3

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.

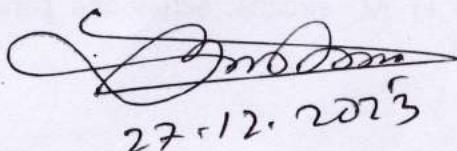
Course Code: CSE 436

Credit: 1

Course Title: Computer Graphics Lab

Course Brief: Laboratory works based on CSE 435

Prerequisite Course: None



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Other Engineering Courses

Course Code: EEE 201

Credit: 3

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

Course Title: Introduction to Electrical Engineering Lab

Course Brief: Laboratory works based on EEE 201

Prerequisite Course: None

Course Code: EEE 203

Credit: 3

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

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

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

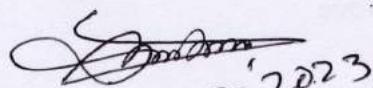
Course Brief: Introduction of Engineering Drawings, Being familiar with the drawing instruments and their uses, drawing instruments including components and parts, drawing of geometrical figures. Orthographic drawing, Isometric and oblique projections, First and Third

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



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Physics Courses

Course Code: PHY 101

Credit: 3

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 Fraunhofer 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

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 metal, 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:

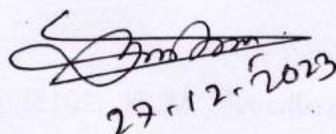
1. Ahmed, G., Physics for Engineering (part-2). Revised and enlarged edition.
2. Kittel, C. (2005). Introduction to solid state physics. Wiley.
3. Walker, J., Halliday, D., & Resnick, R. (2008). Fundamentals of physics. Hoboken, NJ: Wiley.
4. Beiser, A. Concept of Modern Physics, 1999.

Course Code: PHY 104

Credit: 1.5

Course Title: Physics Lab

Course Brief: Laboratory works based on PHY 101 & PHY 103



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Chemistry Course

Course Code: CHE 101

Credit: 3

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.

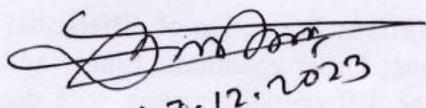
Course Code: CHE 102

Credit: 1

Course Title: Chemistry Lab

Course Brief: Laboratory works based on CHE 101

Prerequisite Course: None


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Mathematics Courses

Course Code: MAT 101

Credit: 3

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

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 2nd 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. 10th Edition.
4. S. L. Loney. The Elements of Coordinate Geometry. 2nd Edition.

Course Code: MAT 105

Credit: 3

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

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

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.

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

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 307

Credit: 3

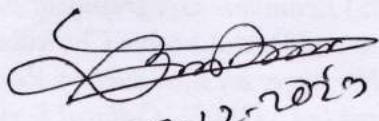
Course Title: Financial & Managerial Accounting

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>



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Arts and Humanities Courses

Course Code: GED 305

Credit: 2

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*.
3. Ahmed, A F Salahuddin and Bazlul Mobin Chowdhury (ed.), (2004), *Bangladesh National Culture and Heritage: an Introductory Reader.I*
4. Rahman, Sufi Mostafizur (ed.) (2007), *Cultural Survey of Bangladesh: Archaeological Heritage (Volume 1)*
5. Islam, Sirajul, (ed.) *Banglapedia: National Encyclopedia of Bangladesh*.
6. Khan, Md. Shamsul Kabir and Khanam, Dr. Daulatunnaher (2011), *Bangladesh Studies*
7. Schendel, Willem Van (1997), *A History of Bangladesh*
8. Ahmed, Rafiq (2005), *The Language Movement*
9. Rahman, Sheikh M (2013), *The Autobiography of Sheikh Mujibur Rahman*
10. Das, Sumon and Mohabbat, (2011), *Bangladesh Studies and Culture*

Course Code: GED 407

Credit: 2

Course Title: Professional Ethics and Environmental Protection

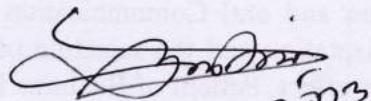
Course Brief: Definition and scopes of Ethics. Different branches of Ethics. Social change and the emergence of new technologies. History and development of Engineering Ethics. Science and Technology- necessity and application. Study of Ethics in Engineering. Applied Ethics in engineering. Human qualities 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



27.12.2023

Business Courses

Course Code: GED 401

Credit: 3

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 403

Credit: 3

Course Title: Industrial and Operational Management

Course Brief:

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 405

Credit: 3

Course Title: Technology Entrepreneurship

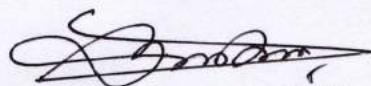
Course Brief:

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


27-12-2023

Language Courses

Course Code: EAP 101

Credit: 3

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

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

Course Title: Functional Bengali

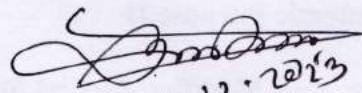
Course Brief:

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), আংশিক

(Dialectal), বৈচিত্র (Variation); অপিনিহিত, অভিশ্রতি, স্বরসঙ্গতি, শ্বাসাঘাত (Stress accent), স্বরভঙ্গ/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 ফেক্রয়ারি, মুক্তিযুদ্ধ, বাংলাভাষা, বিশ্বায়ন, বাংলার উৎসব, ষড়খতু, বাংলা নববর্ষ, আধুনিক তথ্য-প্রযুক্তি, বাংলার লোক সংস্কৃতি, মানবতা ও নৈতিকতা।

দ্বিতীয় খণ্ড-সাহিত্যঃ নির্বাচিত কবিতা - আবদুল হাকিম-নূরনামা, মাইকেল মধুসূদন দত্ত-বঙ্গভাষা, লালন সাঁই-খাঁচার ভেতর অচিন পাখি, রবীন্দ্রনাথ ঠাকুর- নির্বরের স্বপ্নভঙ্গ, কাজী নজরুল ইসলাম- আজ সৃষ্টি-সুখের উল্লাসে, জীবনানন্দ দাস-রূপসী বাংলা, হাসান হাফিজুর রহমান- অমর একুশে, আলাউদ্দিন আল আজাদ-সৃতি স্তম্ভ, শামসুর রাহমান-তোমাকে পাওয়ার জন্য হে স্বাধীনতা, সৈয়দ শামসুল হক- পরিচয়। নির্বাচিত প্রবন্ধ - বক্ষিম চন্দ্র চট্টোপাধ্যায়-বাঙলা ভাষা, রবীন্দ্রনাথ ঠাকুর- সভ্যতার সংকট, হরপ্রসাদ শাস্ত্রী-তৈল, প্রমথ চৌধুরী- যৌবনে দাও রাজটিকা, কাজী নজরুল ইসলাম-বর্তমান বিশ্বসাহিত্য, মুহম্মদ আব্দুল হাই-আমাদের বাংলা উচ্চারণ, কবীর চৌধুরী-আমাদের আত্ম পরিচয়। ছোটগল্প অন্যান্য রচনা - রবীন্দ্রনাথ ঠাকুর- পোস্ট মাস্টার, বোকেয়া সাখাওয়াত হোসেন-অবরোধ বাসিনী, বিভূতিভূষণ বন্দোপাধ্যায়-পুইমাচা, 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 রচনাশিল্পী (জুপিটার পাবলিকেশন্স, ঢাকা); ধ্বনিবিজ্ঞান - জীনাত ইমতিয়াজ আলী : ধ্বনিবিজ্ঞানের ভূমিকা (মাওলা ব্রাদার্স, ঢাকা)।



27.12.2013

B.Sc. in CSE Syllabus (Spring 2018), Department of CSE, GUB

Bi-semester Course Distribution

Fresher

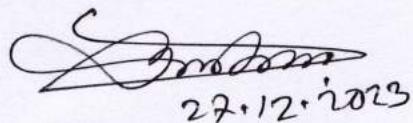
Level-1, Term-1

Course Code	Course Title	Credit	Prerequisite
EAP 101	English I	3	
PHY 101	Physics I	3	
CHE 101	Chemistry	3	
CHE 102	Chemistry Lab	1	
MAT 101	Differential and Integral Calculus	3	
CSE 101	Discrete Mathematics	3	
CSE 208	Engineering Drawing	1.5	
		17.5	

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
EAP 103	English II	2	
PHY 103	Physics II	3	
PHY 104	Physics II Lab	1.5	
MAT 103	Ordinary and Partial Differential Equations and Coordinate Geometry	3	MAT 101
EEE 201	Introduction to Electrical Engineering	3	
EEE 202	Introduction to Electrical Engineering Lab	1	
CSE 103	Structured Programming	3	
CSE 104	Structured Programming Lab	1.5	
		18.0	



27.12.2023

Sophomore

Level-2, Term-1

Course Code	Course Title	Credit	Prerequisite
MAT 105	Linear Algebra and Vector Analysis	3	MAT 101
GED 201	Functional Bengali	2	
CSE 105	Data Structures	3	CSE 103
CSE 106	Data Structures Lab	1.5	
CSE 201	Object Oriented Programming	3	CSE 103
CSE 202	Object Oriented Programming lab	1.5	
CSE 203	Digital Logic Design	3	
CSE 204	Digital Logic Design Lab	1	
		18.0	

Level-2, Term-2

Course Code	Course Title	Credit	Prerequisite
CSE 209	Database	3	CSE 105
CSE 210	Database Lab	1.5	
EEE 203	Electronic Devices and Circuits & Pulse Techniques	3	EEE 201
EEE 204	Electronic Devices and Circuits & Pulse Techniques Lab	1	
MAT 201	Statistics and Complex Variables	3	
CSE 205	Algorithms	3	CSE 105
CSE 206	Algorithms Lab	1.5	
GED 305	Bangladesh Studies	2	
		18.0	

S. Md. Sarker
27.12.2023

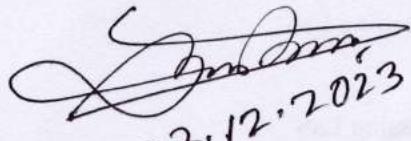
Junior

Level-3, Term-1

Course Code	Course Title	Credit	Prerequisite
	Optional I (any one course with corresponding lab)	3	
CSE 305	Compiler		
CSE 307	Data Communication		
	Optional I Lab	1	
CSE 306	Compiler Lab		
CSE 308	Data Communication Lab		
EEE 205	Electrical Drives and Instrumentation	3	EEE 203
CSE 309	Operating System	3	
CSE 310	Operating System Lab	1.5	
CSE 301	Web Programming	3	CSE 209
CSE 302	Web Programming Lab	1.5	
SE 211	Computer Architecture	3	CSE 203
		19.0	

Level-3, Term-2

Course Code	Course Title	Credit	Prerequisite
CSE 303	Microprocessors & Microcontrollers	3	CSE 203
CSE 304	Microprocessors & Microcontrollers Lab	1	
CSE 311	Computer Networking	3	
CSE 312	Computer Networking Lab	1.5	
CSE 313	Software Engineering	3	
CSE 314	Software Engineering Lab	1.5	
	Social Science I (any one course)	3	
GED 301	Engineering Economics		
GED 303	Sociology		
	Optional II (One Course)	3	
CSE 315	Mathematical Analysis for Computer Science		
CSE 317	Digital System Design		
CSE 319	Embedded Systems		
CSE 321	Human Computer Interaction		
		19.0	



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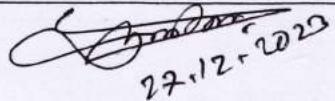
Senior

Level-4, Term-1

Course Code	Course Title	Credit	Prerequisite
GED 307	Social Science II Financial and Managerial Accounting	3	
CSE 401	Mobile Application Development	3	CSE 201
CSE 402	Mobile Application Development Lab	1.5	
CSE 411	Computer and Cyber Security	3	
CSE 400	Project/Thesis	3	
CSE 403	<i>Optional IIIa</i> (any 1 with corresponding lab) Artificial Intelligence	3	
CSE 405	Machine Learning		
CSE 407	Graph Theory		
CSE 409	Algorithm Engineering		
CSE 404	<i>Optional IIIb</i> Artificial Intelligence Lab	1.5	
CSE 406	Machine Learning Lab		
CSE 408	Graph Theory Lab		
CSE 410	Algorithm Engineering Lab		
		18.0	

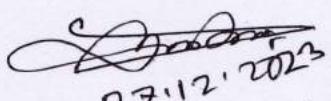
Level-4, Term-2

Course Code	Course Title	Credit	Prerequisite
CSE 413	<i>Optional IVa</i> (any 1 with corresponding lab) Simulation and Modelling	3	
CSE 415	VLSI Design		
CSE 417	Robotics		
CSE 419	Digital Image Processing		
CSE 421	Pattern Recognition		
CSE 423	Data Mining		
CSE 425	Big Data Analysis		
CSE 427	Wireless Networks		
CSE 429	Cloud Computing		
CSE 431	Bioinformatics		
SE 433	Software Testing and Quality Assurance		
CSE 435	Computer Graphics		
CSE 414	<i>Optional IVb</i> Simulation and Modelling Lab	1	
CSE 416	VLSI Design Lab		
CSE 418	Robotics Lab		
CSE 420	Digital Image Processing Lab		
CSE 422	Pattern Recognition Lab		
CSE 424	Data Mining Lab		
CSE 426	Big Data Analysis Lab		
CSE 428	Wireless Networks Lab		
CSE 430	Cloud Computing Lab		
CSE 432	Bioinformatics Lab		
CSE 434	Software Testing and Quality Assurance Lab		
CSE 436	Computer Graphics Lab		
CSE 400	Project/Thesis	3	



27.12.2022

GED 407	Professional Ethics and Environmental Protection	2	
GED 401	Business I	3	
GED 403	Business Communication,		
GED 405	Industrial and Operational Management,		
	Technology Entrepreneurship		
CSE 437	Information System and Design	3	CSE 313
CSF 438	Information System and Design Lab	1.5	
		16.5	


27.12.2023